
1000 FREDERICK LANE, MORGANTOWN, WV 26508 • 304.285.5916

# *Career Firefighter Dies in Collapse involving Lightweight Construction with Two separate Maydays – South Carolina*

## Executive Summary

A 25-year-old career firefighter died on May 26, 2023, following a collapse of a multi-story lightweight construction apartment. At approximately 16:13 hours, the local 9-1-1 communications center dispatched a box alarm assignment to the reports of an apartment fire. Engine 6 (E6), Engine 13 (E13), Ladder 7 (L7), Ladder 175 (L175), Rescue 1 (R1), Battalion 2 (B2), and Battalion 1 (B1) were dispatched. Engine 1 (E1) added themselves to the response. At 16:16 hours, a working fire dispatch was added to the box alarm consisting of Engine 2 (E2), Fire 6 (F6), and Rehab 1. Due to the smoke plume that was visible in the sky while apparatus were responding, L7 requested a second alarm assignment prior to arrival adding Engine 171 (E171, apparatus of the deceased), Engine 9 (E9), Rescue 2 (R2), and Battalion 5 (B5). L7 arrived on-scene at 16:19 hours and reported a working fire in an occupied, three-story apartment building with fire visible on two sides and assumed command. Ladder 9 (L9) added themselves to the incident after hearing L7's size up report. Fire was showing in the attic on Side Bravo with the Side Delta structure fully involved (**see Photo 1**). E6 arrived on-scene and began an offensive fire attack utilizing a 1¾ -inch attack line, attempted to establish a positive water supply, and prepared to supply the aerial ladder pipe to L7. B1 arrived on-scene and assigned himself as the division Alpha supervisor, passing command to B2 when they arrived on-scene at 16:20 hours. B2 served as the incident commander (IC) at the Side Alpha/Delta corner. At 16:22 hours, property management advised that occupants were still trapped within the structure. E6 was able to make a successful rescue of a trapped occupant on the second floor directly across the open breezeway from the original fire apartment. A seized hydrant cap limited the amount of water available for fire attack for several minutes. As the first alarm fire companies arrived on-scene, they worked to secure a secondary water supply and were assigned tasks by meeting face-to-face with the division Alpha supervisor at the front of the structure. E171 arrived on-scene at 16:26 hours and reported to the incident command post (ICP). E171 was assigned to stretch a 1¾-inch attack line to the second floor of division Delta, but E6 was unable to provide adequate pressure on the attack line. E171 assumed the original attack line from E6 as they exited the original fire apartment. At 16:44 hours, a

**Photo 1: Side Alpha arrival conditions. (*Courtesy of the ATF*)**

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Mayday was transmitted reporting the collapse of the third floor with firefighters from E1 and R1 trapped. Less than a minute later the fourth-floor loft bedroom fell through the third floor and into the second floor, trapping the E171 crew. The rapid intervention crew (RIC) was deployed to assist the trapped firefighters and several other companies that had been working in the area assisted. Two firefighters from E171 were able to self-extricate and started working to locate and free the other two firefighters from E171. The third firefighter from E171 was pulled from the debris pile on the second floor, followed by the E1 and R1 firefighters from the third floor. After approximately 45 minutes, the fourth E171 firefighter was removed from the structure where he was transported to a local trauma center and pronounced deceased in the emergency room.

## Contributing Factors

- *Size-up and risk assessment*
- *Personnel accountability*
- *Task-level management and supervision*
- *Risk/benefit analysis that considers building construction*
- *Incident safety officer (ISO)*
- *Simultaneous interior and exterior operations*
- *Communication of changing conditions*
- *Mayday management*
- *Deployment of RICs*
- *Delayed fire department notification*
- *Pre-incident planning*
- *Delayed water supply.*

## Key Recommendations

*Fire departments should:*

- *Ensure initial and ongoing size-ups and risk assessments are conducted throughout the incident.*
- *Use a personnel accountability system to readily identify the location and function of all personnel operating at an incident.*
- *Ensure ICs immediately establish divisions/groups with a supervisor to communicate conditions and provide accountability.*
- *Train personnel on modern fire dynamics and develop fireground strategies based on a thorough risk/benefit analysis that accounts for building types, their characteristics, associated risks, and available on-scene resources.*
- *Utilize safety officers with training on structural collapse and incorporate these principles into fireground incident management.*
- *Ensure interior and exterior operations, such as water application, are not conflicting.*
- *Educate personnel on the use of radio communication processes for sharing critical information on a fire scene.*
- *Provide a Mayday tactical worksheet for ICs in the event of a Mayday.*

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- *Develop and implement an Standard Operating Procedure (SOP)/Standard Operating Guideline (SOG) on the deployment and use of RICs.*
- *Educate the community to help change knowledge, attitudes, and behaviors that can reduce risks, injuries, and fires within the community.*
- *Develop a pre-incident plan for high-risk occupancies that is supported by national standards.*
- *Consider maintaining resources and protocols to address occupational exposure to potentially traumatic events for their members.*

*Additionally, governing municipalities (federal, state, regional/county, and local) should:*

- *Ensure the water agency/authority responsible for municipal water supply shares information on hydrant testing and flow capabilities with the local fire departments.*



For further information, visit the program at www.cdc.gov/niosh/firefighters/fffipp/ or call 1-800-CDC-INFO (1-800-232-4636).


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## Introduction

On May 26, 2023, a 25-year-old career firefighter, with approximately seven years of experience, died following a collapse of a multi-story, lightweight construction apartment. On May 30, 2023, the U.S. Fire Administration (USFA) notified the National Institute for Occupational Safety and Health (NIOSH) of this incident. On June 25-July 1, 2023, two investigators representing the NIOSH Fire Fighter Fatality Investigation and Prevention Program (FFFIPP) traveled to South Carolina to investigate this incident. The NIOSH investigators met with the fire chiefs and staff of responding fire departments and conducted interviews with on-scene personnel. NIOSH investigators inspected and photographed the deceased firefighter's personal protective equipment (PPE) and self-contained breathing apparatus (SCBA). NIOSH investigators also reviewed the on-scene audio, training records, and SOPs. The Bureau of Alcohol, Tobacco, Firearms and Explosives also investigated this incident.

## Fire Department

The deceased firefighter was part of a career fire department that has three stations with 42 uniformed personnel covering 33 square miles across two different counties. The department responds to 5,000 calls for service annually and provides structural and wildland firefighting, technical rescue, swift water rescue, and vehicle extrication. Personnel work a 48-hour shift followed by 96-hours off duty.

## Training, Education, and Professional Development

The fire department maintains a training division to ensure that each member of the fire department receives the necessary instruction and certification to effectively perform their duties and prepare for advancement. The deceased E171 firefighter had seven years of experience in the career fire department. He took part in department health and wellness programs and helped with local firefighting training programs throughout the region. He was a certified Fire Fighter I and II (NFPA 1001), Fire and Emergency Services Instructor I (NFPA 1041), Fire Officer I (NFPA 1021), and had additional certifications in swift water and confined space rescue training.

## Apparatus, Staffing, and Communications

The department staffs two engine companies, one ladder company, and a battalion chief for each tour of duty. The fire department provides medical response to supplement the local emergency medical service (EMS) at the first responder level and participates in automatic aid agreements with several surrounding agencies. Only two resources on this incident, L175 and E171, are from the deceased

firefighter's department. Both resources responded as part of an automatic aid agreement to an adjacent department. The following apparatus were assigned to the initial box alarm assignment (see Tables 1, 2, and 3).

**Table 1: Initial Personnel Assignments**

| Apparatus | Initial Assignment |
|---|---|
| Engine 6 | Water Supply / Fire Attack – Alpha Division |
| Engine 13 | Fire Attack – Alpha Division |
| Engine 1 | Water supply / RIC – Alpha Division |
| Ladder 7 | Search – Alpha Division |
| Ladder 175 | Search – Alpha Division |
| Rescue 1 | Search – Alpha Division |
| Battalion 2 | Incident Command |
| Battalion 1 | Alpha Division Supervisor |

**Table 2: Working Fire Upgraded Personnel Assignments**

| Apparatus | Initial Assignment |
|---|---|
| Fire 6 | Unassigned |
| Engine 2 | Fire Attack - Alpha Division |
| Rehab 1 | Support Services |

**Table 3: Second Alarm Personnel Assignments**

| Apparatus | Initial Assignment |
|---|---|
| Engine 9 | RIC – Alpha Division |
| Engine 171 | Fire Attack – Delta Division |
| Rescue 2 | Fire Attack – Delta Division |
| Ladder 9 | Standby Crew – Delta Division |
| Battalion 5 | Delta Division Supervisor |

Each county has its own 9-1-1 communications center. The fire department operates on both of the counties' 9-1-1 communication systems, which utilize a Motorola P25 digital communication system, and the statewide communications plan.

## Personal Protective Equipment

At the time of the incident, the E171 firefighter (deceased firefighter) was wearing his department issued structural firefighting turnout gear including boots, pants, coat, gloves, hood, and helmet that met the 2018 edition of NFPA 1971. He was also carrying a Motorola APX 6000 portable radio which was found to be in working condition upon investigation. The E171 firefighter was wearing a NIOSH Approved® SCBA that was certified as meeting the 2018 edition of NFPA 1981.

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Approximately 2.5 tons of debris collapsed on firefighter E171. NIOSH investigators determined that firefighter E171 initially survived the collapse and continued to breathe while being pinned under the debris pile for approximately 23 minutes. **Table 4** represents approximate times and actions of firefighter E171's SCBA after accounting for the natural time drift of the internal SCBA clock.

**Table 4: Approximate Times and SCBA Actions**

| Time (Hours) | Action |
|---|---|
| 16:28 | SCBA activated and turned on |
| 16:45 | PASS device pre-alert activation (Immediately following collapse) |
| 16:51 | Manual PASS device activation by E171 firefighter |
| 16:51-17:07 | Breathing rate began to decrease as measured by liters per minute |
| 17:07 | Breathing rate stops as measured by liters per minute |
| 17:29 | Low pressure second stage regulator hose cut for extrication |

# Weather and Road Conditions

On May 26, 2023, there were cloudy skies. The temperature was 70°F with winds N between 10 and 12 mph. The humidity was between 36 and 39% with zero precipitation.

# Building Construction and Occupancy Status

The building in this incident was a multi-family four-story apartment. The foundation of the building consisted of concrete footings with concrete masonry unit and wood framed cripple walls up to the level of the first floor, with wood frame platform construction above this point. The floor level of the first floor was approximately nine feet above grade on Side Charlie of the building. A large parking lot was located on Side Alpha of the building, and walkways extended from the parking lot to the stairwells. The first floor of the building was located approximately four feet below the grade level of the parking lot on Side Alpha. A party wall spanning the depth of the building approximately midline along the width of the structure separated the building into two sections with six apartments on each side of the party wall. The floors of the six apartments on the northeast / Side Bravo end of the building were offset approximately three feet above the floors of the apartments on the southwest / Delta end of the building. A single fourth floor loft bedroom was located above the third-floor apartment in the Delta end of the building, immediately adjacent to the party wall. The loft bedroom was surrounded by attic space on three sides, the fourth wall was an exterior wall on Side Alpha with three windows facing northwest towards the parking lot. The loft bedroom was accessible only via an interior staircase from the apartment below. There were no fire stops in the party wall.

The building was rectangular in nature measuring approximately 125' wide by 45' deep. It was a four-story structure with 12 apartment units on three floors and a fourth story loft bedroom above a single third floor apartment visible from the front of the building. The front / Side Alpha of the building faced northwest and contained two sets of wood-framed, open air, half-turn stairs with landings that provided access to the apartments. Topography sloped downward gently from northeast to southwest - from left to right looking at the front of the building, and topography dropped off steeply from northwest to southeast - towards the rear of the building away from the front. Access to the southeast / Side Charlie

via the southwest / Side Delta was difficult due to the steep downward slope. Access via the northeast / Side Bravo was difficult due to the remains of the foundation walls of a previous building creating steep drop offs and deep mud trapped within those foundation walls.

During the collapse, the fourth-floor loft bedroom fell through the third floor and continued into the second floor. No fire alarm or sprinkler systems were installed but working single point smoke detectors were in the building. The building was a Type V lightweight wood structure with open web parallel chord trusses at each floor level lacking fire stops. This construction allowed for rapid and unrestricted horizontal fire spread between the floors. The roof structure was pitched to accommodate runoff of the building and was built of common lightweight metal plate connected trusses with plywood roof decking and asphalt shingles. The structure had an open attic with no fire stops allowing for rapid horizontal fire spread. Four open chimney chases extended vertically through all floors as well as the attic and lacked fire stops, allowing for the rapid and unrestricted vertical fire spread throughout the structure.

## Occupancy Status

This multi-family four-story apartment building was part of an apartment complex of 16 similarly constructed, separate buildings built on an approximately 17-acre site in 1984. The fire building, building 14, was in a dead-end cul-de-sac at the rear of the property. At the time of the fire, only 13 buildings remained in the complex. Three buildings near the fire building; 13, 15 and 16, had been destroyed by previous fires and were not rebuilt. Records indicate that the size-up reports for two of the fires from 2013 and 2017 were nearly identical to the size up report for this fire; heavy fire on three sides involving several floors, alarms assignments were upgraded enroute or on arrival, and structural collapse occurred on both previous fires. Two firefighters were injured in the 2017 fire.

## Timeline

The following timeline is a summary of events that occurred as the incident evolved. Not all incident events are included in this timeline. The times are approximate and were obtained by examining the dispatch records, audio recordings, witness statements, and other available information. The timeline is not intended, nor should it be used, as a formal record of events.

| Time | Fireground Response, Operations, and Details |
|---|---|
| **16:13 Hours** | • E6, E13, L7, L175, R1, B2, B1 dispatched for an apartment fire. E1 added themselves to the response. |
| **16:16 Hours** | • E2, F6, Rehab 1 added to the box alarm as a working fire assignment. |
| **16:17 Hours** | • E171, E9, R2, B5 dispatched on the second alarm assignment. L9 added themselves to the response. |
| **16:19 Hours** | • L7 on-scene, assumed incident command, reported fire on three floors from Side Delta. |

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| Time | Fireground Response, Operations, and Details |
|---|---|
| **16:20 Hours** | • L7 captain reported that a 360 had been completed with "no change"<br>• B1 on-scene as first due chief, assigned himself division Alpha.<br>• B2 on-scene, assumed IC at Side Alpha/Delta corner. |
| **16:22 Hours** | • Property management reported trapped occupants on the second floor.<br>• E6 made a successful rescue directly across the breezeway from the original fire apartment while protecting the open wooden stairwell with a 1¾ attack line.<br>• The fire hydrant closest to the building had a seized cap and could not be used. |
| **16:24 Hours** | • F7 (Division Chief) on-scene and assigned division Delta supervisor. |
| **16:25 Hours** | • E6 apparatus mounted deck gun flowed into the attic space above crews working inside the structure. |
| **16:25-16:37 Hours** | • Both interior fire attack and defensive fire streams utilized for fire attack.<br>• A water supply was established from a second hydrant 300' away<br>• E171 arrived on-scene. |
| **16:37 Hours** | • 10 of 12 apartments searched and cleared. The other two apartments had been destroyed by the fire. |
| | • The master streams were redirected to flow into the area directly above E1, R1 and 171. |
| **16:44 Hours** | • Unknown unit – "Mayday, third floor collapse onto the second floor, stop the exterior master streams." (This Mayday was declared for units on the third floor.) |
| **16:45 Hours** | • RIC (E9) deployed to second floor division Bravo and IC requested additional resources.<br>• Multiple crews work to remove the four buried firefighters in two locations. |
| **16:53-17:06 Hours** | • R2, L9, L7 and E2 remove one buried firefighter from debris on the second floor in division Delta.<br>• E1, R1, E13, and RIC removed two buried firefighters from the debris from the third floor in division Bravo. |

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| Time | Fireground Response, Operations, and Details |
|---|---|
| **17:07 Hours** | • Division Bravo advised IC that both firefighters were removed from the structure and to clear the Mayday.<br>• Division Delta informed IC to hold the Mayday, still had one firefighter trapped from E171 on the second-floor division Delta. |
| **17:07-17:25 Hours** | • L7, R2, L9 and the balance of E1's crew continued to access and extricate the E171 firefighter from division Delta second floor.<br>• IC informed that one Mayday was still in progress and all other firefighters were accounted for. |
| **17:33 Hours** | • E171 firefighter was removed from the structure and transported by local EMS to a trauma center where he was pronounced deceased. |

## Investigation

On May 26, 2023, the 9-1-1 communications center received a 9-1-1 call reporting an apartment fire in the back of a multi-building apartment complex. At 16:13 hours the communications center dispatched E6, E13, L7, L175, R1, B2, B1 to the box alarm assignment. Engine 1 added themselves to the assignment. Engine 6 could see a large column of black smoke and upgraded the box alarm assignment to a working fire assignment adding E2, F6, and Rehab 1. While still enroute, E6 requested the assignment be upgraded to a full second alarm due to the smoke plume and flames that were visible in the sky. The second alarm assignment added E171, E9, R2, and B5. L9 added themselves to the assignment after hearing L7's size up report.

L7 arrived on-scene at 16:19 hours, reported a working fire with heavy fire visible on two sides of the building (Side Alpha and Delta) and assumed IC. Fire was showing in the attic on Side Bravo and with half of the Side Alpha of the structure fully involved (**see Photo 1**). E6 discovered the 4-inch steamer cap was stuck on the hydrant closest to the building and relayed the information to command. E6 established a limited water supply using the 2 ½" hydrant outlet while E2 and E13 stretched supply lines to a hydrant 300' away. L7's captain stated "360 complete, no change." At 16:20 hours, B1 arrived as the first chief on-scene, assigned himself as the division Alpha supervisor, and began directing firefighting and rescue efforts. B2 arrived on-scene shortly after B1, assumed IC, and established the ICP on Side Alpha at the Side Delta corner of the structure inside the battalion chief vehicle (**see Photo 2**). B2 acknowledged L7's 360 report but did not conduct his own 360.

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**Photo 2: First alarm apparatus positioning showing seat of the fire.**
**(*Prepared by NIOSH*)**

Property management contacted B1 and reported a trapped occupant in the apartment directly across the open-air breezeway from the original fire apartment. E6 was able to extinguish enough fire in the open stairwell for crew members to rescue the occupant and exit the structure. The occupant was then taken to on-scene EMS. E13 and L175 were assigned to division Bravo. They stretched a 200-foot, 1¾-inch attack line to the third floor of division Bravo where heavy fire was observed in the attic space and spreading horizontally towards Side Bravo.

E1 arrived on-scene and split their crew to assist in deploying a second 300-foot, 1¾-inch attack line from the rear of E6 to the second-floor breezeway of division Bravo and was assigned RIC on Side Alpha at 16:25. Upon arrival, E2 completed a forward lay from another hydrant down the street to establish a positive water supply to E6. Between approximately 16:25 through 16:45 hours, the apparatus mounted deck gun of E6 and the aerial master stream from L7 were observed flowing water onto the apartment building in a sweeping motion to introduce water into the attic spaces of the building. R1 arrived and split their crew to assist with conducting primary searches of both divisions. L7 gave an update from Side Charlie indicating "fire from two floors through the whole building, second floor all the way through the roof." This heavy fire on Side Charlie had been visible from several blocks away and prompted E6 to call for a second alarm prior to units arriving on-scene. L7's initial 360 did not include fire conditions nor did it include the changes in topography. The topography information was not transmitted by radio to crews on the fireground.

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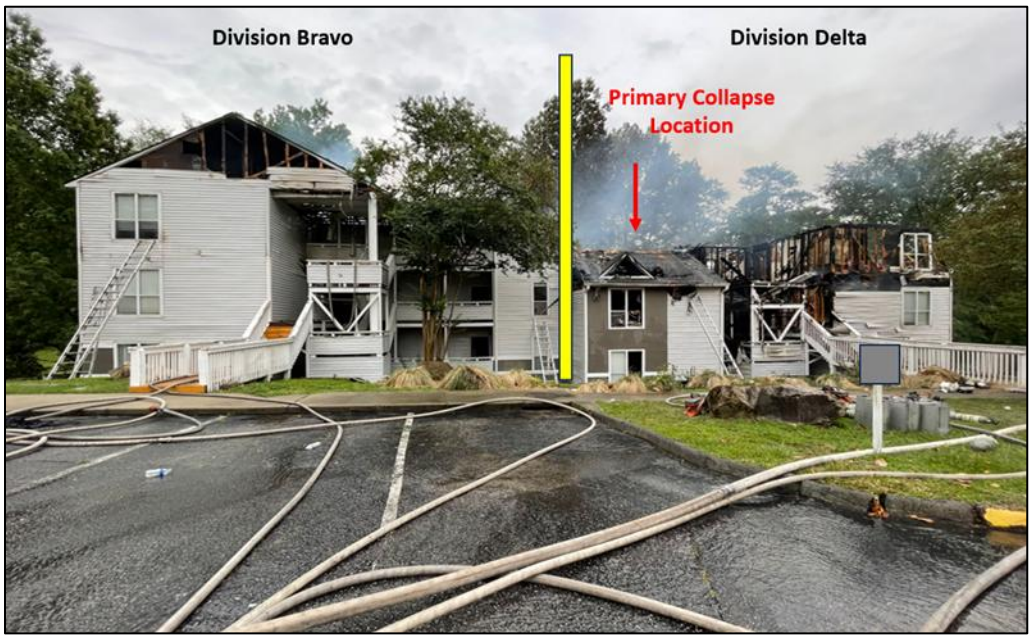


**Photo 3: Division Bravo (left) and division Delta (right) separation. (*Prepared by NIOSH*)**

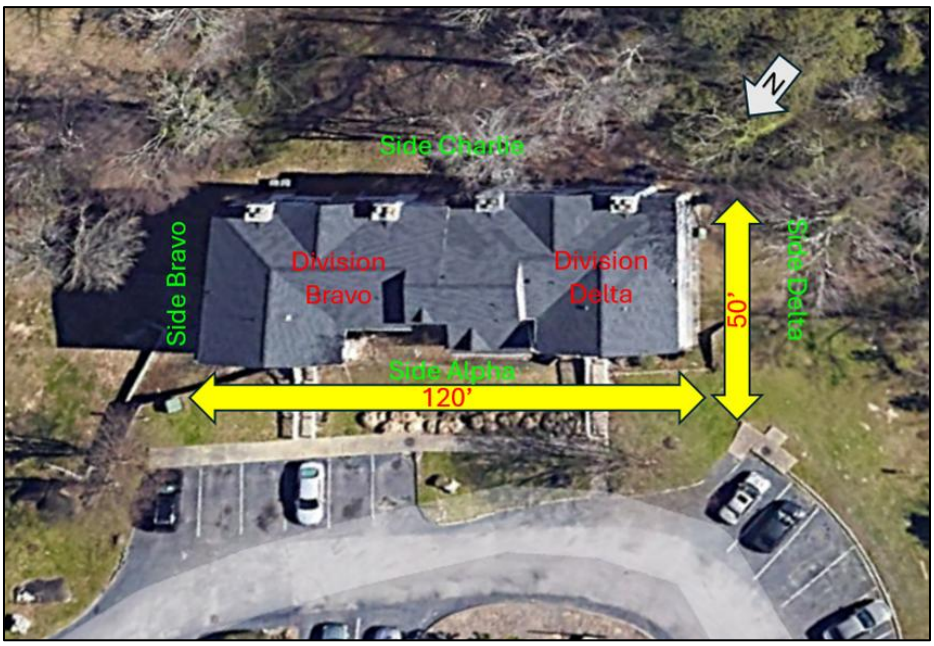


**Photo 4: Aerial view of apartment building. (*Prepared by NIOSH*)**

B1 reported to IC that E1 was working with E2 on the second floor of division Bravo at 16:30. E1 had been assigned RIC, and B1 did not announce a new RIC assignment. F6, a division chief who served as the shift commander, arrived on-scene and checked in with the IC. He was not given an incident

command system role, nor did he assist the IC with command. IC divided the 12-unit apartment building into two divisions, divisions Bravo and Delta (**see Photo 3 and 4**), and reassigned B1 from the division Alpha supervisor to the Delta supervisor. F7 (a division chief, not assigned on the alarm dispatch) had arrived on-scene and was assigned as the division Bravo supervisor on Side Alpha. B1 acknowledged his assignment as the Delta supervisor but continued to call himself "Alpha" and when asked what units he had with him listed off the resources in the Bravo division.

Ten of 12 apartments were searched and cleared by on-scene resources by approximately 16:37 hours. B1 reported that apartments were cleared on the Alpha and Charlie divisions. When the IC asked for clarification, B1 replied, "Alpha and Charlie, unable to search the second and third floor on the Charlie." The two unsearched apartments were on the third floor, Delta half of the building and were inaccessible due to heavy fire damage and a roof collapse. Crews were visible to command operating on the second floor of Side Delta. L7 had made access to those second-floor apartments through their balconies and cleared them from the exterior. The fourth-floor loft bedroom space was never searched nor was it ever recognized as a fourth floor by the IC or units on-scene.

E171, assigned on the second alarm, arrived on-scene at approximately 16:26 hours and reported to the ICP to deliver their accountability tags. E171 was assigned to stretch a 1¾-inch attack line from E6 to the third floor of division Delta, but E6 could not supply the line with water. E6 was supplying three 1 ¾-inch attack lines, its own deck gun, and L7's aerial master stream at the time and did not have enough capacity for a fourth attack line. During the stretch, the first arriving companies of division Delta were beginning to exit the fire apartment to recycle and swap SCBA cylinders. With active fire still being reported on the second floor, B1, still acting as the division Alpha supervisor, instructed the crew of E171 to assume the original 1¾-inch attack line from the interior crew of E6 and take over E6's assignment to suppress fire on the second-floor side Delta in the apartment of origin. As E6 exited the original fire apartment, there was local face-to-face communication between E6 and E171 personnel about the floor beginning to sag on the second floor. This critical information was not relayed to either division supervisor or the IC. E171 crews found the floor of the second floor to be solid and were unsure what sagging E6 was referring to.

Crews in division Bravo were active on the first three floors conducting fire attack as well as search and rescue operations. Fire conditions were present in the walls and floor truss system, prompting crews to open walls and ceilings to prevent the fire from further spreading. Crews were also committed to conducting searches of the last two apartments on the third floor. L175 was tasked with accessing those apartments by ladder from Side Charlie. B1 requested E9 to report to the Side Alpha/Bravo corner at 16:38. He advised IC that E9 was now on RIC at 16:39. IC asked F7 if he had E171 with him and Delta confirmed that he did. A report was made to IC that debris was falling from the third floor on Side Charlie at 16:41. IC acknowledged the report and warned all units on the fireground to "be mindful of it." The master streams from both E6 and L7 were redirected towards the Delta end of the building at 16:43. L7 began flowing water into the Delta/Charlie area and E6 began flowing water into the attic space and fourth floor loft area.

E1 and R1 crews breached the wall between the third floor of division Bravo and the third floor of division Delta, which, was directly above the original fire apartment where E171 was working. One

member from E1 and R1 entered the third floor of division Bravo through the wall, crossing into division Delta with a 1¾-inch attack line, as water from E6's deck gun began to fall on them. Shortly after they entered the apartment, the floor dropped several feet, and a large volume of water poured onto the third floor from the loft and continued down to the second. The captain from E1 called a Mayday at 16:44 and requested assistance from the RIC team as both firefighters were attempting to retreat to the wall opening. As they struggled to climb back up to the breach in the wall, the fourth-floor loft bedroom collapsed through the third floor of division Delta onto the second floor, approximately 40 seconds after the initial Mayday was declared. The floor that E6 reported as beginning to sag held the collapse from falling to the first floor. The division assignments at the time of the Maydays are listed in **Table 5**.

The collapses buried two firefighters from E1 and R1 in debris that also landed on top of the E171 crew (**see Figure 1**). Prior to the collapses, four firefighters from E171 were working to extinguish hidden fire in the ceiling and wall spaces of the original fire apartment. The E171 crew was working to exit the original fire apartment due to safety concerns when the collapses occurred. Two firefighters from E171 were able to free themselves quickly and one of them attempted to declare a Mayday but his portable radio was "bonking," preventing transmission due to heavy radio traffic. The radio traffic that was transmitted by Alpha was heard by E171 personnel and thought to be for them. division Bravo crews were aware that the E171 crew was located directly underneath their operation but unaware that the E171 crew had been trapped. The E171 crew was aware that a crew of firefighters were above them, and tried to help them after the floor gave way but was not aware that those firefighters had been trapped above them after the second collapse. Each division assumed that the radio traffic being heard and communicated to the IC was specific to their respective Mayday operations.

**Table 5: Division Assignments at the time of Mayday**

| Division Bravo | Division Delta |
|---|---|
| B1 – Division Supervisor<br><br>R1, E1, E2, E13, E9, L175 | F7 – Division Supervisor<br><br>E6, L7, R2, L9, E171, E2 |

B1, who was still calling himself "Alpha" but had been assigned the role of division Delta supervisor, entered the second floor of division Bravo where RIC was deployed and began working to rescue the trapped firefighters from E1 and R1. B1 reported to command that he did not have accountability of crews in his division, and that he was working to access and rescue the downed firefighter. E1 requested that the exterior master streams from E6 and L7 be discontinued as crews worked to breach the interior walls and find the firefighters from E1 and R1. The buried firefighter from E1 was able to manually activate his PASS device and the emergency alert button on his portable radio. The 9-1-1 communications center confirmed the activation and notified the IC. One of the three firefighters from E171 in division Delta was able to get free of the debris and escape through a balcony door to the exterior. He met the E171 company officer who had freed himself from debris close to the apartment

doorway and was able to see the arm of one of the two remaining firefighters from E171 pinned under debris in the original fire apartment.

At the time of the Mayday, F4 had already joined B2 in the command vehicle and was assisting with the command workload. After the Mayday was declared, F4 prompted B2 to take several actions. Numerous crews self-deployed into the structure, encountered downed firefighters, and began requesting hoselines, tools, and equipment over the radio. B1 entered the building on Side Bravo second floor and began using the "Echo Quadrant" location to identify where the firefighters were, which confused personnel outside who did not know where to take the equipment being requested. The lack of clarity resulted in all the equipment that was requested by B1 going to the second floor of Side Delta for the rescue efforts of E171, which is where crews outside saw the collapse occur.

B5 approached the window of the command vehicle and spoke to F4. B5 was requesting additional engines, and at 16:46 during their conversation E1 reported over the radio the names of the two trapped firefighters from E1 and R1. This radio traffic was missed by B2 and F4. B1 did not hear the traffic while he was inside the building working in the area where the two were trapped. When asked by command to clarify how many were trapped, B1 did not know.

F1, chief of the department, arrived on-scene and dispatch advised him that there was a Mayday in progress, which F1 acknowledged. F3 approached the window of the command vehicle and spoke to F4. F3 was asked to look at Side Charlie and walked away to conduct a 360. F1 approached the window as F3 left to tell command that F7 was not wearing any PPE. As F4 explained the Mayday situation to F1, B1 reported by radio what crews were working with him. F4 did not hear the radio traffic due to his conversation with F1. B1 requested a hoseline and B2 tasked one of the crews that B1 had just reported as working on the rescue effort inside the building to bring a hoseline.

B5 approached the window again and asked where B1 was located. B5 thought that there might be two Maydays based on what B1 described and what B5 knew was happening on Side Delta. F4 could not confirm the number of Maydays and assigned B5 to take over division Bravo. F3 returned to the window and gave a report on the fire conditions, issued several tactical orders to F4, and told F4 to get everybody not involved in the Mayday out of the area. F4 asked F3 to manage staging of the additional alarm and F3 refused the assignment. F4 ended up managing the additional alarm resources.

IC attempted to conduct a PAR over the radio, starting with units committed to the Mayday. Now able to focus on command again, F4 redirected the PAR effort and told B2 to assign B1 to the Mayday. B2 began requesting PARs from units he could physically see from his position at the same time units inside were requesting equipment and tools over the radio. A full PAR of fire apparatus crews on the fireground was not completed until approximately 17:10, after three firefighters had been rescued and only one from E171 remained trapped. This PAR did not account for all personnel on the fireground, as multiple chief officers had self-dispatched and engaged in fireground tasks without notifying command.

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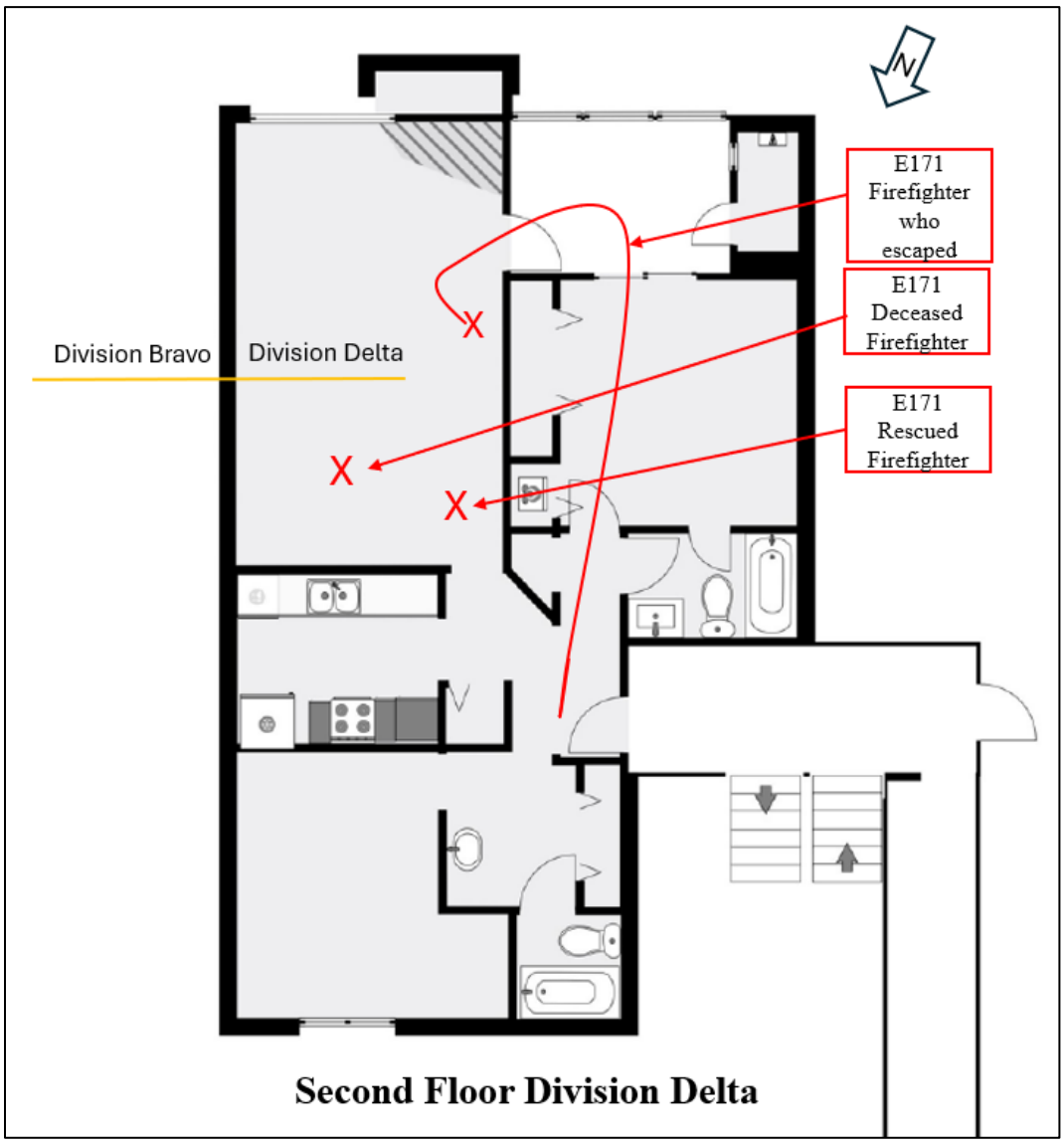


**Figure 1: Original fire apartment layout.**
**(*Prepared by NIOSH*)**

Rescue efforts were immediate to all four firefighters (E1, R1, and two from E171). Neither of the two division supervisors or their assigned crews knew about the other division's situation. As crews entered the structure to assist in the rescue, they encountered trapped firefighters and assumed they had found the only personnel involved in the collapse. The arm of the first trapped E171 firefighter was observed as crews entered the collapse area, and L9's crew extricated him from the collapse pile. L9 crew members could also hear and see the second E171 firefighter buried deeper inside the debris and began to utilize hand tools and eventually hydraulic tools to lift and remove debris to create an access tunnel to him. At 17:07 hours, the division Bravo supervisor informed IC that both firefighters from E1 and R1 were removed from the structure and that the Mayday could be cleared. It was at this point that

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B1 notified IC that he still had an active and on-going Mayday of a trapped E171 firefighter on the second floor of division Delta. Prior to this, IC did not know how many firefighters were trapped or which apparatus they were from.

L7, R2, and L9 continued to tunnel through the debris, attempting to gain access to the remaining second E171 firefighter. All other personnel on the fireground had been accounted for at this time as resources worked to shore up the collapsed area around the remaining E171 firefighter. A firefighter from L9 was successful in tunneling through the debris on his stomach to reach the firefighter from E171. He assessed the SCBA of the trapped E171 firefighter and noted the cylinder still had approximately 980 psi of air, but he was unable to hear any inhalation. The L9 firefighter placed the E171 firefighter on the air supply from the RIC kit and opened the bypass valve to provide free flowing air into the SCBA facepiece of the E171 firefighter. The L9 firefighter attempted to maneuver the firefighter, but the SCBA, debris, and entanglement made it difficult. The L9 firefighter exited the tunnel because he was low on air and was replaced with a firefighter from E1.

The E1 firefighter was able to cut the SCBA shoulder straps of the E171 firefighter and utilized the drag rescue device incorporated into E171 firefighter's turnout coat to pull and slide the firefighter through the tight tunnel and out of the structure. The E171 firefighter was carried outside to EMS, CPR was performed, and resuscitative measures were continued as he was quickly transported by EMS where he was pronounced deceased shortly after arriving in the emergency room.

## Fire Origin and Cause

The origin of the fire was listed as accidental in nature, determined by the Bureau of Alcohol, Tobacco, Firearms and Explosives National Response Team. The cause was a cooking fire that involved oil used for frying.

## Cause of Death

The postmortem examination of the E171 firefighter determined the cause of death was mechanical asphyxia due to the structural collapse and entrapment.

## Contributing Factors

Occupational injuries and fatalities are often the result of one or more contributing factors or key events in a larger sequence of events that ultimately result in injuries or fatalities. NIOSH investigators identified the following items as key contributing factors in this incident that ultimately led to the fatality:

- Size-up and risk assessment
- Personnel accountability
- Task-level management and supervision
- Risk/benefit analysis that considers building construction
- ISO
- Simultaneous interior and exterior operations
- Communications

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- Mayday management
- Deployment of RICs
- Delayed fire department notification
- Pre-incident planning
- Delayed water supply

# Recommendations

Fire departments should:

***Recommendation #1: Ensure initial and ongoing size-ups and risk assessments are conducted throughout the incident.***

Discussion: Continuous communication supports effective risk assessments. It also allows the IC and all personnel operating at an incident to be aware of changing conditions and adjust to avoid hazards or mitigate risks. Performing a 360° is an important component of the scene size-up and can be used in the risk assessment. The International Association of Fire Chiefs' *Rules of Engagement for Structural Firefighting* recommends that the first rule for ICs is to rapidly conduct or obtain a 360° situational size-up of the incident. Many incidents contain obstacles that prevent the viewing of all sides of a structure. In this incident, the attached garage and fence obstructed the view to Side Charlie. When the 360° reconnaissance is achieved, it provides the IC and personnel knowledge of the building layout, construction, access/egress points, fire location and direction of spread, and obstacles or hazards. It allows the IC and personnel to know how much air is entering the structure from existing openings and what options are available for future ventilation [NIOSH 2017].

A dedicated ISO can perform initial and on-going size-ups throughout the incident. Expectations and authority for the ISO include determining hazardous incident conditions, advising the IC to modify control zones or tactics to address corresponding hazards, communicating fire behavior and forecasting growth, and estimating building/structural collapse hazards. The ISO also has the authority to stop or suspend incident operations based on imminent threats posed to firefighter safety [NFPA 1550 2024]. The ISO should be separate from the IC, operations, or accountability positions so they can focus on their responsibilities and the primary objective of continually assessing all on-scene hazards to firefighter life and safety.

***Recommendation #2: Use a personnel accountability system to readily identify the location and function of all personnel operating at an incident.***

Discussion: A personnel accountability system is implemented during an incident to collect and maintain the status and location of the resources working in, or potentially working in, an immediately dangerous to life and health IDLH environment [NFPA 1550 2024]. All members operating at an incident are responsible for understanding and participating in this system. The IC is responsible for the system but may delegate certain responsibilities to another person such as the ISO. An integral part of the accountability system is ensuring that the firefighters who are assigned and operating in the hazard zone are accounted for throughout the entire incident. A properly initiated and enforced

personnel accountability system can enhance firefighter safety and survival [NIOSH, 2024]. A functional personnel accountability system should have the ability to identify:

- Members operating in the hazard zone (who)
- Where members are in the hazard zone (where)
- Conditions in the hazard zone (conditions)
- Actions used in the hazard zone (actions)
- Paths of access and egress in and out of the hazard zone (exits)
- RICs and their assignments

Different methods and tools are available for resource accountability, including:

- Tactical worksheets
- Command boards
- Apparatus riding lists
- Company responding boards
- Electronic bar-coding systems
- Accountability tags or keys

***Recommendation #3: Ensure ICs immediately establish divisions/groups with a supervisor to communicate conditions and provide accountability.***

Discussion: Within a division/group, firefighters advise their supervisor of work progress and provide accountability for crew members engaging in task level activities. The IC should assign divisions/groups to a supervisor early. This is especially important when firefighters are operating from tactical positions that the IC has little or no direct control over (e.g., out of sight). All requests for additional resources or assistance within a division/group are directed to the supervisor who is responsible for communicating with the IC. Supervisors can provide ongoing conditions, actions, needs (CAN) reports to the IC of all four sides and the interior of an incident which may influence tactics and strategy [SKCFTC 2023]. Division/group supervisors can also assist in providing personnel accountability reports when requested by the IC, ISO, or operations. When the IC does not establish divisions/groups with a supervisor, firefighters should follow established fireground operations reporting procedures while operating in the incident and hazard zone.

***Recommendation #4: Train personnel on modern fire dynamics and develop fireground strategies based on a thorough risk/benefit analysis that accounts for building types, their characteristics, associated risks, and available on-scene resources.***

Discussion: During this incident, resources were dedicated to the hazard zone for rescue when an assessment of conditions showed already rapid deterioration and extreme fire conditions. Specifically, first arriving fire companies encountered a well-developed fire in a second-floor apartment with both vertical and horizontal fire spread, including the hidden void spaces and exterior stairway. Upon arrival, the apartment building was occupied, and it was quickly discovered that persons were trapped inside the building. An offensive fire attack was initiated in conjunction with successful search and rescue efforts.

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A risk/benefit analysis uses hazard identification and situation assessment to weigh the potential risks to be taken against the benefits to be gained [NFPA 1670 2017]. ICs should include the type and occupancy status of a structure in a risk/benefit analysis to aid in decision making. Initial and continuous size-ups of the incident's conditions, including Side Charlie, should produce information that becomes the basis for the incident strategy and the IAP. Collecting current, accurate, and relevant information is essential for effective initial and ongoing actions [Brunacini 2002].

Building construction factors directly affect fire development. This includes fuel type, compartment volume, ventilation, and fuel load. Active fire conditions, to include those hidden within void spaces like floors, walls, ceilings, and attics, impact the stability of a structure. Size-ups should include an assessment of building construction when evaluating current fire conditions to forecast the development of the fire. Personnel should be trained on the various types of structures found within their response areas, the impact that fire can have on these structures and understanding how fire travels throughout various structure types. This assessment can assist ICs with risk/benefit analysis and determining strategies, especially if a building is considered unsalvageable [IFSTA 2016].

It can be difficult for ICs to predict the integrity of a building being impacted by active fire. Fire departments should consider the amount of time a fire has been burning as a collapse predictor. Other factors to also consider include [NIOSH 2014]:

- Construction type
- Age and condition of the building
- Pre-existing structural damage/deterioration
- Structural weakness caused by explosion or impact
- Presence of free-standing parapets
- Presence of wall anchor plates or stars
- Engineered load systems/lightweight construction
- Types of doors and windows
- Roof design and covering, including HVAC units on fast food occupancy roofs
- Renovation/modification to structure
- Height of the building
- Fire duration, size, and location
- Fuel loads
- Fire behavior
- Fire protection features such as sprinkler systems and fire walls
- Weight of firefighters and water used for extinguishment

The use of technology and programs can assist fire departments in conducting pre-incident planning, inspections and provide real time data during emergency response. Community risk assessments, when coupled with pre-fire planning programs, can provide pre-incident insights to the organization, incident managers and officers for occupancy risk, inherent collapse probability and projected operational demands during a fire. Determining when to establish a collapse zone starts with a community risk assessment program [Naum 2015]. Fire department community risk assessment programs should be

routinely updated based on different types of structures within their jurisdiction. Risk assessment programs aid in developing risk reduction efforts for the community and the fire department [NFPA 1300 2020].

Research has shown that lightweight engineered lumber trusses and joists can lose their structural integrity and be prone to collapse within five minutes of being exposed to open flame (**see Photo 5 and 6**). These experiments included metal-plate-connected wood parallel chord trusses [Kerber et al. 2012].

**Photo 5 and 6: Lightweight parallel chord trusses. Left shows the truss as new and the other shows how the truss loses structural integrity after less than 5 minutes of fire exposure. (*Courtesy of FRSI*)**

***Recommendation #5: Utilize safety officers with training on structural collapse and incorporate these principles into fireground incident management.***

Discussion: There was no dedicated ISO during this incident. The SOPs of the fire department tasked division supervisors with performing accountability, tactics, and safety for individual divisions.

The ISO can provide a fire department with a higher level of expertise to perform the necessary incident scene functions and assist the IC with fireground safety. Some ICs believe that any fire officer should be able to fill the fire department ISO function at any time under any circumstance, and therefore believe their agency does not need a predesignated ISO. Whether the ISO position is predesignated or filled by a fire officer, fire departments should ensure that the ISOs are trained in how to assist the IC and other officers in fireground operations [Dodson 2021; Sullivan 2012; NIOSH 2013].

ISOs with the right knowledge, skills, abilities, and experience are invaluable assets on the fireground. While a fire department may use an appointed officer as an ISO, they may be delayed in recognizing a hazardous situation or operation. This can be overcome by training all individuals who may be appointed as an ISO to ensure they have clear understanding of responsibilities and expectations [NIOSH 2013].

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Understanding a building's design and structural anatomy, construction methods and materials, and vulnerabilities under fireground conditions directly correlates to safer firefighting operations and improved firefighter survivability [NIOSH 2013]. Knowledge of building construction is critical to help ISOs recognize the potential for structural collapse. During the growth stage, the fire consumes combustible structural members. During the decay stage and post-suppression activities, the structure becomes further weakened due to the state of the remaining structural members and the buildup of water. Additionally, the contents of a building, such as furniture or machinery, also contribute to the potential for structural collapse by [IFSTA 2015b]:

- Adding fuel load in the structure and generating higher temperatures that weaken structure components.
- Adding weight to the weakened structural members.
- Retaining water which increased weight of contents and applies more stress on the structural members.

ISOs should be trained to recognize these hazards and their potential to contribute to a structural collapse. When incorporated into fireground incident management, the ISO should be able to forecast or reasonably predict a collapse. Specifically, the ISO can forecast this potential when evaluating building construction, building contents and fire load, and burn time. Whenever a collapse is forecasted, all interior operations should be halted, and all firefighters removed from the structure immediately. The ISO should communicate forecasted predictions as hazard identification to the IC, allowing time for changes in strategy to be implemented [IFSTA 2015b]. When the structure is visibly unstable, a collapse zone equal to one and a half times the height of the building should be established at minimum. This perimeter size keeps firefighters and other personnel out of imminent danger from the collapse. When a collapse zone is established, the IC should communicate a "no re-entry" strategy until otherwise directed [NIOSH 2008].

***Recommendation #6: Ensure interior and exterior operations, such as water application, are not conflicting.***

Discussion: During this incident, firefighters operated in the structure while on-scene apparatus applied water onto the structure from master streams. Division Bravo requested that exterior streams be stopped after the Mayday declaration due to hot water run off causing minor burns.

Conflicting interior and exterior operations are a significant safety concern on the fireground. Exterior water application, such as from master streams, should never be used directly on a building where firefighters are operating inside. These devices deliver high volumes of water flow which can comprise the structural stability of the building. The force of water from a master stream can knock over chimneys and walls. Large amounts of water can add thousands of pounds of weight to the already damaged structural components and facilitate a structural collapse. Additionally, the application of large volumes of water can overwhelm firefighters by generating large amounts of steam that obscures visibility and burning firefighters, and flooding areas such as basements where firefighter may be operating [Phoenix Regional 2018; Van der Feyst 2021; Guzzi 2002]. Interior and exterior operations

should be coordinated to lessen these potential life safety hazards. The IC, ISO, or operations should monitor this coordination during the continuous size-ups and risk assessments.

***Recommendation #7: Educate personnel on the use of radio communication processes for sharing critical information on a fire scene.***

Discussion: During this incident, critical information about the integrity of the structure was shared by firefighters engaged in operations but not with operations or IC for fireground awareness. As the first arriving companies began to exit the original fire apartment, there wereface to face communications about the floor beginning to sag on the second floor of division Delta. This critical information was not relayed to either division supervisor or the IC.

Safety hazards, such as the structural issues in this incident, may dictate an immediate change in strategy and tactics to preserve life and safety [IFSTA 2015b]. Consequently, firefighters on-scene should immediately communicate safety hazards through the chain of command so they can be brought to the attention of those working in the hazard zone, IC, ISO, and operations.

In terms of task-level management, fire departments should develop communication plans specifying how to share critical information on a fire scene. When firefighters report hazardous conditions to the division supervisor, this information should be relayed to operations and IC to document for tactical decisions and objectives. Division supervisors can provide the best assessment of hazard zone conditions for the IC and provide ongoing conditions, actions, and needs (CAN) reports. It is important to have visual observation of all four sides and the interior of an incident to influence the IAP. Without the observations and CAN reports, the IC will have limited information to make decisions [SKCFTC 2023].

***Recommendation #8: Provide a Mayday tactical worksheet for ICs in the event of a Mayday.***

Discussion: When a Mayday is transmitted, ICs have a very narrow window of opportunity to locate the lost, trapped, or injured member(s). The IC will need to restructure the strategy and tactics to include a priority rescue [NFPA 1550 2024]. A Mayday tactical worksheet serves as a guide and a tailored checklist for any Mayday. It can provide reminders to prompt the firefighter to activate their EAB for priority radio transmissions and other important items such as PASS activation, air status and location information. This worksheet can be easily located on the back of a tactical worksheet to assist ICs in ensuring the necessary steps are taken to clear the Mayday as quickly and safely as possible. A Mayday is too important to operate from memory and risk missing a vital step that could jeopardize the outcome of the rescue of a firefighter who is missing, trapped, or injured [IAFF 2010].

Some departments have adopted the term LUNAR—location, unit assigned, name, assistance needed, and resources needed—to gain additional information in identifying a firefighter who is in trouble and in need of assistance. The IC, division/group supervisors, company officers, and firefighters need to understand the seriousness of the situation. It is important to have the available resources on-scene and to have a plan established prior to the Mayday [Brunacini and Brunacini 2004; NFPA 1550 2024].

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***Recommendation #9: Develop and implement an SOP/SOG on the deployment and use of RICs.***

Discussion: Effective RIC operations are dependent on proactive efforts. Upon arrival, the RIC officer, accompanied by one member of the RIC, will get a report from the IC and then should perform an incident scene survey while the remaining RIC members assemble the RIC equipment. During the 360-degree survey, the RIC officer and members should look for ways in and out of the structure, including window configuration, fire escapes, and construction features. The RIC officer should note the feasibility for placement of ground ladders for rescue or escape purposes. The RIC officer should be responsible for setting up and securing a suitable secondary egress for interior crews [Rowett 2018; Toledo Fire & Rescue Department 2012]. After the above tasks are completed, the RIC equipment is put in place and then the RIC officer should inform the IC that a 360-degree survey is complete and the RIC is ready to intervene, if necessary. The entire RIC should stay in an area immediately accessible to the building for rapid deployment and maintain radio contact with IC. The RIC officer should brief all RIC members with the results of the incident scene survey [Toledo Fire & Rescue Department 2012]. The RIC officer and members will coordinate with the IC to formulate rescue plan contingencies and to continue to monitor radio and fireground conditions. RIC protection is not a passive assignment. This is a process of ongoing information gathering and diligent scene monitoring until the unit is released by the IC [NIOSH 2024; NFPA 1407 2020].

***Recommendation #10: Educate the community to help change knowledge, attitudes, and behaviors that can reduce risks, injuries, and fires within the community.***

Discussion: The fire in this incident was started accidentally by occupants in one apartment. According to the authority having jurisdiction, the occupants evacuated the residence immediately upon discovering the fire. They left doors open, allowing for a flow path (feeding the fire with oxygen), and were delayed in calling 9-1-1 to report the emergency. These factors facilitated a rapid-fire growth and spread prior to the arrival of the first on-scene firefighters.

Fire and life safety education is a critical element of community-risk reduction. This effort works to change knowledge, attitudes, and behaviors among community residents to reduce risks, injuries, and fires [IFSTA 2015a]. Fire departments act on this effort by training firefighters and other personnel as Fire and Life Safety Educators (FLSEs). FLSEs coordinate and deliver educational programs that teach people about a particular hazard and how to reduce or prevent the risks [NFPA 2024].

Fire and life safety education initiatives can teach community members about fire and injury prevention, including what actions they can take during an emergency. Example topics of these programs include:

- The importance of smoke alarms to reduce deaths in structure fires
- The use of child safety seats to lessen injuries of children involved in vehicle accidents
- The need for carbon monoxide detectors and proper use of gas-powered appliances
- Closing bedroom doors while sleeping or closing doors upon egressing during a fire incident

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Specific to this incident, an applicable topic could be teaching community members to close doors during an evacuation to limit oxygen ingress and to report fires as soon as possible to get firefighters dispatched immediately. Fire Safety Research Institute's 'Close Your Door' encourages those trapped in a room during a fire as well as those who can safely leave a home to close as many doors as possible to limit the growth and spread of the fire. The webpage, https://fsri.org/programs/close-before-you-doze offers a series of free resources, including videos that fire departments can use to educate the public. These types of initiatives can be provided by fire departments in the form of scheduled lectures at community centers or fire stations, school visits by firefighters for fire prevention week, or informational graphics posted on social media [IFSTA 2015a].

***Recommendation #11: Develop a pre-incident plan for high-risk occupancies that is supported by national standards.***

Discussion: NFPA 1660, *Standard for Emergency, Continuity, and Crisis Management: Preparedness, Response, and Recovery*, A.17.2.1 states, "a pre-incident plan is one of the most valuable tools available for aiding responding members in effectively controlling an emergency." The pre-incident plan is defined as "a document developed by gathering general and detailed data that is used by responding members in effectively managing emergencies for the protection of occupants, participants, responding members, property, and the environment" [NFPA 1660 2024]. A pre-incident plan identifies deviations from normal operations and can be complex and formal, or simply a notation about a particular problem, such as the presence of flammable liquids, explosive hazards, modifications to structural building components, or structural damage from a previous fire [NIOSH 1999].

NFPA 1660 outlines the steps involved in developing, maintaining, and using a pre-incident plan by breaking the incident down into pre-, during- and post-incident phases. In the pre-incident phase, for example, it covers factors such as physical elements and site considerations, occupant considerations, protection systems and water supplies, hydrant locations, and special hazard considerations. Building characteristics including type of construction, materials used, occupancy, fuel load, roof, and floor design, and unusual or distinguishing characteristics should be recorded, shared with other departments who provide mutual aid, and if possible, entered into the dispatcher's computer so that the information is readily available if an incident is reported at the noted address [NFPA 1660 2024].

Because many fire departments are unable to pre-plan for all the structures within their jurisdiction, departments may opt to prioritize plans for structures that have elevated or unusual fire hazards and life safety considerations. Strategies and tactics employed at an emergency incident need to match the structure. The pre-plan information can help ensure that residential fire tactics are not applied at commercial structures.

Coupled with the pre-incident planning program, the critical incident dispatch system (CIDS) program provides critical building information that may not be readily apparent to responding companies upon arrival. This program also provides accurate and consistent information for required radio progress reports and indicates where variations in SOPs would be necessary due to previously known features found at this location [FDNY 2011].

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***Recommendation #12: Consider maintaining resources and protocols to address occupational exposure to potentially traumatic events for their members.***

Discussion: Following the death notification of E171 firefighter, the fire department in this incident requested assistance from surrounding fire departments. This was done to provide station coverage for the incident fire department and allow their firefighters to be off duty for the next eight days. A state fire mental health crisis team was activated to provide free, voluntary sessions with licensed behavioral health specialists to members of the incident fire department and their families. Command staff utilized telephone calls, emails, text threads and meetings with members and their spouses to ensure knowledge of and ease of access to the resources for their members and families. Although the resources were voluntary at first, the fire department required every member to check in with a mental health professional at least once prior to returning to duty. Upon return to duty, members were encouraged to look out for each other, to access mental health services whenever needed, and to report concerns about fellow firefighters through the chain of command.

According to NIOSH, public safety sector workers, including firefighters and EMS clinicians, are at a high risk of occupational exposure to traumatic events and stress. As such, mental health programs are critical for addressing the unique challenges these workers face including the potential health effects that may result from these exposures [Kiederer et al. 2024]. This includes chronic exposure to highly stressful situations as well as acute exposure to catastrophic events such as those in this incident. There is variation among people regarding their threshold for developing symptoms, how adverse events are processed, the coping strategies they use, and their willingness to seek help when their capacity to cope is challenged. These have implications on the mental health symptoms they may experience following a single exposure or cumulative exposures over time. These can also affect their overall well-being, interpersonal relationships, and job performance [NVFC 2021].

Effective programs deployed by agencies should be multi-faceted, address organizational factors, and focus on building resilience, stress management, post-traumatic stress disorder awareness, and coping strategies [NIOSH 2024]. NFPA 1550 provides recommendations for fire departments to prepare for and address occupational exposure to potentially traumatic events:

- Establish and maintain a relationship with an appropriately licensed behavioral health specialist that has knowledge and experience working with the fire department culture and traumatic exposure.
- Adopt and utilize a written policy outlining protocols to address exposure, including for the critical injury of a member or a line-of-duty-death.
- Ensure members are aware of and have access to a clear outline of assistance and interventions available for affected members [NFPA 1550 2024].

NFPA 1550 notes that participation in clinically related interventions such as employee assistance programs shall be voluntary at the member's election. The member's identity should remain confidential and anonymous. Also, where specialty treatment is indicated, referral should be made to licensed specialists who are both certified to provide specialized evidence-based treatment that is appropriately covered in insurance networks. Outside of these recommendations, organizations such as

the National Volunteer Fire Council suggest that fire departments create and maintain an environment that promotes resilience and the ability to successfully cope with extreme work-related stressors. An environment where members feel comfortable talking about mental health and seeking help when needed is critical for managing occupational exposure to potentially traumatic events in the fire service [NVFC 2021].

Additionally, governing municipalities (federal, state, regional/county, and local) should:

***Recommendation #13: Ensure the water agency/authority responsible for municipal water supply shares information on hydrant testing and flow capabilities with the local fire departments.***

Discussion: A mutual aid fire department assumes responsibility for fire hydrant testing and providing monthly hydrant status reports on behalf of the jurisdiction's water department. At the time of the incident, status reports did not show that the affected hydrant was out-of-service, nor did they indicate the last date the hydrant was serviced. Regular testing of hydrants on an annual basis and accurate record keeping could have made a difference in this incident. The hydrant could have been in serviceable condition or identified to responding units as unserviceable, triggering an alternate plan sooner in the event.

- Fire departments can use the recommendations below to improve water supply issues or prevent them from developing: The water company makes a good-faith effort to meet or exceed the *AWWA (American Water Works Association M17-2006: Installation, Field Testing, And Maintenance of Fire Hydrants*, 4th Edition best practice of conducting flow tests on all parts of the distribution system every 10 years.
- If development is anticipated to increase in a service territory, flow tests should be conducted before development is permitted by local land use regulators and before development commences to better gauge the available flow and ensure adequate supply to meet the changing demand.
- The water company should develop or enhance protocols that clearly identify and communicate specific hydrant usage between the fire departments, county fire coordinators, and the water company's service territory during or immediately after fire events.
- Improve communication between the water company and local fire departments, including infrastructure and flow data availability, immediately upon request at the time of an incident. The information should include hydrant locations, which hydrants share a main, and which hydrants have greater available flow.
- Fire hydrant inspection and repair data should be readily available to fire department members upon request.
- The water company should organize system orientations and trainings for fire department members on a regular basis. These should be conducted on a timeline and frequency that is appropriate for both water company employees and fire departments to promote understanding of the system components and operations. Such orientations should also be made available upon reasonable request for fire departments located within the water company's service territories.

- The water company should attempt to support opportunities to educate the local governments and land use regulatory authorities within its service territories on system constraints, load, the interplay of local government fire safety inspections, development planning, local land use, and fire protection and emergency services planning. Such education should also include promotion of conservation efforts that can assist with alleviating system constraints. Orientations should be available upon request and held on at least an annual basis.

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## Investigator Information

This incident was investigated by Mike Richardson, Investigator (former), and Patrick R. Montague, Investigator (former), with the Fire Fighter Fatality Investigation and Prevention Program, Surveillance and Field Investigations Branch, Division of Safety Research, NIOSH located in Morgantown, WV. The report was written by Patrick R. Montague and Dr. Wesley R. Attwood, Investigator and Program Advisor, with the Fire Fighter Fatality Investigation and Prevention Program, Surveillance and Field Investigations Branch, Division of Safety Research, NIOSH.

Dan Madrzykowski and Keith Stakes from Fire Safety Research Institute, part of the UL Research Institutes, provided a technical review of the investigation report. An expert review was provided by Christopher E. Way, Fire Chief/Paramedic, Kootenai County Fire & Rescue, Idaho. The NFPA Public Fire Protection Division also provided a technical review.

## Additional Information

**UL Research Institutes**

Fire Safety Research Institute (FSRI) continues to work with fire departments and fire service organizations to conduct research on fire dynamics, fire safety issues, and fire ground operations. Access to reports from completed studies and information from on-going studies can be found at https://fsri.org. Consider accessing free online training on Building Construction https://training.fsri.org/course/133/building-construction and Structural Stability of Engineered Lumber in Fire Conditions, https://training.fsri.org/course/76/structural-stability-of-engineered-lumber-in-fire-conditions.

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**NFPA 1550*, Standard for Emergency Responder Health and Safety* (2024 edition)**
NFPA 1550 marks the integration of NFPA 1500, *Standard on Fire Department Occupational Safety, Health, and Wellness Program*; NFPA 1521, *Standard for Fire Department Safety Officer Professional Qualifications*; and NFPA 1561, *Standard on Emergency Services Incident Management System and Command Safety*, into a single standard that addresses emergency responder health and safety. NFPA 1550 maintains the chapter on "Command Safety." This chapter provides a foundation for incorporating the incident management system at all emergency incidents, especially *Type V* and *Type IV* incidents. The chapter on Command Safety clearly defines the requirements for the IC, including establishing a fixed command post, personnel accountability, the use of staff aides and rapid intervention crews, and the appointment of a safety officer and assistant safety officer(s) (as needed). The standard addresses the expectations and authority of the safety officer. Annexes cover Functional Assignments for High-Rise Building Incidents, Development of Subordinate Officers or Implementing a More Efficient Management System, Incident Management for the Fire Service on Type V or Type IV Incidents, and Structural Fire-Fighting—Risk Assessment and Operational Expectation.

# Disclaimer

The information in this report is based upon dispatch records, audio recordings, witness statements, and other information that was made available to the National Institute for Occupational Safety and Health (NIOSH). Information gathered from witnesses may be affected by recall bias. The facts, contributing factors, and recommendations contained in this report are based on the totality of the information gathered during the investigation process. This report was prepared after the event occurred, includes information from appropriate subject matter experts, and is not intended to place blame on those involved in the incident. Mention of any company or product does not constitute endorsement by NIOSH, Centers for Disease Control and Prevention (CDC). In addition, citations to websites external to NIOSH do not constitute NIOSH endorsement of the sponsoring organizations or their programs or products. Furthermore, NIOSH is not responsible for the content of these websites. All web addresses referenced in this document were accessible as of the publication date. *NIOSH Approved is a certification mark of the U.S. Department of Health and Human Services (HHS) registered in the United States and several international jurisdictions.*