EXPLOSION IN FREMONT

20 KILLED AFTER
NATURAL GAS
EXPLODES

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At 9:32 am on Saturday, January 10, a natural gas explosion killed 20 people in Fremont, Nebraska, and destroyed the Pathfinder Hotel and six adjacent buildings. The exact cause of the explosion is unknown, but the natural gas leak that preceded the explosion was caused by an underground pipe separation. The odor of the natural gas was first detected about four hours before the explosion. However, hotel employees were unable to reach gas company personnel to request assistance for nearly two hours, even though they used emergency telephone numbers. The fire that resulted from the explosion spread vertically through inadequately protected elevator shafts, stairways, and pipe chases. This incident was remarkably similar to the Paramount Hotel disaster that occurred in Boston in 1966. On January 28, 1966, almost ten years to the day before the Fremont incident, the Paramount suffered a severe explosion and fire that also traveled through nonfirestopped pipe shafts and inadequately protected elevator shafts.

Photo 1. The north face of Pathfinder Hotel. The fire from the gas leak is on the ground at center of photo.
The Pathfinder Hotel, constructed in 1917, was approximately 95 feet wide by 125 feet long and consisted of two sections: a two-story unit and a six-story unit. These sections were not separated by fire-resistive walls or partitions. There was a basement beneath both sections. The hotel's guest rooms were in the main section of the building, the six-story section, which was L-shaped. The two-story section was on the southeast corner and covered approximately 40 by 70 feet of the hotel's rectangular shape (see Figure 1). It contained the dining room and kitchen on the first floor and a ballroom on the second floor.

All structural components of the building were fire resistant. The floors were of poured, reinforced concrete supported by massive, reinforced-concrete columns and beams. The exterior walls on the second through the sixth stories of the building between the concrete columns were of hollow tile with brick facing. These were nonbearing walls. On the ground floor, the space between the exterior support columns was 80 percent glass display windows. The remainder of the openings consisted of a low, 1- to 1½-foot wall that amounted to little more than a windowsill. The building was not equipped with either an automatic fire detection system or an automatic extinguishing system.

Vertical fire resistance of the building was diminished when each floor was penetrated by insufficiently protected elevator shafts, stairways, and numerous pipe chases. Horizontally, the original rooms or apartments on each floor were separated by tile blocks with a plaster veneer. All of the new interior partitions installed during one of the hotel's many renovations were of plaster over wood studs.

The hotel's natural gas service mains and meters were located along the southeast wall of the basement. A 2-inch gas line connected the hotel to the 4-inch steel gas main in Broad Street near the southwest corner of the hotel. The gas line was buried along the south end of the hotel and looped around a southeast corner to the meters, which were located on the inside of the east wall of the boiler room. From here, gas was distributed to all the hotel equipment. The hotel's gas-fired equipment had the proper automatic combustion safeguards.

The hotel rented rooms on a nightly, weekly, or monthly basis. Although permanent residents lived on the upper four floors, there were no cooking facilities in their individual apartments. There was a dining room on the ground floor, but there were no bedrooms on the ground or lobby floor (see Figure 2). The hotel's front desk was staffed 24 hours a day.

The Fire

At approximately 5:30 am on the day of the explosion, a man entered the hotel lobby to purchase a newspaper. At this time, he told the night desk clerk that there was a faint odor of natural gas in the lobby area. The desk clerk did not smell the gas, but checked other sections of the first floor and did not detect anything unusual. A few hours later, at approximately 7:00 am, the desk clerk coming on duty to relieve the night clerk also smelled the natural gas. A few minutes later, three men checking out of the hotel said that they smelled gas on the third floor. At this point, the new desk clerk attempted to telephone the gas company. She called the gas company's emergency number and got a prerecorded mes-
sage telling her the numbers of three gas company employees who were on duty to respond to emergencies. She was unable to reach any emergency gas company personnel at any of the numbers, although she tried for approximately one hour.

She then called the hotel's maintenance man at his home; he responded as soon as he could, but did not reach the hotel until about 8:30 am. His first actions were to check the boiler room and the gas meters. Determining that the odor was not coming from this area, he searched the other areas of the basement. In the northwest corner of the basement, the odor of natural gas was so strong that it almost knocked him over. He immediately left the area and tried to contact the gas company. At about 8:50 am, he reached the wife of a gas serviceman and explained the urgency of the problem. She relayed his message to the gas company serviceman, who eventually responded. The maintenance man, after contacting the serviceman's wife, met two other gas servicemen in the alley behind the hotel. These men had been called to investigate a gas odor by employees of a bakery located directly across Broad Street.

The maintenance man directed all three gas company personnel to the northwest corner of the basement. They inserted the probe tube of a gas analyzer into a hole along the northwest wall of the basement. The unit indicated that there was an explosive concentration of a flammable gas in the basement. The gas servicemen ordered the hotel evacuated. They immediately ran from the basement, using the stairway to the kitchen. While the maintenance man informed the kitchen personnel of the danger and told them to leave, the gas servicemen went to the front desk to initiate the hotel's evacuation. The maintenance man returned to the basement to shut off the boilers and the gas service main that fed the hotel's gas-fired equipment. (Although there was no gas leak in this area, it is surmised that he shut them off to prevent this gas from contributing to a possible fire if an explosion occurred in the other section of the basement and damaged the piping.)

As the maintenance man started up the stairs to leave the basement, the explosion occurred. The maintenance man was tossed up the last two or three stairs and landed on the first floor in the south end of the building. The first floor, between the lobby area and the north wall of the hotel and extending across the entire hotel, was destroyed and fell into the basement (see Figure 2). It is believed that there were 15 people, including the three gas servicemen, on the first floor between the front desk and the Sixth Street entry. Of these, only the front-desk clerk survived the explosion. Additionally, the sidewalk over the basement along the north and west walls of the hotel was blown out, leaving a 12-foot-wide hole in the ground along these two sides of the building. All three gas servicemen were killed in the explosion.

Emergency Operations

The Fire Department began to respond at the sound of the explosion, before it had received any alarms. A moment later, the first of many alarms was received. The first alarm came over on the 911 emergency line from the police station, which was located diagonally across the street from the hotel. The Department's two 1,250-gpm engines, a 100-foot aerial ladder, and a rescue vehicle were dispatched to the hotel. The duty captain called in a general alarm for mutual aid while he was en route to the scene. The Fire Department's major effort, on arriving at the scene, was to evacuate the survivors. The basement floor was at this time engulfed in flames, and there were no signs of life there. Therefore, rescue efforts were directed to those individuals still on the upper floors of the building.
The 100-foot aerial ladder took an initial position on Sixth Street, as many hotel occupants could be seen in the windows of the hotel’s north side (see Photo 1). It was difficult to maneuver the ladder truck properly, because of debris from the sidewalks scattered throughout the street and the wide opening above the basement where the sidewalk had been blown out. Policemen and civilians worked with fire fighters to clear away debris so that the ladder truck could be put in position. Then fire fighters and civilian volunteers assisted hotel residents down the aerial ladder to the rescue vehicles waiting to take them to the hospital. Fire fighters used ground ladders on the southeast corner of the building to help rescue occupants from the roof of the hotel’s two-story section. Other occupants were evacuated down the outside fire escapes on the northeast corner and south side of the building. After additional debris was removed from the roadway, the aerial ladder was repositioned to Broad Street, one-third of the length of the building from the northwest corner. Twenty-one people were rescued by aerial ladder.

By this time, fire fighters and apparatus from nine neighboring communities were on the scene. With the hotel evacuated, Fremont’s Fire Chief intensified efforts to extinguish the fire.

**Discussion**

Although the majority of deaths and the greatest physical damage were caused directly by the explosion, the fire following the explosion caused six deaths on the upper floors of the building and numerous injuries.

The fire initially involved the basement, and spread to each of the higher floors through the vertical pipe chases and elevator shafts. Fire officials theorized that while these vertical openings contained some combustible materials, the fire’s rapid spread through these openings was primarily sustained by flammable gas permeating them before the explosion. The fires in these openings easily burned through the thin wood partitions that covered the shaft openings on each floor. However, the fires had not spread any significant distance from these openings on each floor before fire fighters began to control them. Three of the people who died on the upper floors were found in the two rooms immediately adjacent to the elevator shaft on the sixth floor. The partitions between their rooms and the elevator were destroyed by the fire, exposing the occupants to intense heat and smoke. These three people and others removed from the northeast wing of the third floor were believed to have died in their rooms, but they were pronounced dead on arrival at a hospital.

Area hospitals treated 41 people injured during the explosion and fire. Although most of them were treated and released, 14 people required hospitalization, and several were in critical condition. On February 9 and March 6, two persons succumbed to their injuries while in the hospital, raising the death toll to 20.

The damage to the hotel was so severe that the building will have to be demolished. The pressure wave from the explosion blew out the large display windows and low wall on the north and west sides of the hotel, in addition to the floor areas discussed earlier (see Photo 2). Several reinforced-concrete columns and supporting beams in the hotel’s basement-level structural frame were severely cracked, and one of the 2-by-2½-foot horizontal beams was totally blown out (see Photo 3). These damaged and missing beams had to be reinforced before the public emergency officials were allowed to search for and remove bodies of the victims from the basement.

Several Fremont building inspectors thoroughly surveyed all of the buildings facing the Pathfinder Hotel. The buildings closest to the northwest corner of the hotel (Numbers 2, 3, 5, 6, 10, and 11 in Figure 1) were so severely damaged that the building inspectors recommended they be demolished. Although the remaining buildings surrounding the hotel had received major damage, the building inspectors thought that they could be repaired.

**Cause of the Explosion**

The hotel’s maintenance man was one of the first survivors evacuated from the building. He immediately
informed police and fire fighters of the presence of flammable natural gas in the basement shortly before the explosion. These authorities immediately contacted additional officials of the local gas company and the Pipeline Safety Division of Nebraska’s Fire Marshal’s Office. Shortly after the arrival of these officials, the National Transportation Safety Board (NTSB) in Washington, D.C. was contacted.

During the first 2½ hours following the explosion, fire fighters noted a continuous non-expanding fire near the northwest corner of the hotel. The fire was located in the street, 10 to 15 feet from the blown-out sidewalk over the hotel basement’s northwest corner. (It can be seen in Photo 2.) There did not seem to be enough ordinary combustible material there to sustain a fire for such a long time. During that time, the gas company had begun the process of lowering gas pressure throughout the entire city. By 11:30 am, the gas pressure had been lowered to ½ psi. By 1:10 pm, gas mains feeding the intersection of Sixth and Broad Streets were shut off, and at that point the fire from the leak on Sixth Street had died down and eventually went out.

Combustible gas analyzers were used to probe soil in this area, and explosive concentrations of natural gas were still detectable. This indicated a gas leak in that location. Gas company personnel dug down to the cross-main at Sixth and Broad Streets and found a 2-inch plastic gas main on Sixth Street that had separated by about one-quarter inch from a compression coupling at the east side of the intersection.

Investigating officials of the NTSB theorized that the natural gas leaking from this pipe separation had permeated the soil between this point and the hotel’s basement wall, and then had seeped into the hotel’s basement. This continued until an explosive concentration accumulated and was ignited by a mechanical or electrical spark. The precise ignition source for the explosive air/gas mixture has not yet been determined.

The NTSB, investigating the cause of the gas leak in the street, found that, during an effort to upgrade old gas distribution piping, a 2-inch plastic gas main had been installed to replace the existing 4-inch steel main in Sixth Street. The replacement was completed by inserting the 2-inch plastic main into the 4-inch main and connecting the 2-inch plastic main to gas cross mains at the intersections of Sixth and Broad Streets, and Sixth and Park Streets. (The use of plastic pipe for replacing old corroded gas piping is acceptable by NTSB standards.) The 2-inch pipe in Sixth Street was approximately 348 feet long. It was connected to a 2-inch black steel pipe cross-main with a compression coupler (see Figure 3). The plastic pipe had a 2-inch (diameter) steel-pipe sleeve inserted into it. The sleeved pipe extended from the point at which the plastic was butted against the steel cross-main pipe to several inches past the compression

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coupler. (This was done to prevent the plastic pipe from collapsing under the compression forces of the coupler.) The plastic pipe extended approximately 2½ inches into the compression coupler.

The plastic pipe manufacturer’s installation instructions state: “The (plastic) pipe is affected by expansion and contraction from pipe temperature fluctuations.” The instructions further state that this pipe could expand or contract “at the rate of one inch” per 100 feet of length per 10°F change in temperature. Authorities from the NTSB theorized that this pipe in front of the Pathfinder Hotel “could have contracted in length from 3 to 9½ inches given a 25°F temperature differential.” Their investigation of the explosion concluded that the plastic pipe did contract in this manner, and that this caused the separation of the joint, and the ensuing leak.

The Plastic Pipe Manufacturer’s Handbook states: “Since inserted pipe is not restricted in linear movement as in direct burial, the effect of expansion and contraction must be considered when using compression-type fittings.” It further states: “In relative short service runs (100 feet), properly tightened fittings will hold over a normal temperature range; however, in longer runs positive transition fittings may be required to prevent pull out.”

In view of these statements, the NTSB recommended that all plastic pipe couplings in the City of Fremont be examined and serviced accordingly, to prevent any similar explosions.

The information on this fire was obtained by Mr. Di Mello, who gratefully acknowledges the assistance of Robert Vogt, Nebraska Deputy State Fire Marshal, Harley Minnier, Assistant State Fire Marshal for Pipeline Safety, Freemont Fire Chief Howard Schneider, and Freemont Fire Marshal Thomas Hovemel.

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