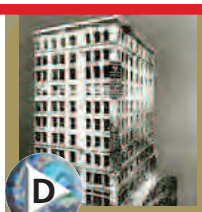
A TECHNICAL PUBLICATION OF ASSE'S FIRE PROTECTION PRACTICE SPECIALTY

Fireline

VOLUME 3 • NUMBER 3



PAGE 5
ASSE
A Century of Safety

PAGE 6
PRINZLER'S INVENTION
The Iroquois Theater Fire

PAGE 11
FIRE PROTECTION
Evolution of the Fire Sprinkler

PAGE 22
INTERVIEW
Phil Moser on Emergency Vehicle Operations

Triangle

100 Years Later

BY **GABE F. MIEHL,** CSP, CFPS

The bulk of the research for this article relied on the book *Triangle: The Fire That Changed America* by David Von Drehle. In 283 pages, Von Drehle was not only able to tell the story of the victims and survivors of the fire from a first-person perspective, but he also includes a significant discussion on the socioeconomic and political issues of the time that played a role in the conditions leading up to the fire and its aftermath. An appendix at the back of the book provides the "first complete list of Triangle fire victims ever compiled."

ABOVE PHOTO: HORSE-DRAWN FIRE ENGINES EN ROUTE TO THE TRIANGLE SHIRTWAIST FACTORY FIRE.

The fire started on the eighth floor at approximately 4:40 p.m. on March 25, 1911, just at the end of the working day when employees were preparing to leave.

On March 25, 1911, fire struck the eighth, ninth and tenth floors of the Asch Building located at the corner of Washington Place and Greene

continued on page ***31***

For a complete Table of Contents, see page 3

Triangle

continued from page 1

Street in Lower Manhattan. The fire lasted 35 minutes, during which 146 people were killed. The Triangle Shirtwaist Co. occupied these floors, owned by Max Blanck and Isaac Harris. Fires at shirtwaist factories were nothing new, considering that Blanck and Harris may have had association with as many as seven previous fires; however, the practice of fire prevention was nothing new (Gottschalk, 2002).

Heat-actuated sprinkler systems were developed in 1860 with the National Fire Protection Association authoring "Rules and Regulations of the National Board of Fire Underwriters for Sprinkler Equipment, Automatic and Open Systems as Recommended by the National Fire Protection Association" in 1896. Fire hazards were recognizable and prevention and suppression tools were available in 1910, so how did this tragedy occur?

The Building

The Asch Building consisted of ten floors in the typical open floor loft construction of the early 1900s (Von Drehle, 2003). Open-floor construction was an advancement that moved clothing production from apartment sweatshops to a more efficient factory setting. The gain in productivity was realized by using an electric motor to drive long rows of sewing machines versus individual foot-powered machines (Von Drehle, 2003). Enough room was now available to house the entire operation, from pattern-cutting to sewing to shipping, saving both time and money. The original factory was established on the ninth floor in 1902 but had expanded to the eighth and tenth floors by 1909.

The building was serviced by a stairway and two personnel elevators from the main entrance off of Washington Place. A second stairway and two freight elevators could be accessed from a service entrance off of Greene Street. The Greene Street stairs had windows that provided natural lighting and ran basement to roof while the Washington Place stairs stopped at the tenth floor with lighting provided by a single roof skylight and recently installed light fixtures (Von Drehle, 2003). A fire escape, approved by city officials, was provided in lieu of a third stairwell inside an exterior airshaft that was located behind the Greene Street stairwell (Von Drehle, 2003). The airshaft was a small void between buildings adjacent to the Asch Building on both the Washington Place and Greene Street sides that was intended to provide ventilation.

The original factory was located on the ninth floor; however, all three floors shared the same physical layout. All floors were basically wide open rooms with 12-ft ceilings. Natural lighting was provided by a long series of windows on the south and east sides of the building. Approximately 9,000 sq ft of working space was available on the ninth floor, which housed the main assembly line and inspection department (Von Drehle, 2003). The eighth floor housed both cutting tables and sewing machines (Von Drehle, 2003). The tenth floor housed the executive and administrative offices along with the pressing (ironing) department, packing department and shipping and receiving department (Von Drehle, 2003).

The Process

Shirtwaists are defined as "a woman's tailored garment (as a blouse or dress) with details copied from men's shirts . The primary component of these garments was cotton fabric. Cotton has an ignition temperature of 752 °F with a burning temperature of approximately 1560 °F (NFPA, 1997). Cotton is a hollow cellulosic fiber. The hollow space contains air, which allows fire to spread into piles of cotton material (NFPA, 1997).

The process began with a design that was transferred on to thin pieces of paper that would be reinforced with metal on the edges. These patterns would then be used to cut the individual pieces of fabric that would then be assembled into a final garment. Multiple pieces would be cut at once as the cutters would work on tables that had been prepared the night before with several layers of fabric separated by tissue paper. To minimize waste, the cutters would work to place the patterns, which were stored on wires above the cutting tables, in the smallest area of fabric (Von Drehle, 2003).

The original factory was located on the ninth floor; however, all three floors shared the same physical layout. All floors were basically wide open rooms with 12-ft ceilings.

The finished pieces were baled and distributed by the foreman based on what was needed to keep the lines running. These pieces were placed into wicker baskets at the feet of each sewing operator with finished garments stacked in heaps at each work table. Garments, complete or in-process, would be left stacked at buttonholing machines, inspection tables or in the shipping department waiting for orders to be completed at the end of each work day (Von Drehle, 2003). At any given time, a large amount of fuel was available to feed a potential fire.

The Fire

The fire started on the eighth floor at approximately 4:40 p.m. on March 25, 1911, just at the end of the working day when employees were preparing to leave (Gottschalk, 2003). A large amount of fuel was available in the form of material and tissue paper stretched on tables, wicker baskets heaping with half-finished garments, paper patterns hanging from wires above the cutting tables and hundreds of pounds of scrap material stored in wooden boxes underneath the cutting tables. Improperly discarded smoking material, a cigarette butt, ignited the scrap contained in a scrap box under a cutting table located next to the windows along the Greene Street side of the building (Von Drehle, 2003). With materials readily available to feed the fire, it spread quickly.

At 5 to 6 minutes post-ignition, most of the combustible contents on the eighth floor were burning (Von Drehle, 2003). The fire department was notified via telephone and box alarm at approximately 4:45 p.m., at which time the building alarm finally sounded, providing one of the first alerts to the occupants of the ninth floor of the fire (Von Drehle, 2003). Fire quickly spread to the ninth floor when embers entered through the air shaft windows, initially, and then through the windows at the Greene Street side of the floor. The elevator shafts provided a steady flow of air that readily fed and spread the fire across the floor (Von Drehle, 2003). By 4:51 p.m., the fire on the ninth floor was so intense that the exits were inaccessible (Von Drehle, 2003).

One element that minimized the loss of life was the use of the Washington Place elevators for evacuation, especially on the ninth floor.

The tenth floor was initially notified almost immediately by a new device called a telautograph, which transmitted the movements of a writing pen electronically to the tenth floor and duplicated the written message; however, while the message alert signal was received, no written message was generated. Two minutes passed before contact was made via telephone from the eighth to the tenth floor to convey the fire alert (Von Drehle, 2003). By this time, flames were visible through the windows at the air shaft at the back of the building. Materials stored in the packaging department adjacent to the air shaft windows were ignited by flames from the lower floors, spreading the fire to the tenth floor (Von Drehle, 2003).

What Went Wrong

Means of Egress

To maximize and make use of belt-driven machinery, long work tables stretched across both the eighth and ninth floors of the Asch Building. Workers needed to traverse the entire length of the table before reaching a narrow aisle that would lead to an exit stairwell or an elevator. On both floors, the Greene Street stairwell and elevator were the main means of entry and exit. On the eighth floor, a wooden partition was located just inside the Greene Street exit that funneled workers into a single line to facilitate inspection of handbags to prevent theft (Von Drehle, 2003).

On the day of the fire, the Washington Place stairwell doors were locked. Locked doors were not a new occurrence as it was noted on a fire inspection report in 1909 (Von Drehle, 2003). On the eighth floor, a manager was able to reach the door and unlock it; however, a flaw existed with the Asch Building's exit doors. Due to the narrow stairwell landings, the exit doors opened inward. Time was lost as the crush of workers pushing against the doors prevented them from being immediately opened (Von Drehle, 2003).

A similar flaw existed with the airshaft fire escape. The escape landings were barely wide enough to fit one person across with the sloped ladders that connected the landings approximately 18 in. wide. There was no exit to the exterior of the building as the escape ended at a skylight at ground level while the top reached the roof via a tall, gooseneck ladder that was described as being able to "make even a lumberjack nervous" (Von Drehle, 2003). The steel shutters that led from the building to the fire escape opened outward. At a point during the evacuation, a shutter opened and locked in place, blocking the escape at the eighth and tenth floors. As workers continued to flood the fire escape, it became overloaded and broke from the side of the building, ejecting the occupants. Those who escaped the building using the fire escape did so by breaking a window on the sixth floor and proceeding down an internal stairwell (Von Drehle, 2003).

Evacuation Planning

Based on Von Drehle's book, it is not clear whether exit drills had been conducted. An observation from a manager that workers moved toward the dressing room on the eighth floor to retrieve hats, coats and other valuables after the cry of fire had gone out may answer the question (Von Drehle, 2003). In fact, after Blanck and Harris applied to increase fire insurance coverage in 1909, a recommendation was made after an inspection that a fire prevention expert be used to organize and conduct fire drills for the company. This recommendation was never implemented (Von Drehle, 2003).

In terms of making a headcount of evacuated employees at street level, it appears that no clear record exists of how many employees were present on each floor. Von Drehle notes that 278 sewing machines were on the ninth floor with an estimated 250 people present the day of the fire (Von Drehle, 2003). Approximately 180 people were present on the eighth floor. No headcount process was in place to tell who made it out and who did not.

Von Drehle also makes an important observation about the delay of warning to the ninth floor. Had the tenth floor been able to notify the ninth floor at 4:42 instead of 4:45, as there was a 2-minute delay due to the failure of the telautograph, an extra 3 minutes of evacuation time would have been available (Von Drehle, 2003). This may have been enough time to evacuate the entire floor to the ground or to the roof.

One element that minimized the loss of life was the use of the Washington Place elevators for evacuation, especially on the ninth floor. The elevator operators overloaded their cars, evacuating approximately half of the workers who escaped the fire (Von Drehle, 2003).

At approximately 4:48 p.m., 8 minutes after ignition, the fire was so intense that building occupants started to jump from the ninth floor. The fire department erected a safety net; however, "no one could recall a person being saved by a net after falling nine stories" (Von Drehle,

2003). The fire department attempted to raise a ladder to the trapped occupants, but the ladder fell 30 ft short (Von Drehle, 2003). Fifty-four people fell or jumped to their deaths (Von Drehle, 2003).

Fire Prevention

Based on photographs, the building structure suffered minimal damage. The building contents provided fuel for the fire. Cotton material, paper patterns and in-process and finished garments were stretched across tables, ready for the next workday. On the eighth floor, hundreds of pounds of scrap material were stored in bins that occupied a space that stretched uninterrupted under the seven long cutting tables. These bins allowed the cutters to sweep scrap easily out of their workspace and minimized downtime. These bins had also yet to be emptied at the time of the fire and considerably added to the fuel load (Von Drehle, 2003). Cans of machine oil were also stored throughout the floor to maximize machine uptime (Gottschalk, 2002). The production process favored open storage of combustible material versus minimization or compartmentalized storage using fire-resistant construction to prevent ignition.

The exit doors to the stairwells were not effective in confining the fire, as the first arriving fire company on the scene found the door leading from the eighth floor to the Washington Place stairs completely destroyed (Von Drehle, 2003). Without confinement of the fire to the building floor, the time available for occupants to exit down the stairwells was limited.

Smoking is the listed cause of the fire; however, it is unclear what steps were taken to prevent smoking in the workplace. Harris had previously fired a worker after dousing a smoldering basket of unfinished garments and finding a cigarette butt in the remains, so smoking appears to have been a known practice (Von Drehle, 2003).

Fire Suppression

The building was not equipped with an automatic sprinkler system. The automatic sprinkler system was invented by Henry Parmelee, a Connecticut piano maker, in 1862. Buildings equipped with properly designed and maintained automatic sprinkler systems have never experienced a multiple-death fire (Gottschalk, 2002). Out of 1,000 shops surveyed in New York in 1910, only one garment factory was found equipped with a sprinkler system (Von Drehle, 2003).

The fire extinguisher of the time consisted of red water-filled buckets located throughout the floor. An elevator operator and the manager of the eighth floor attempted to extinguish the fire as it was initially discovered in the scrap bin with such a bucket filled at a water tank near the entrance at the Greene Street side of the building (Von Drehle, 2003).

Fire hoses were available in the stairwells at each floor of the building, activated by a valve adjacent to the hose storage rack and fed by a roof top water tank. Almost immediately after the fire began, a hose was provided after a shipping clerk from the tenth floor was able to fight his way against the evacuating workers to the Greene Street stairwell. The valve was turned but no water flowed. A second hose yielded the same results. The floor manager returned to using buckets, climbing tables to better reach the fire; however, fire buckets were not enough, given the heavy fuel load readily available for the fire (Von Drehle, 2003).

The fire department response was quick. A fire alarm box activated by an observer on the street, Number 289, provided the initial notification to the fire department at 4:45 p.m., 5 minutes into the fire (Von Drehle, 2003). Eight fire wagons were dispatched immediately, with the first wagon (Engine Co. 72) running a hose from a nearby fire hydrant to the Washington Place stairwell standpipe system. This standpipe was the same system, fed by the roof-mounted gravity tank, which failed when used in an earlier attempt to douse the fire. New York City had just begun a fire hydrant modernization project, which allowed water engineers to increase water pressure in a given area by strategically closing various shutoff valves. The neighborhood where the Asch Building was located was one of the first to be equipped with these shutoff valves (Von Drehle, 2003).

Smoking is the listed cause of the fire; however, it is unclear what steps were taken to prevent smoking in the workplace.

A firefighting team from Engine Co. 72 quickly reached the seventh floor, removed the building hose and tied into the Washington Place standpipe. Upon reaching the eighth floor, the team noted that the door leading from the stairwell was completely burned from the frame and the entire floor was fully involved. The team began to fight the fire from the stairwell. At approximately the same time, Battalion Chief Edward Worth reached the scene and observed from the exterior of the building that the entire eighth floor was fully involved with the western part of the ninth floor showing signs of fire. No sign of fire was observed on the tenth floor. At 4:48 p.m., the chief initiated a second alarm from Box 289.

As the second alarm was sent from Box 289, a team from Engine Co. 18 hooked a hose from a hydrant to the Greene Street stairwell standpipe system. The team proceeded into the building and hooked their hose into the standpipe system at the sixth floor of the Greene Street stairwell. Like the team from Engine Co. 72, the team from Engine Co. 18 found fire at the eighth floor; however, the stairs were not passable. Even though both teams were separated by only 140 ft, neither could see each other through the inferno on the eighth floor (Von Drehle, 2003).

At the same time, Engine Co. 13 tried to provide relief to the building occupants whom could not evacuate, and now lined the ninth floor windows, by spraying water from a 1.5-in. hose line along the cornice of the

building. The idea was to "prevent the people from jumping." It did not work (Von Drehle, 2003). At approximately 4:55 p.m., progress was made as both teams worked through the eighth floor; however, progress was not quick enough. The last occupant of the ninth floor jumped at 4:57 p.m. (Von Drehle, 2003).

By 5:00 p.m., ten minutes into the interior attack, the eighth floor was under control, with the Greene Street team continuing to the ninth floor. The fire on the ninth floor was observed to be "in a more uneven condition" and needed only a few minutes to extinguish. Bodies were found only feet from either stairwell. By 5:15 p.m., only 35 minutes after starting, the fire was under control on all three floors (Von Drehle, 2003).

Changes

By October 1911, the public demand for stronger regulations, codes and enforcement resulted in the formation of the New York City Bureau of Fire Prevention. As a result, there was an effort to streamline the responsibility and authority for fire prevention activities inside the city. By 1916, changes to the building code required improvements, such as fireproof materials in stairwells and prohibition of smoking in factories. On June 30, 1911, the Factory Investigative Commission was created, which turned the spotlight on fire safety to the whole State of New York. A Bureau of Fire Prevention was formed at the state level, with the power to investigate and determine if proper processes and procedures, such as fire drills and smoke alarms, were in place. Soon after, as the result of numerous investigations, requirements were passed that required factory doors to remain open and unlocked during hours of operation. The commission, after 4 years of operation, drafted 36 laws, which were passed by the New York State legislature. Within 20 years, many of these same laws were passed at the national level.

Lessons Still Learned

The Triangle Shirtwaist Fire lasted only 35 minutes but resulted in the deaths of 146 people. The New York City Fire Department was able to bring the fire under control in approximately 27 minutes; however, inadequate fire prevention and evacuation planning contributed to the catastrophe. Fire prevention and evacuation planning are not new concepts, but fatal fires continue to occur. This is just a small list of the fatal fires that have occurred in the U.S. since Triangle:

•Consolidated School Gas Explosion, New London, TX, March 18, 1937, 296 deaths

•Cocoanut Grove Nightclub Fire, Nov. 28, 1942, 492 deaths

•Hartford Circus Fire, Hartford, CT, July 6, 1944, 168 deaths

•Winecoff Hotel Fire, Atlanta, GA, Dec. 7, 1946, 119 deaths

•Our Lady of the Angels School Fire, Chicago, IL, Dec. 1, 1958, 95 Deaths

•MGM Grand Hotel Fire, Las Vegas, NV, Nov. 21, 1980, 87 deaths

•Station Nightclub Fire, West Warwick, RI, Feb. 20, 2003, 100 deaths

On Dec. 14, 2010, a fire reminiscent of Triangle occurred in a garment factory located in Ashulia, Bangladesh. The fire reportedly occurred on the ninth and tenth floors of a ten-story building, resulting in at least 20 deaths and 100 injuries. Occupants reportedly attempted to jump to safety with others trapped behind a locked gate in a stairwell. Approximately 13,000 people work at the factory; however, many were away from the building since it was lunchtime. The cause is still under investigation.

To ensure that the lessons of the Triangle fire are not forgotten, several websites have been constructed. Cornell University hosts the website Remembering the Triangle Factory Fire: 1911-2011, 100 Years Later. This website has organized a wealth of information, including original newspaper articles and testimonials from the fire, photos, a 3D model of the building and a links to commemorative activities. These sites provide a valuable reminder that fire safety can never be taken for granted. ✪

References

Gottschalk, J. (2002). *Firefighting*. New York: DK Publishing Inc.

NFPA. (1997). *NFPA Handbook* (18th ed.). Quincy, MA: Author.

Von Drehle, D. (2003). *Triangle: The fire that changed America.* New York: Grove Press.

Gabriel F. Miehl, CSP, CFPS, *is a technician with the Erie County (Pennsylvania) Hazardous Materials Response Team and is the past chair and current planning chair of the Erie County Local Emergency Planning Committee. He has worked in the environmental, health and safety field since 1998 with experience in frozen food manufacturing and heavy industrial machining and assembly operations. He is currently employed as an environmental, health and safety technical advisor with General Electric Transportation in Erie, PA. He has held several positions within ASSE's Northwest Pennsylvania Chapter, including president and secretary, and is the past newsletter editor and current assistant administrator for the Fire Protection Practice Specialty.*

ASSE Fire Safety Contributions

ASSE is working with the New York Triangle Fire Coalition to populate an online archive and resource site with occupational safety facts and information. To view the progress of this ongoing project, **click here**.