FIRE INVESTIGATION REPORT

Residential High-Rise
Six Fatalities
North York, Ontario, Canada
January 6, 1995
ABSTRACT

At approximately 5 a.m. on Friday, January 6, 1995, a fire in a North York, Ontario, residential high-rise building resulted in the deaths of six residents. All were found on upper stories in exit stairways. The fire appeared to have been ignited by the improper disposal of smoking materials and initially involved a couch in a fifth-floor apartment. The fire caused severe damage to the apartment and to an exit access corridor. The loss was estimated at $1 million, Canadian ($730,000, U.S.).

After unsuccessfully attempting to extinguish the fire, the occupant in the apartment of fire origin left without closing the dwelling unit door to the corridor. Fire and smoke passed through the open door into the exit access corridor and made that corridor untenable for many fifth-floor residents. The residents who did not escape early in the incident stayed in their apartments until they were rescued by fire fighters. The combination of closed doors and noncombustible walls prevented untenable conditions and deaths from occurring in other fifth-floor apartments.

The door to one of the building’s two exit stairways was heavily damaged by the fire, and the door to the other exit stairway was held open by a fire department hose-line used during the fire suppression operations. As a result, smoke entered both stairways. Natural stack effect moved the smoke vertically through the stairways, elevator shafts, and heating, ventilation, and air conditioning ducts. On the upper floors, the smoke passed through open doors and seeped past closed doors. As a result, smoke accumulated to varying degrees in exit access corridors and in apartments.

The smoke that spread throughout the floors above the fire had a significant effect on the occupants of these floors. In many instances, the smoke spreading through the building made occupants aware of the fire. However, the smoke also made the exit stairways untenable, prevented residents from escaping, and caused the death of six residents.

The communication of specific information to residents in the building was not effective in this incident. No one in the building was trained to use the emergency voice alarm communication system so it was not used during the initial stages of the fire. When the emergency voice alarm communication system was used at some point later in the fire, many residents did not hear or could not understand the messages. Residents in the building turned on radios and TVs hoping that they could receive useful information, but little was provided.

Without guidance that could be communicated through the use of the emergency voice alarm communication system or information from other sources, residents made decisions based on their personal knowledge, experience, and the cues they were receiving. Once aware of the fire, some residents attempted to evacuate early in the incident and were successful. Other residents who attempted to minutes later were unable to do so. Some residents moved through worsening smoke conditions only to be forced to abandon their attempted escape and seek refuge in apart-
ments. Many residents who sought refuge in their apartments or in apartments of 
other residents were able to stay safely in the apartments where they were rescued 
by fire department personnel. Some residents moved from the apartments to their 
balconies. In many instances, the people who remained in their apartments or moved 
to the balconies were exposed to less risk to their safety than those who attempted 
to escape. However, those residents that left upon activation of the alarm bells were 
able to get out of the building safely.

The events in this incident point directly to the importance of being able to reliably 
communicate information to residents and the need for resident training so that res-
idents are able to make an educated decision on whether to evacuate or to stay in 
place during a fire emergency.

The 1994 edition of the Life Safety Code® contains several requirements for ex-
isting apartment buildings that, if enforced, could have changed the outcome of 
this incident. The code requires that all high-rise apartment buildings be fully sprin-
klered or that the buildings have smokeproof enclosures for the exit stairways. In 
addition, the code requires that the doors between living units and corridors be self-
closing and have latches to keep the doors tightly closed. These fire protection fea-
tures would have minimized smoke development or smoke spread within the build-
ing.

Based on the NFPA's investigation and analysis of this fire, the following significant 
factors were considered as having contributed to the loss of life and property in this 
incident:

- Lack of automatic sprinkler protection
- Lack of door self-closing devices on apartment entrance doors
- Vertical smoke movement due to stack effect
- Staff who were not trained with respect to managing fire emergencies in the build-
ing for which they were responsible
- Lack of fire safety training for building residents
- Voice communication equipment that could not transmit messages that were 
  understood by residents
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. INTRODUCTION</td>
<td>5</td>
</tr>
<tr>
<td>II. BACKGROUND</td>
<td>7</td>
</tr>
<tr>
<td>- Occupancy Classification</td>
<td>7</td>
</tr>
<tr>
<td>- Applicable Codes and Enforcement</td>
<td>7</td>
</tr>
<tr>
<td>- The Building</td>
<td>7</td>
</tr>
<tr>
<td>- Fire Protection Features</td>
<td>10</td>
</tr>
<tr>
<td>- Means of Egress</td>
<td>15</td>
</tr>
<tr>
<td>- Apartment 509</td>
<td>16</td>
</tr>
<tr>
<td>- Building Occupants</td>
<td>18</td>
</tr>
<tr>
<td>- Fire Department</td>
<td>20</td>
</tr>
<tr>
<td>- Weather Conditions</td>
<td>20</td>
</tr>
<tr>
<td>III. THE FIRE</td>
<td>21</td>
</tr>
<tr>
<td>- Discovery and Occupant Activities</td>
<td>21</td>
</tr>
<tr>
<td>- Fire Department Notification and Response</td>
<td>21</td>
</tr>
<tr>
<td>- Building Evacuation</td>
<td>24</td>
</tr>
<tr>
<td>- Casualties</td>
<td>25</td>
</tr>
<tr>
<td>- Damage</td>
<td>27</td>
</tr>
<tr>
<td>IV. ANALYSIS</td>
<td>32</td>
</tr>
<tr>
<td>- Origin and Cause</td>
<td>32</td>
</tr>
<tr>
<td>- Fire Growth and Spread</td>
<td>32</td>
</tr>
<tr>
<td>- Smoke Movement</td>
<td>32</td>
</tr>
<tr>
<td>- Compartmentation</td>
<td>36</td>
</tr>
<tr>
<td>- Performance of Fire Protection Equipment and Systems</td>
<td>37</td>
</tr>
<tr>
<td>- Human Behavior</td>
<td>38</td>
</tr>
<tr>
<td>- Code Analysis</td>
<td>40</td>
</tr>
<tr>
<td>- NFPA 1, Fire Prevention Code®</td>
<td>41</td>
</tr>
<tr>
<td>- NFPA 72, National Fire Alarm Code®</td>
<td>41</td>
</tr>
<tr>
<td>V. DISCUSSION</td>
<td>47</td>
</tr>
<tr>
<td>VI. ADDITIONAL NFPA INFORMATION</td>
<td>50</td>
</tr>
<tr>
<td>VII. NFPA CODE SECTIONS</td>
<td>51</td>
</tr>
<tr>
<td>VIII. CORONER’S JURY RECOMMENDATIONS</td>
<td>60</td>
</tr>
</tbody>
</table>
I. INTRODUCTION

The National Fire Protection Association (NFPA) has a long-standing fire investigations program. Under this program, NFPA documents incidents and analyzes the significant factors that result in the loss of life and property. NFPA also reports lessons learned that will affect future life safety and the prevention of property losses.

The NFPA became aware of the fire in North York, Ontario, the day after it occurred. Michael S. Isner, Senior Fire Investigator in the NFPA Fire Investigations Department, traveled to North York to perform an on-site study of this incident. That three-day, on-site study and subsequent analysis of the event were the basis for this report. Entry to the fire scene and data collection activities were made possible through the cooperation of the North York Fire Department and the Ontario Office of the Fire Marshal (OFM).

This report is another of the NFPA’s studies of fires having particular important educational or technical interest. All information and details regarding fire safety conditions are based on the best available data and observations made during the on-site data collection phase and on any additional information provided during the report development process. It is not the NFPA’s intention that this report pass judgment on, or fix liability for, the loss of life and property resulting from the North York fire. Rather, the NFPA intends that its report present the findings of the NFPA data collection and analysis effort and highlight factors that contributed to the loss of life and property.

Current NFPA codes and standards were used as criteria for this analysis so that conditions at the apartment building on the day of the fire could be compared with state-of-the-art fire protection practices. It is recognized, however, that these codes and standards may not have been in effect in North York during construction or operation of the building. The NFPA has not analyzed the North York apartment building regarding its compliance with local codes and standards that were in existence when the building was constructed and during its operation.

The cooperation and assistance of the North York Fire Department and the Ontario Office of the Fire Marshal are greatly appreciated. OFM provided significant support and assistance in the development of this report.
Figure 1:
North York residential high-rise plan
II. BACKGROUND

Occupyancy Classification
The fire occurred in an apartment high-rise that was part of a North York, Ontario, complex containing several buildings (See Figure 1.). The address of the building in which the fire occurred was 2 Forest Laneway. In addition to the fire building, the complex contained two other residential high-rise buildings (4 and 6 Forest Laneway), two office high-rise buildings (4881 Yonge Street and 2 Sheppard Avenue East), a 73-store shopping mall in the base structure, one level of concourse parking, and two levels of underground parking. The fire building was a 29-story structure with 365 apartments or suites.\(^1\) Ten of these apartments were not occupied at the time of the fire. The high-rise building was connected to the mall but did not have common exits with the mall. Since it had separate exits, the fire building will be considered an “apartment occupancy” according to NFPA 101®, Life Safety Code\(^2\).

Applicable Codes and Enforcement
The building was constructed under a North York bylaw that was applicable before the first Ontario Building Code was adopted in 1975. The most current edition of the Ontario Building Code can only be applied to any renovations or retrofitted systems that are covered by the current code. In these cases, the renovated areas and retrofitted system are required to meet the minimum requirements of the code.

At the time of this fire, the City of North York was enforcing the 1990 edition of the Ontario Building Code with 1991 and 1993 revisions. This document and its revisions were written by the Ministry of Municipal Affairs and Housing. The city was also enforcing Sections 9.5 and 9.6 of the Ontario Fire Code which was prepared by the Ontario Office of the Fire Marshal. The Ontario Fire Code included amendments that were added in 1992. These amendments contained regulations regarding retrofit activities for apartment buildings.

The Building
The high-rise building involved in this fire was constructed in 1974, and it had a footprint that was approximately 36.5 m (120 ft) by 27.5 m (90 ft). The building’s structural frame was made of reinforced concrete columns, reinforced concrete bearing walls, and reinforced concrete floor slabs. (See Photos 1 and 2.) The concrete bearing walls served as both exterior and, in many locations, interior walls. Nonbearing interior walls between apartments were constructed with metal studs and were covered with two layers of 12.7-mm (1/2-inch.) type X (fire-rated) gypsum wallboard on both sides of the studs. Nonbearing walls inside the apartments were constructed with one layer of 12.7-mm (1/2-inch.) gypsum wallboard on each side of the studs. No information regarding the fire resistance ratings of the structural
Photos 1 and 2:
Building exterior

Credit:
North York Fire Department, used with permission
components was available so the construction classification could not be confirmed. However, the building appeared to most closely resemble Type I construction according to NFPA 220, Standard on Types of Building Construction, 1992 edition.

The arrangement of all floors above the second floor was similar to the arrangement of the fifth floor. Apartments were located along the perimeter of the floor (see Figure 2), and every apartment had an exterior balcony that could be accessed through sliding glass doors. The balcony for the apartment of fire origin was 2.1 m (7 ft) wide and 5.5 m (18 ft) long, and the sliding door was approximately 0.9 m (3 ft) wide and 2.1 m (7 ft) high. An H-shaped exit access corridor separated the apartments from a center core area that contained the building’s two exit stairways, two elevator shafts (each with two elevators), a trash chute room, and vertical chases for plumbing pipes, heating, ventilation, and air conditioning (HVAC) ducting, and some electrical conductors. The stairways, elevator shafts, and chases were enclosed in masonry block walls.

Figure 2:
Typical residential floor plan
The building’s HVAC needs were handled by a central HVAC system and individual heating/cooling units in the apartments. The central HVAC system serviced the building’s core and common areas. The equipment for this system was located in a penthouse and conditioned air was supplied to the respective floors via ducts located near the elevator shafts. This system was 100 percent supply; there were no return-air ducts. The central system was interlocked with the building’s fire alarm. This interlock shut down the central HVAC system when the fire alarm system was activated. The apartment heating/cooling unit was powered by electricity.

As a means to control cooking odors, air flow in this apartment building, as in most apartment buildings, tended to be from the corridor into the apartment. Gaps around the apartment entrance doors facilitated this air flow. Many occupants found the normal drafts created by these gaps to be annoying and installed weather stripping around their doors to reduce the drafts.

The kitchen and bathroom exhaust ventilation systems had the only ducts with openings in the apartment units. The kitchen exhaust system servicing floors 1 through 16 had one fan located in the basement. Similarly, the bathroom exhaust system servicing these floors had one fan located in the basement. Both fans were rated for 5.9 m³ per second (12,500 cfm). Four fans for kitchen exhaust systems servicing floors 17 through 30 were rated at either 1.3 m³ per second (2750 cfm) or 1.7 m³ per second (3650 cfm). Another four fans for the bathroom exhaust systems on the same floors, in addition to the aforementioned kitchen fans, were located in the roof penthouse. These fans were rated at 1.3 m³ per second (2800 cfm) or 1.6 m³ per second (3500 cfm). The fans for both systems were interlocked with the building’s fire alarm system and would shut down upon the activation of the fire alarm system. The interlocks between the two exhaust systems and the fire alarm system were tested after the fire and were found to have operated properly.

**Fire Protection Features**

The apartment building had been provided with a building-wide fire alarm system that was activated by system smoke detectors and manual fire alarm boxes. (See Figure 3) The smoke detectors were installed in the trash chute rooms, electrical closets, locker rooms, elevator machinery rooms, elevator shafts, and at the top of the exit stairways. The ground floor had five manual fire alarm boxes, and all the residential floors had two manual fire alarm boxes which were located next to the exit access doors. The fire alarm signaling appliances were bells. On the residential floors, 152-mm (6-inch) bells were mounted on the walls near Apartments 03, 04, 09, and 12. The fire alarm system provided a building-wide, not complex-wide, alarm. Conversely, fire alarms operating in other buildings within the complex would not initiate an evacuation alarm in the 2 Forest Laneway building. (See Figure 3).
During the week following the fire, the Ontario Office of the Fire Marshal (OFM) investigators tested the audibility of the alarm appliances. In the immediate area of the appliance, sound levels of 100 dBA were measured. Near the elevator lobby, the sound level had dropped to 85 dBA, and in the bedroom of some units the sound level was less than 50 dBA, even with the bedroom door open.

In addition to activating the fire alarm system, the smoke detectors and the manual fire alarm boxes sent alarm signals to the complex’s main fire alarm control panel located in the 4881 Yonge Street building. Signals were also sent to the 2 Forest Laneway building’s fire alarm control panel located in the basement of that building, to an annunciator panel in the exterior lobby of the ground floor of the 2 Forest Laneway building, to a satellite control panel at a constantly attended security guards’ office in the 4 Forest Laneway building, and to an off-site central station monitoring facility. The elevators were not interlocked with alarm system so the elevators would not be recalled to the ground floor when alarm system operated.

Figure 3: Fire protection equipment, fifth floor
Every apartment had at least one single-station, batteryoperated ionization smoke detector, though many apartments had more. The smoke detectors were mounted in various locations within the apartments.

Other detection devices in the building were heat detectors located at the top of the two exit stairways, elevator shafts and in air handling ducts. The detectors in the shafts were intended to open the smoke vent at the top of each stairway or elevator shaft. The stairwell vents provided a 762-mm x 914.4-mm (30-inch x 36-inch) opening, while the elevator shaft vents measured 762-mm x 1371.6-mm (30-inch x 54-inch).

The building was provided with an unsupervised emergency voice alarm communication (EVAC) system with speakers in three locations on all floors. A 203-mm (8-inch) cone speaker was installed at the east and west ends of the exit access corridor, and a ceiling-mounted 203-mm (8-inch) speaker was installed in the elevator lobby. (See Photo 4.) Speakers were also provided in both stairways on every landing. Multiconductor cable installed in vertical metal conduit connected the speakers on each floor with the EVAC system panel located in the ground-floor entrance lobby of the 2 Forest Laneway building. This panel contained a microphone and selector buttons for each floor and an “all call” button. The microphone for the EVAC system was interlocked with the fire alarm system, and activation of the microphone caused the fire alarm bells to stop operating while announcements were being made. Fire alarm bells would resume operation once the microphone’s “press to talk” switch was released.

Each apartment had an intercom unit near its entrance door. This intercom system was connected to the EVAC system so any message being transmitted over corridor speakers would also be transmitted by the intercom.

According to the building’s fire safety plan, the building’s supervisory staff would “… supervise the evacuation of the building and EVAC should be used where available.” The controls for the EVAC system were located in the entrance lobby and were incorporated into the fire alarm system annunciator panel. The panel also included the visitor’s buzzer system, public address system, fire fighter telephone jacks, the fire department approved fire safety plan, and the list of handicapped persons.

OFM investigators determined that the building supervisors had not received any formal training on the use of the EVAC system. One of these supervisors had worked in the building for nine months before the fire, and the other had worked in the building for two months. The OFM investigators also noted that the security operations manual instructed security personnel to not make any announcements using the EVAC system. The manual stated that this was a function of building management or fire department personnel.
The building also had a fire fighters' telephone system to enhance fire fighter communications. This system's master control panel was located in a cabinet in the entrance lobby. The panel had a master telephone handset and selector switches for every floor. The cabinet also contained three handsets that fire fighters could use. These handsets could be connected to a dedicated receptacle located next to the manual fire alarm box on the east side of each floor. After the fire, OFM investigators tested the handsets and found that only one out the three were operational.

Emergency lights were installed in the exit access corridor and in the exit stairways. The emergency lights in both areas were fluorescent fixtures that could be used for normal and emergency lighting. In the corridor, the emergency lights were located over the entrance doors to Apartments 05, 06, 07, and 10. In the stairways, the emergency lights were ceiling-mounted fixtures. Illuminated exit signs were located in the corridor next to each door that provided access to the exit stairways.
Two 350 kW diesel-driven emergency generators provided back-up electrical power to several systems in all the buildings in the complex. The generators were located in a commercial section of the complex on the Yonge Street side. The generators supplied power to the standpipe fire pumps, emergency lights, illuminated exit signs, elevator penthouse machinery, and the fire alarm system in the 2 Forest Laneway building.

Two standpipes had been installed in the building. The hose stations for the standpipes were located in the exit access corridors on each floor and near the door to the enclosed stairway (see Photo 5). Each hose station had a 65-mm (2 1/2-inch) connection, a 38-mm (1 1/2-inch.) connection, and a 38-mm (1 1/2-inch.) hoseline equipped with a nozzle. According to NFPA 14, Standard for the Installation of Standpipe and Hose Systems, 1996 edition, the standpipe in this building would be classified as a Class III system for use by building occupants and fire department personnel. A 9.5-liter (2 1/2-gallon) pressurized–water fire extinguisher was also provided at each hose station.

The automatic sprinklers were installed in the trash chute, in the trash chute discharge room in the basement, in underground parking areas, and within common storage rooms provided for tenant’s use.

The primary water supply for the sprinkler and standpipe system was the municipal water system. An electric booster pump, rated at 380L/min @ 930 kPa (100 gpm @ 135 psig) was provided to increase the pressure in the sprinkler system and both standpipes. A fire department connection was also provided so fire fighters could pump into and support the standpipe systems.

Several vertical penetrations for plumbing pipes and for the bathroom ventilation system duct were observed in the concrete slab above the apartment of fire origin. Most penetrations were sealed with a material that appeared to be a fiberglass mat insulation. However, one of the unused penetrations that was observed above the bathroom was covered with a metal plate. A second penetration containing a waste water pipe was not sealed.

**Means of Egress**

Each living unit had one door that opened into the exit access corridor. The door was 91 mm (36 inches.) wide and had wood veneer and a solid composite core. The door was not fire-rated and did not have a self-closing device.

A common corridor provided occupants of all living units on a floor with access to the building’s two exit stairways located in the center core. The exit access corridor was approximately 1.4 m (4.5 ft) wide, and the longest travel distance from an apartment door to an enclosed stairway was approximately 9.1 m (30 ft). Walls between the apartments and the corridor ran from slab to slab. Most of these walls were constructed with metal studs and had two layers of 12.7-mm (1/2-inch) type...
X gypsum wallboard covering both sides. A few walls, such as those near the exit stairways, had narrow metal studs that were placed against the concrete and masonry block walls enclosing the stairway. The narrow studs were covered with a single layer of 12.7-mm (1/2-inch) type X gypsum wallboard.

The wall finish in the corridor was wallpaper with a wood baseboard, and the corridor floor was covered by carpet. After the fire, OFM investigators had a sample of the wallpaper tested in accordance to CAN/ULC-102-M, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies. This test was similar to the test described in NFPA 255, Standard Method of Test of Surface Burning Characteristics of Building Materials. The test revealed that the sample had a flame spread rating of 33.84 and a smoke development classification of 34.0.

The 1994 edition of the Life Safety Code would allow wall finish materials to have flame spread rating up to 75 and smoke development rating up to 450. The building code being enforced in North York at the time of the fire would have allowed flame spread rating of 75 and smoke development classification of 100. Accordingly, the wall paper would have been acceptable under the Life Safety Code and the local building code requirements.

The OFM investigators also tested a sample of the carpet used in the exit access corridor in accordance to CAN/ULC-102.2-M, Standard Method of Test for Surface Burning Characteristics of Flooring, Floor Covering, and Miscellaneous Materials and Assemblies. This test was significantly different from NFPA 253, Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radi-
ant Heat Energy Source. As a result, the findings of the test could not be compared with Life Safety Code requirements since they were written in terms of NFPA 253.

The carpet test revealed that the sample had a flame spread rating of 217.0 and a smoke development classification of 263.0. The carpet sample was found to produce large quantities of dense black smoke during the tests. The building code being enforced in North York at the time of the fire would have allowed the carpet to have a flame spread rating of 300 and smoke development classification of 500. Accordingly, the carpet on the floor of the exit access corridor would have been acceptable under the local building code requirements.

The two exit stairways were “scissors stairways”; that is, they were located in the same enclosure, but they were separated by a masonry block wall within that enclosure. (See Figure 4.) The door openings for the stairways were protected by 1 1/2-hour fire-rated and labeled metal doors and frames. These doors had self-closing devices and latching devices, and they were 0.9 m (36 inches) wide.

The stairways’ design had the stairway entrance doors at the opposite ends of the H-shaped corridor, placing the exits in locations remote from each other. The stairway design also alternated landings between the east and west corridors on consecutive floors. As a result of the landing alternation, many evacuating occupants became confused as to their location in the building when they left the stairways and attempted to seek refuge. Similarly, fireground operations were made more complicated because of confusion that arose while the fire fighters used the stairways.

At ground level, one stairway was connected to an exit passageway that led to the building’s exterior and the other stairway discharged into a first-floor corridor. (See Figure 5.) This corridor led to the building’s elevator lobby and entrance foyer. This corridor also provided access to a stairway to the lower levels in the building and to another corridor that discharged into the mall area.

**Apartment 509**

Apartment 509 was the apartment of fire origin. This two-bedroom unit was located in the northeast corner of the 2 Forest Laneway building. Since it was a corner apartment, it had windows on the north wall and a 6.7-m (12- ft) wide window/door assembly providing access to the balcony area on the east side of the apartment.

The interior finish materials in the apartment were predominately noncombustible. All interior wall surfaces were painted gypsum wallboard. The bathroom had a ceramic tile floor and the powder room had a vinyl tile floor. The ceilings in all rooms were constructed with noncombustible materials.

However, some combustible construction materials were used in the apartments. For example, the entrance doors were a solid core with a wood veneer. The interior doors

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also had wood veneers, but these doors had hollow cores. Wood baseboards lined the walls of the living room and bedrooms, and these rooms had 6.4-mm (1/4-inch.) thick wood parquet floors.

Based on their examination of the debris, OFM investigators determined that the living room contained a couch, coffee table, end tables, lamps, video cassette recorder (VCR), stereo system, television, other electrical equipment, and a large collection of vinyl phonograph records. (See Figure 6.) The couch had a wood frame with metal springs, polyurethane cushions, and a synthetic cover material. The master bedroom had a bed and bureau. The investigators were able to confirm these items with remnants found after the fire. The second bedroom was not heavily damaged during the fire so the contents were readily identified after the fire. This room contained office furnishings and equipment that included a computer, a printer, a computer table, a chair, bookshelves with books, and file cabinet. (See Photo 6).

**Building Occupants**

Following the incident, National Research Council of Canada (NRCC) researchers performed a study of the building occupants and their activities during the fire. Questionnaires were returned by 233 of the estimated 545 building occupants, and of these respondents, 219 indicated that they were in the building at the time of the fire. NRCC researchers considered this to be a good return and considered the results of their study as being representative of the building’s population.
The NRCC study reported that 55 percent of the occupants who responded to the survey were female and 45 percent were male. The majority of the respondents (69 percent) were between the ages of 21 and 50. The oldest respondent was 96 years old. When asked about their occupation, the majority of the respondents considered themselves to be professionals (43.4 percent), support staff (25.1 percent), or retired (18.7 percent). The remaining 12.8 percent considered themselves to be students, not employed, or did not answer the question.

The NRCC study found that fire safety knowledge and experience varied greatly from one individual to another. Approximately 27 percent of the respondents reported that they received fire safety information from multiple sources. Another 16 percent reported that their fire safety information was obtained at work. Slight-
ly more than 35 percent reported that their sources included school, publications, radio, TV, or other sources. The remaining respondents, approximately 21 percent, either had received no fire safety information or did not answer the question.

The OFM investigators determined that the two building supervisors, one who had worked in the building for nine months and the other who had worked in the building for two months, had not distributed fire safety information to any building residents. In addition, the OFM investigators were not able to determine the last time that fire safety information had been distributed to residents. Residents who had moved into the building just prior to the fire reported that they had not received fire safety information when they signed their leases.
The following instructions for occupant response were provided on a sign that had been secured to one of the walls in the elevator lobby on every floor:

- Leave fire area immediately and close the doors
- Pull the fire alarm located by the stairwell exit
- Dial 911, ask for the North York Fire Department
- Do not use the elevators
- Upon hearing the fire alarm
  - leave the building via the nearest exit
  - take apartment key
- Caution
  - if smoke is heavy in the corridor, it may be safer to stay in the apartment
  - close the door behind you
  - place wet towel at base of door
  - listen for instructions over the public address system
- If you encounter smoke in stairway, use alternate exit
- Remain calm

Fire Department

At the time of the fire, the North York Fire Department had 18 fire stations, 20 engines, 6 aerial trucks, 2 rescues, and 4 auxiliary vehicles. The auxiliary vehicles included an emergency support vehicle, a mechanical support vehicle, a hazardous materials support unit, and a command vehicle that was not available when this fire occurred because it was undergoing modifications. The department’s chief officers included the department chief, one deputy chief, one assistant deputy chief, one administrative chief, four platoon chiefs, and 16 district chiefs. According to its 1993 annual report, the North York Fire Department responded to 27,105 emergency calls.

In addition to the fire suppression resources, the department had a communication division, a fire prevention bureau, a fire safety education group, a fire protection engineer, and a training division for fire suppression personnel. Though the fire safety education group primarily focused on fire safety programs for schools, they have organized displays in malls and attended community activities such as the North York Winter Carnival. The fire department’s fire safety education group also conducted seminars for residential building occupants in response to requests by tenants associations and similar groups. During these events, fire fighters provided a variety of fire safety information to the public.

The North York Fire Department prepared building information cards (BIC) for structures within its jurisdiction. These cards were carried on the first assignment fire units and contained information regarding the following building details:
• Occupancy (day and night)
• Number of floors
• Alarm system
• Annunciator panel
• Fire fighters’ communication system
• Fire safety plan

The building information card for the 2 Forest Laneway building indicated that there was no fire department prefire plan.

**Weather Conditions**

The morning of the fire was clear and the temperature was approximately -7.1°C (19.2°F). Winds were from 22 degrees north-northeast at 14 knots/hour. (25.9 km/hour.). There were no recorded wind gusts.
III. THE FIRE

Discovery and Occupant Activities

The only resident of Apartment 509 was working on his computer in his second bedroom when he became aware that there was smoke in his apartment. He investigated and found that the smoke was coming from the couch in his living room. The resident removed the cushions, causing the smoldering fire to transition to a free-burning fire. He then attempted to extinguish the fire with pots of water and was not able to do so. Smoke quickly filled the living room, so the resident opened his patio door to remove the smoke.

Two residents in Apartment 507 awoke to the smell of smoke. They began to investigate their apartment for the source of the smell and realized that it was coming from the corridor. When they opened their apartment door they found thick smoke in the corridor. The two male residents of Apartment 507 went to Apartment 509 to alert the occupant. The resident in Apartment 509 opened his door, releasing more smoke into the corridor.

One of the men from Apartment 507 returned to his apartment and called “911” to notify the fire department. When he went back into the corridor the resident of Apartment 509 asked for assistance, so the resident from Apartment 507 went to the standpipe hose cabinet and got the fire extinguisher. He returned to Apartment 509, and the occupants attempted to enter the apartment, but the smoke was too thick. They left the fire extinguisher by the apartment door and decided they should leave the building. At some point in these activities, one of the Apartment 507 residents used a manual fire alarm box.

The two residents of Apartment 507 went back to their apartment and got dressed. They then went to the elevator to evacuate, where they were met by the resident of Apartment 509 and two residents from another fifth-floor apartment. Before they left the floor, one of the Apartment 507 residents remembered that the door to his apartment was not closed, so the other Apartment 507 resident went back to close the door. When he returned to the elevator, the five 5th-floor residents took the elevator to ground floor. One of the Apartment 507 residents reported that he saw fire apparatus arriving on the scene as they left the building.

No one closed the door to Apartment 509. The rapidly growing fire engulfed the apartment and spread into the corridor through the open apartment door.

Fire Department Notification and Response

The North York Fire Department received a direct line call from an unidentified woman who reported alarms were operating at 2 Forest Laneway.10 Moments later, they received a 911 telephone call, which was quickly followed by a call from the
central station reporting a fire alarm activation at the 2 Forest Laneway building. The first 911 call was received at 5:09:47 a.m. In response to these calls, the North York Fire Department dispatched two pumpers (1 Pump and 17 Pump), one aerial truck (1 Platform), and a platoon chief. Each of the responding companies had four fire fighters. Another pumper (12 Pump) was dispatched at 5:14:17 as an assist pumper.

The first company (1 Pump) arrived on-scene at 5:14:44 a.m., approximately five minutes after being dispatched. These fire fighters observed flames venting from the balcony of a 5th-floor apartment upon arrival. The platoon chief requested a second alarm at 5:15:29. In response to this request, two pumpers (6 Pump and 13
Pump), one aerial truck (9 Aerial), and a rescue (6 Rescue) responded. The pumpers and the aerial truck had four fire fighters and the rescue had three fire fighters.

Two fire fighters from 1 Pump were joined by two fire fighters from 1 Platform. Not knowing where each stairway discharged, the fire fighters entered Stairway 2, which brought them to the west landing of the fifth floor — the landing farthest from the apartment of fire origin. As they approached the fifth floor, they found the metal stairway door in the open position, and pressurized smoke was causing the door to swing back and forth. The smoke was also moving up the stairway.

The fire fighters attempted to reach the standpipe connection on the fifth floor. One of these fire fighters sustained a second degree burn, so the crew withdrew and returned to the 4th floor. On that floor, they were relieved by another crew who removed the occupant hose from the 38-mm (1 1/2-inch.) connection and attached their own 38-mm (1 1/2-inch.) hoseline. The fire fighters advanced the hoseline up the stairway and entered the fifth floor. Shortly after these fire fighters entered the floor, one of the fire fighter's low air alarm operated, and the crew withdrew from the floor. A third crew took the hoseline and advanced down the corridor. As they advanced, the fire fighters had to extinguish fires involving the wood veneer on many apartment doors and involving the carpet (See Figure 7.)

Four fire fighters from 6 Pump entered the other stairway (Stairway 1), which brought them to the east landing of the fifth floor. As this crew approached that floor, they encountered heavy fire entering the stairway, and that fire was holding the door open. Like the fire fighters in the first stairway, these fire fighters returned to the 4th floor, removed the occupant hoseline from the standpipe and attached their own 38-mm (1 1/2-inch.) hoseline. After charging the line, they returned to the 5th floor and started their attack against the fire that was entering the stairway.

Initially, 6 Pump fire fighters could only operate for a short time before the extreme heat forced them to retreat, at which time other fire fighters relieved them. The fire fighters continued to rotate the crews operating the hoselines until they were eventually able to control the fire entering the stairway and advance toward the apartment of fire origin. After making entry into Apartment 509, the fire fighters who were operating from Stairway 1 were joined by the fire fighters who had made their way from Stairway 2. The rotation of fire crews continued until the fire was extinguished.

In addition to performing fire suppression, many fire fighters became involved in search and rescue operations. For example, before the fire suppression operation was started, fire fighters in Stairway 2 encountered three tenants on the 4th-floor east landing. Some fire fighters escorted the tenants to a lower area where police officers took the tenants and brought them out of the building. Other fire fighters went to the top of the building where they started their search and rescue activities. As fire fighters encountered occupants on these floors, the fire fighters instructed the occupants to stay in place and to go to their balconies if they needed to get fresh air. As more fire companies arrived, the number of fire fighters assigned to search
and rescue increased allowing fire fighters to concentrate on specific groups of floors. Fire fighters rescued 11 occupants who were in the stairways. (See Figure 8.)

No occupants were evacuated over ground ladders, aerial ladders, or elevated platforms. Fire fighters considered the use of aerial equipment, but landscaping features and the building’s location with respect to streets prevented the fire department’s aerial apparatus from being positioned in locations where they could be used to safely rescue occupants waiting on the balconies.

Ultimately, three alarms were struck, bringing 16 pieces of fire apparatus, one platoon chief, one chief responsible for administrative activities, three district chiefs, the fire department’s emergency support unit, one air unit from the Mississauga Fire
Department, and several ambulances to the scene. In addition, ambulance support
buses and units and public transit buses came to the scene. The public buses were
used as shelters, as needed. Extinguishment was declared at 7:25 a.m.

Building Evacuation

The NRCC report indicated that less than 20 percent of the respondents successfully
evacuated during the first hour of the incident. Though a few occupants left the
building over the next few hours, most respondents remained in the building until
they were assisted out by fire fighters. Approximately one-half of the respondents
reported that they had attempted to leave before 10 a.m. (elapsed time from the
start of the fire, approximately 5 hours), but they were unsuccessful. These individu-
als generally encountered smoke in the stairways. Some returned to their own
apartments, and the rest took refuge in the apartments of other residents. Once resi-
dents returned to their own apartment or took refuge in another apartment, they
tended to stay at that location until escorted out by fire officials. Fire department
personnel escorted most of these people out of the building between 10 a.m. and 1
p.m., as can be seen in the following table:

Time at Which People Were Asked to Evacuate by Rescue Personnel

<table>
<thead>
<tr>
<th>Time</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before 5 a.m.</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td>5 - 7:59 a.m.</td>
<td>5</td>
<td>2.3</td>
</tr>
<tr>
<td>8 - 9:59 a.m.</td>
<td>9</td>
<td>4.1</td>
</tr>
<tr>
<td>1 - 10:59 a.m.</td>
<td>27</td>
<td>12.3</td>
</tr>
<tr>
<td>1 - 11:59 a.m.</td>
<td>56</td>
<td>25.6</td>
</tr>
<tr>
<td>1 - 12:59 p.m.</td>
<td>23</td>
<td>10.5</td>
</tr>
<tr>
<td>1 p.m. and after</td>
<td>3</td>
<td>1.4</td>
</tr>
<tr>
<td>Not sure</td>
<td>5</td>
<td>2.3</td>
</tr>
<tr>
<td>No answer</td>
<td>90</td>
<td>41.1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>219</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

Casualties

Six residents died in this fire. All were found in the exit stairways and all died from
smoke inhalation. The following table provides basic information regarding the
six victims.

 Victim Information

<table>
<thead>
<tr>
<th>Victim #</th>
<th>Apt. #</th>
<th>Sex</th>
<th>Age</th>
<th>COHb\textsuperscript{13} Level</th>
<th>Stairway #</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3008</td>
<td>M</td>
<td>35</td>
<td>0.67%</td>
<td>1</td>
<td>30th fl, east landing</td>
</tr>
<tr>
<td>2</td>
<td>2911</td>
<td>F</td>
<td>16</td>
<td>0.65%</td>
<td>2</td>
<td>29th fl, east landing</td>
</tr>
<tr>
<td>3</td>
<td>2902</td>
<td>F</td>
<td>29</td>
<td>0.69%</td>
<td>2</td>
<td>29th fl, east landing</td>
</tr>
<tr>
<td>4</td>
<td>2902</td>
<td>M</td>
<td>33</td>
<td>0.56%</td>
<td>2</td>
<td>29th fl, east landing</td>
</tr>
<tr>
<td>5</td>
<td>1601</td>
<td>M</td>
<td>29</td>
<td>0.41%</td>
<td>1</td>
<td>27th fl, west landing</td>
</tr>
<tr>
<td>6</td>
<td>2711</td>
<td>F</td>
<td>35</td>
<td>0.79%</td>
<td>2</td>
<td>27th fl, east landing</td>
</tr>
</tbody>
</table>

\textsuperscript{13} COHb: Carbon Monoxide Hemoglobin
Eleven respondents to the NRCC survey reported injuries. Seven of them suffered from smoke inhalation, two from exhaustion, one from exposure to cold, and one did not specify the nature of the injury. The North York Fire Department also reported 11 resident injuries. The fire department information stated that seven of the injured residents were admitted to the hospital.

**Damage**

In Apartment 509, the apartment of fire origin, nearly all combustible contents, furnishings, and wall hangings were consumed in the living room, master bedroom, and kitchen. In the living room, the parquet wood flooring was almost completely consumed, and in the master bedroom, it was heavily damaged. The contents of the apartment's second bedroom were severely damaged by heat and smoke but, for the most part, were unburned. The combination of fire exposure and suppression operations resulted in total destruction of most gypsum wallboard on metal stud partitions within the apartment. (See Photos 5, 6 & 7)

The entrance door to Apartment 509 was destroyed by the fire. The metal door frame was severely distorted. The door's three hinges were found in the "open" position although none were in the same position. Investigators recognized that the hinges had most probably been moved during fire suppression operations. The remnants of the entrance door were found in the debris on the floor, and the location of the remnants indicated that the door was in the full open position during the fire.

Heavy fire damage occurred throughout the north/south exit access corridor directly outside the apartment of fire origin. The single layer of gypsum wallboard was
extremely calcinated and in many areas had fallen off, leaving the metal studs exposed. However, the gypsum wallboard on the apartment-side of the corridor walls was intact in all areas despite some calcination in a few areas and notable discoloration of the paper facing in other areas. (See Photo 8)

Doors along the fifth-floor corridor had varying degrees of damage. The doors closest to the apartment of fire origin sustained the most severe damage. For example,
the solidcore wood door for Apartment 511 was almost completely consumed by the fire, and the 1 1/2-hour rated metal door for the exit stairway was destroyed. It is believed that this door was open for at least part of the fire. The first firefighter to go up this stairwell reported this door to be open when he arrived. An identical door to the refuse chute intake room is located approximately a foot away and survived the fire intact. Both the metal stairway door and its frame were bent, and the door’s metal panels were separated from the door’s structural frame. (See Photo 9) OFM investigators believed that the extreme damage to the metal stairway door was due to the direct flame contact and sudden cooling by firefighters’ hose streams.

The damage to the doors decreased as distance from the apartment of fire origin increased. The solid-core wood doors for other apartments in the east corridor — Apartments 507, 505, 503, and 501 — were heavily charred on the side facing the corridor. (See Photo 10) Most of these doors were virtually undamaged on the apartment side. (See Photo 11)
Photo 10:
Fire damage to solid core door of Apt. 503 - corridor side

Photo 11:
Enterance door to Apt. 503 - apartment side
The damage to doors in the elevator lobby was less than that in the east corridor. Burned paint and the warping of 5th-floor steel elevator doors revealed that these doors were exposed to high heat and, possibly, direct flame contact.

The doors in the west corridor had the least amount of damage. The wood veneer covering the entrance doors to Apartments 502, 504, and 506 had been burned and was delaminating. This damage confirmed that the doors were in direct contact with flames. Smoke stains and the lack of burning on entrance doors to Apartments 508, 510, 512, and 514 revealed that these doors were exposed to only smoke.

All surfaces in both exit stairways were coated with a heavy soot stain on the 5th floor. However, the stairway closest to the apartment of fire origin had slightly heavier staining than the other stairway. This apparent difference between the two stairways was generally true in all areas where soot stains were observed. The soot accumulations in both stairways gradually decreased on each subsequent floor above the fire floor. However, near the 20th floor the amount of soot staining in both stairways began to increase, reaching an apparent maximum density (though still less than that in the area of the 5th floor) around the 27th floor level.

Soot stains also accumulated on the edges and corridor-side of the doors to the exit stairways. On floors above the fire, the stains indicated that smoke from the stairway was seeping from the stairway into the exit access corridor on the occupant floors. The amount of staining on the doors appeared to be consistent with the amount of staining within the stairway; that is, areas with heavy soot stains in stairways had heavy soot stains on the edges of the stairway doors. Conversely, areas with light soot staining in stairways had light soot stains on the edges of the stairway doors.

On the floors above the 5th floor, the most visible smoke stains typically occurred on the top five stories of the building. In these areas, light smoke staining on the elevator shaft doors confirmed that smoke in the elevator shafts spread into the occupant areas. Light smoke stains could be seen on apartment doors, and in some apartments, a light, but detectable layer of soot covered surfaces.

Several apartments above the fire had significant smoke staining. Of these apartments, Apartment 609 had heaviest smoke stains. Within that apartment, the heaviest smoke stains were in the bathroom, and some soot streaks were observed near the base of the wall directly outside the bathroom. The rest of the apartment had a light soot film on exposed surfaces. Apartments 709, 809, and 909 also had notable smoke stains in the bathroom, but the stains were not as severe as those in Apartment 609.

The damage to the building and its contents was estimated at $1,000,000, Canadian ($730,000, U.S.) with $600,000, Canadian ($438,000, U.S.) being assessed to building damage and $400,000, Canadian ($292,000, U.S.) assessed to damage to contents.
IV. ANALYSIS

Origin and Cause

Based on statements made by the occupant of Apartment 509 and physical evidence, OFM and North York Fire Department investigators determined that the fire started in the living room of Apartment 509. They also determined that improperly discarded smoking materials most probably ignited the couch in that room. However, the damage was so extensive in the suspected area of fire origin that investigators

Figure 9:
Fire and smoke movement
could not find physical evidence that confirmed that ignition scenario. As a result, the OFM investigators classified the cause as “undetermined.”

**Fire Growth and Spread**

The primary fuels for this fire were the contents of the living room, master bedroom, and kitchen in Apartment 509. Since the fire started in the largest piece of furniture in the living room – the couch - it was able to become large enough to support a fire capable of reaching other combustible materials in the living room, such as other furnishings, electronic equipment, wood doors, wood trim, and the parquet floor.

The severity of the fire was enhanced by the occupant opening the sliding door to his balcony and leaving the door to his apartment open. (See Figure 9) The two open doors ventilated the fire, allowing it to burn intensely. Evidence of the fire’s severity was the almost complete consumption of contents and parquet floor in the living room and the extensive damage to the contents of both the master bedroom and the kitchen.

In addition to contributing to the effective ventilation in Apartment 509, the open entrance door to that apartment allowed the fire to spread into the 5th-floor exit access corridor. Once in the corridor, the fire reached even more combustible materials. These were in the form of the wallpaper that covered the walls, the wood veneer on the apartment entrance doors, the wood baseboards, and the carpet covering the floor.

**Smoke Movement**

Testimony from witnesses throughout the building revealed that the smoke spread in the building was very rapid. Approximately 3 minutes before the first fire fighters arrived on the scene, an occupant of Apartment 511 called 911 and reported that “there’s smoke, lots of smoke in our hallway.” A resident on the 28th floor reported that she found smoke in the corridor at about the time that she first heard the sirens of responding fire department vehicles. The occupant of Apartment 1607 stated that he heard the alarms at about 5:10 a.m. and left his apartment between 5:13 a.m. and 5:16 a.m. He used stairway 2 and encountered smoke at the 12th floor. By the 8th floor, the smoke had become so thick that it forced him to return to the 16th floor. As he attempted to move back up the stairway, the smoke spreading up the stairway was moving as fast as he was. Based on these and other statements, the OFM investigators believed that within 4 to 5 minutes of the alarm operating the smoke filled both stairways on floors near the fire floor. They also estimated that the smoke filled both stairways as high as the 30th floor and spread throughout the building within 15 minutes of the alarm sounding and possibly as early as 10 minutes.
The smoke movement in the building was strongly influenced by “stack effect.” According to the NFPA’s *Fire Protection Handbook*, stack effect is characterized by a strong draft from the ground floor to the roof of a tall building. This phenomenon is like the natural draft up a chimney. The magnitude of stack effect is a function of the building height, the air-tightness of the exterior walls, the air leakage between floors of the building, and the temperature difference between the inside and outside of the building. The fire occurred on a cold morning in a 29 story building so the building’s height and the inside/outside temperature differential would have caused significant stack effect forces within the North York residential high-rise building.

Leakage between floors, another factor affecting stack effect, will occur through all vertical openings in a building. These openings can be as small as a crack in the floor or a poorly sealed pipe penetration in a floor slab. For example, smoke from Apartment 509 spread through an unused penetration hole between Apartments 509 and 609 that was covered with a metal plate and through the waste water pipe penetration that was not sealed. This means the smoke spread was confirmed by heavy smoke staining in the bathroom in Apartment 609. This smoke staining was caused principally by smoke coming from the exhaust duct that is connected to the same vertical riser as the exhaust from Apartment 509. Although there is a fire damper where the riser penetrates the concrete floor slab, it is a heat-actuated damper. At the beginning of the fire there was a period of time when there was substantial smoke being produced, but the fusible link was not yet exposed to sufficient heat to activate. Smoke also moved vertically through service shafts and seeped out openings for wires and plumbing and out cracks in the service shaft. This form of vertical smoke movement was minor compared with that which occurred through stairways, ducts, and elevator shafts.

The two exit stairways were significant avenues for vertical smoke movement. The first fire fighters to reach the 5th floor found that pressure caused by the fire was holding the east side door open, allowing the stack effect forces to easily push large quantities of smoke into both stairways. The west side door was opened by fire fighters entering the floor. According to the OFM investigators, the open 5th-floor doors and the opening of doors below the 5th floor enhanced the bottom venting of both stairways and lowered the neutral plane — the point at which smoke would flow out of the stairways. Smoke stains on carpeting and door frames revealed that the neutral plane in the North York incident had become so low that smoke was migrating out of the stairways on all floors above the fire floor. Witnesses also noted that smoke movement increased in one of the stairways when one of the residents opened the hatch at the top of the stairway, increasing the top venting of the stairway.

In order for the fire fighters to start their suppression operation, they had to connect their hoselines to the 4th-floor standpipe connections and advance their hand lines up the stairway to the fire floor. The hoseline held the 5th-floor stairway door partially open, so fire fighters could not close the door and minimize the amount of smoke entering one of the stairways. The entrance door for the other stairways was
so heavily damaged that the fire fighters could not have closed it. As a result of the smoke entering the stairways because of the open doors, neither stairway could be used for evacuation during the fire suppression operations.

This is not the first high-rise fire documented by the NFPA during which the fire suppression operations affected occupant evacuation or vice versa. On January 2, 1986, a fire occurred in a Boston, Massachusetts, office high-rise building that was occupied by approximately 1500 people.\textsuperscript{17} Fire suppression operations had to be substantially delayed until the stairway from which fire fighters planned to initiate their attack was cleared of evacuating occupants. Similarly, fire fighters responding to the June 30, 1989, fire at a high-rise building in an Atlanta, Georgia did not start their interior attack operations until they ensured that they were the only people in the stairway.\textsuperscript{18} Fire fighters commonly operate from stairways during high-rise fires, and they must open the stairway door in order to make entry into the fire area. The two earlier incidents and the North York fire clearly show that there can be a dual function for stairways in high-rise buildings. More importantly, these incidents show that the two functions of stairways — serving as a base for fire suppression operations and serving as a means for occupant evacuation — cannot occur simultaneously.

In the early stages of the fire, another significant means for vertical smoke movement was HVAC supply-air ducts. According to its design, the central HVAC system shut down when the building fire alarm system operated. A supply-air register was located in the east corridor wall near the standpipe/hose cabinet. The exterior grill melted, causing foreign material to collect on the frame of a fire damper intended to prevent fire from entering the duct. The foreign material prevented the damper from closing properly when its fusible link released. The failure to close properly, in turn, allowed smoke to travel through the duct, spreading to areas above the 5th floor. The fusible link for the fire damper protecting the supply-air register in the west corridor did not fuse, so the damper remained open, allowing vertical smoke movement through this duct, too.

One of the OFM investigators provided the following commentary regarding smoke movement:

\textit{Several occupants reported going down the stairs, encountering smoke at some lower level, returning back up the stair with smoke following behind them and then running into smoke ahead of them which was coming from the corridor into the stair shaft. Other occupants reported that, in the early stages of the fire, the smoke in the corridor was worse than the smoke in the stairs. This smoke must have been coming from the supply air ducts. These ducts were designed to present minimal resistance to air flow and therefore would conduct the smoke up the building much faster than it could move up the stairs which, because of their design, inherently presented much more resistance to the movement of smoke. This resulted in the smoke “leapfrogging” past people returning up the stairs.\textsuperscript{19}}
Smoke also moved vertically through the elevator shafts; however, the smoke movement via this path did not appear to have been as significant as that which occurred through the stairways and the HVAC ducts. Several occupants and firefighting reported having observed smoke seeping past the closed doors to the elevator shafts. Smoke stains on elevators doors also confirmed that, at times, smoke in the elevator shafts entered occupant floors. Additionally, enough smoke entered the elevator shafts to cause the smoke detectors at the top to operate and open the roof-level smoke vents. Once the roof vents opened, the propensity for smoke to seep from the shaft to the occupant floors was reduced.

Once in the exit access corridor, the smoke also seeped past many closed apartment entrance doors. This infiltration of smoke was confirmed by towels that many residents had placed at the base of their doors, tape placed over the gap between the entrance door and its frame, and smoke stains left on door frames. Most of the smoke that seeped passed the closed doors entered the apartments by passing through the gap between the bottom of door and the floor. Lesser amounts of smoke seeped around the sides and top of the closed doors. These were the paths that would allow air to flow from the corridor into the apartment under normal conditions. OFM investigators reported that smoke flow into apartments would have been greater if many residents had not installed weather stripping to control the drafts that occurred around the doors under normal conditions.

The kitchen and bathroom exhaust systems also provided avenues for smoke to spread into apartments. Several residents reported that they observed smoke flowing out of vents in their apartments. Initially, the fans for these system were operating, drawing the smoke out of the building. Once the fire alarm operated and shut down the fans, buoyancy and stack effect forces moved the smoke through the exhaust systems. Apartments 7, 9, and 11 up to the 16th floor shared the same exhaust systems as Apartment 509. As a result, the most extensive smoke movement through exhaust ducts occurred in the 7, 9, and 11 apartments. The bathroom exhaust vent was closer to the center of the fire than the kitchen vent, and smoke movement through the bathroom exhaust system was greater than that which occurred through the kitchen exhaust system. Early in the fire, smoke that migrated from the 5th-floor corridor into 5th-floor apartments was drawn into the exhaust systems for these apartment, and stack effect moved the smoke to apartments above.

The NRCC study corroborated the OFM investigator's findings. Of the 219 occupants who responded to the NRCC survey, 157 (76 percent) reported that smoke entered their apartments. Most of these 157 respondents (102 people, 65 percent) indicated that the smoke entered their apartment by seeping around their entrance door. Approximately 13 percent (21 people) reported that the smoke entered through the ventilation system, and one person stated that the smoke entered through a window. The remaining 21 percent of the respondents did not know how the smoke entered their units.

The NRCC study stated that, with the exception of the 5th and 6th floors, the floors below the 15th floor had significantly less smoke reported by occupants than on the floors above the 15th floor. The findings of the NRCC study were consistent
with the physical evidence (i.e., smoke staining on surfaces) observed by the NFPA investigator and with theoretical smoke movement as a result of stack effect.

Many means for smoke movement were identified and contributed to the smoke spread during the January 6, 1995, fire in the North York apartment high-rise building. Though some building features significantly contributed to the smoke movement, investigators could not identify any one building feature as the primary means for smoke spread. Throughout the incident, venting within the building was changing. Occupants and fire fighters were opening and closing stairway doors, apartment doors, apartment windows, and balcony doors on all levels of the building. The changing ventilation affected the location of the neutral plane and affected which building feature was the predominant mechanism for smoke movement at any specific time. Conceivably, the predominant mechanism for smoke movement changed throughout the incident.

**Compartmentation**

Fire was able to spread from Apartment 509 only through door and window openings because of the wall, floor, and ceiling assemblies that remained intact for the duration of the incident. The ceiling in the apartment was a concrete slab, just as the floor was also a concrete slab. Only smoke, and no fire, was able to spread vertically through the poorly sealed openings in the slab above the bathroom. The wall between Apartments 509 and 507 was a concrete bearing wall. All of these concrete assemblies formed substantial barriers that prevented fire spread.

The wall between Apartments 509 and 511, which was comprised of two layers of fire-rated gypsum wallboard, was damaged but was still able to stop the fire from spreading to Apartment 511. In Apartment 509's kitchen, the outer gypsum wallboard layer on the wall between the two apartments was noticeably calcinated, and part had fallen away. The paper surface on the layer directly underneath had been discolored, and there were a few areas with heavier damage. Other walls inside the apartment, such as the wall between the kitchen and the living room, were not fire-rated assemblies and were destroyed by the fire. The interior wall between the living room and kitchen initially acted as a barrier, preventing the fire from immediately impinging on the wall separating Apartments 509 and 511. As a result of the combined protection provided by the interior walls and the inherent fire resistance of the wall itself, the wall between Apartments 509 and 511 did not fail.

**Performance of Fire Protection Equipment and Systems**

Fire detection equipment did not provide early warning in this scenario. The occupant of Apartment 509 sensed the smoke in his apartment before the single-station, battery operated, ionization smoke detector operated. The only other detection equipment on the 5th floor was the heat detector in the trash chute room. This detector was intended to sense a fire in the trash chute room, not a fire in the corri-
The heat detector did not operate before one of the 5th-floor occupants used the manual fire alarm box while evacuating.

During the initial stages of the fire, one of the residents tried to extinguish the fire using the equipment provided in the building for that purpose. The individual went to a hose cabinet that contained both a water fire extinguisher and a hose line. The resident selected the water fire extinguisher rather than the hose line. When he returned with the extinguisher, conditions in Apartment 509 had become so severe that he could not enter the apartment and use the fire extinguisher.

Firefighters used the building’s standpipe system as the only water source for their fire attack. Preferring not to use the occupant hose line, the firefighters had to disconnect that hose line before they could attach their own hose line. The tactics chosen by the firefighters, once again, showed the real value of a standpipe system for use by fire fighters in high-rise buildings.

According to the NRCC study, the fire alarms were heard by 164 people (75 percent of all respondents), 52 people (24 percent) did not hear the alarms, and 3 people (1 percent) did not answer the question. Of the people who provided information about the sound of the alarms, 54 percent felt that the alarms were loud enough to be heard from inside the apartment, and 43 percent felt the alarms were not loud enough. However, when asked about sound levels in the corridor, 65 percent felt the alarms were loud enough and 23 percent felt that the alarms were not loud enough.

The building’s public address system was not used effectively during this fire. None of the building managers had been trained in the use of the system or had been instructed as to what information needed to be provided to residents in the event of a fire. In addition, the operations manual for security personnel instructed them not to use the system. As a result, no one at the facility on the morning of the fire knew how to properly use the public address system.

A North York fire officer attempted to use the public address system at one point in the fire. However, the VU meters on the system did not respond properly when the microphone was used. The fire officer felt that the meters were indicating that the system had been seriously damaged by the fire. Still the fire fighter attempted to use the system not knowing if it was operating. Investigators examined the public address system after the fire and confirmed that the public address system had, in fact, sustained substantial damage. The investigators also found that the fire alarm system had been damaged.

However, the NRCC survey reported that 10 respondents (5 percent) indicated that they had heard the public address system operate. Of these individuals, 5 understood that they were being instructed to stay in their apartments. One respondent understood that he or she should put a wet towel at the bottom of the door, and 4 stated that the messages were heard, but not understandable. Fire officials, who were not able to confirm the operation of the EVAC system, had several theories regard-
ing the respondents reports. For example, fire officials believed that despite the damage to the EVAC system, weak signals may have been reaching some areas of the building or that the respondents may have heard fire fighters in the corridors and thought that the voice was coming from the public address system.

Even though a fire fighter telephone system had been provided, it was not used by any fire fighters.

**Human Behavior**

The NRCC study of occupant behavior provided a detailed discussion of resident activities that is beyond the scope of this report. The following comments represent only a few of the findings in the NRCC study.

According to the study, the operation of the fire alarm system brought the existence of an “unusual situation” to the building to the attention of 57 percent of the respondents. Another 17 percent became aware of the situation by being told by someone else. Several occupants (14 percent) were alerted by smelling smoke, and 7 percent reported that they became aware of the situation by the sound of movement. The remaining 5 percent reported that they became aware through a combination of smoke and alarms, or they did not provide an answers to the questions.

Once aware of the unusual situation, over 70 percent of the occupants began to investigate or seek additional information. The first actions of other respondents included alerting others, waiting (doing nothing), and taking a protective action like stopping smoke from entering their apartment.

Many of the respondents (37 percent) recognized that the “unusual situation” was the result of a fire when they saw smoke. Smelling smoke was the next most common means (27 percent) by which respondents recognized that the “unusual situation” was a fire, followed by “being told by others” (15 percent). The remaining respondents reported that they realized a fire was in progress by the following means:

- Saw fire trucks outside: 9.1 percent
- Told by fire fighters: 3.7 percent
- Opened door: 2.7 percent
- Heard fire crackling: 1.8 percent
- Heard alarm: 1.4 percent
- Alarm and smoke: 0.5 percent

Approximately 60 percent of the respondents stated that during the incident they were able to successfully communicate with others in order to obtain or to provide information. Sixteen percent of all respondents called 911 and were instructed to remain in their units, stay calm, use towels to seal the door, and go onto the balcony. Approximately 35 percent called friends or relatives to let them know the caller was safe. Slightly less than 44 percent of the respondents reported that they
turned on a television or radio in an attempt to get information. Rather than providing information that was potentially useful to the occupants who were still in the building, the media focused on the fatalities and increased some occupants' fears without providing advice on what the residents inside the building should be doing while waiting for rescue.

Many occupants attempted to evacuate but were forced to return to their own apartment or to take refuge in the apartments of other occupants. People who lived in the same apartment tended to stay together during their activities. Only four respondents reported that they tried to use elevators without specific instruction from rescue personnel. One-hundred and five respondents reported that they attempted to use the stairways. Of these people 92 percent attempted to go down, 6 percent attempted to go up, and two percent did not indicate the direction that they traveled. Of the respondents who attempted to use the stairways, 69 percent used the stairways before 6:00 a.m. These people personally made the decision to evacuate within 5 to 10 minutes of becoming aware that there was a real fire. In addition, these occupants evacuated without instruction or help from rescue personnel.

During the course of the incident, many respondents (72 percent) chose to stay on their balconies rather than inside the apartments. In many cases, smoke had entered the apartments. People 65 years of age and older were less likely to go onto their balconies because it was very cold outside.

In addition to the noted differences in the use of balconies, the study found that age had a significant effect on many other occupant responses. For example, respondents who were 65 and older were less likely to hear the operating alarms and were more likely to be told of the fire than respondents in younger age categories. Also, the residents age 65 and older had a greater tendency to report that they stayed in their apartment because they believed it was a safe area. Respondents in younger age categories tended to report that they stayed in their apartments because of the conditions in the corridors and stairways.

The NRCC study also reported that the respondents' location in the building significantly affected their actions and their evacuation possibilities. Occupants below the fire floor were only slightly affected by the fire. Occupants of the 5th floor correctly recognized the seriousness of the situation, and some were able to escape early in the scenario. Occupants above the floor of the fire were more likely to turn back and take refuge after attempting evacuation. Respondents in the northeast quadrant (the quadrant in which the fire occurred) had notably different actions from respondents in other quadrants.

The NRCC study documented that the presence of smoke was a major factor affecting the evacuation potential of respondents. Occupants who saw smoke did not panic, freeze, or become hysterical. Rather, they tried to move through the smoke filled stairways. The study also revealed that some people continued to move through smoke conditions that were becoming increasingly worse. This was not the first time that occupant movement through a worsening smoke condition has been doc-
umented. A human behavior study following the February 26, 1993, explosion and fire at New York's World Trade Center also revealed that occupants moved through smoke even though its severity was increasing.⁲¹

Lastly, the NRCC study found the time that respondents chose to evacuate had an affect on their evacuation. Residents of the 5th floor had to leave very early in the fire in order to successfully evacuate without assistance. As time passed, it became increasingly difficult for anyone to get below the 5th floor. Many of these residents returned to their apartments or sought refuge in other apartments. Once in an apartment, the residents waited for fire fighters to escort them out of the building.

The NRCC report provided the following observation regarding panic:

Researchers have emphasized for the last 20 years the fact that panic behavior is rare during a fire emergency.⁲²,⁲³ This study was consistent with previous findings; people did not panic during the 2 Forest Laneway Fire. Many of the occupants felt fearful and anxious, but none of the respondents to the questionnaire acted in an irrational, thoughtless or careless way, which is characteristic of panic. Even though occupants themselves sometimes reported their reactions as "I panicked," they are usually describing sudden fear and stress, but not irrational behavior. Occupants of the 2 Forest Laneway did not panic during the January 6th fire. Overall, they tried to make what they judged to be the best decisions, with respect to what they knew about fire safety and what they understood of the situation in the building that morning.⁲⁴

**Code Analysis**

The 1993 edition of NFPA 1, Fire Prevention Code; the 1996 edition of NFPA 72, National Fire Alarm Code®; and the 1994 edition of NFPA 101®, Life Safety Code®, were used as the basis for the comparison of the North York apartment high-rise building with NFPA codes. It was recognized, however, that these codes were not part of the legal requirements for this facility. The following discussion is not intended to be a complete description of all parts of the codes that could be applied to this facility. The discussion does, however, highlight requirements that have particular relevance to this fire. Section VII contains the full text of all code sections cited in this section.

**NFPA 1, Fire Prevention Code**

The North York residential high-rise fire stands as a clear example of the value of standpipe systems for fire department use. These standpipes were used as the sole water supply for the fire fighters' hoselines.
The NFPA Technical Committee on Fire Prevention Code also recognizes the value of standpipes and currently requires standpipes in all new buildings more than three stories in height or new buildings over 50 ft (15.25 m) in height above grade and containing intermediate stories or balconies (1: 6-2.2.1). The standpipe system is also required to be designed, installed, and maintained in accordance with this section and NFPA 14, Standard for the Installation of Standpipe and Hose Systems (1: 6-2.1). NFPA 1 also requires that standpipe systems be periodically inspected and provides several requirements regarding inspections (1: 6-2.3.1, 1: 6-2.3.2, and 1: 6-2.3.3).

In addition, NFPA 1 provides requirements regarding the operating features of an apartment building. Paragraph 1: 17-2.1 (based on the Life Safety Code requirement 101: 31-6.5) requires that residents of apartment buildings be provided with emergency instructions on a yearly basis. The information that is provided is required to inform the residents about the location of alarms, egress paths, and actions to be taken, both in response to a fire in the living unit and in response to the sounding of the alarm system. The building management apparently did not provide this information directly to the residents of each unit. However, much of the required information was posted in public areas. This investigator and the NRCC researchers did not determine whether the posted information had any effect on occupant activities.

**NFPA 72, National Fire Alarm Code**

In order for an emergency voice/alarm communication system (EVAC) and fire alarm system to be effective during a fire emergency, the signals must be audible in the occupied areas within a building. NFPA 72 contains two requirements that are intended to ensure that these systems are clearly heard when activated.

The first requirement (72: 6-3.2.2) applies to audible signal appliances intended for public mode use. This paragraph requires the system to provide signals meeting the greater sound level of the following two criteria:

- Sound level at least 15 dBA above the average ambient sound level
- 5 dBA above the maximum sound level having a duration of at least 60 seconds

The sound level is to be measured 5 ft (1.5 m) above the floor in the occupied area.

The second requirement (72: 6-3.4) requires audible appliances to be installed in a manner such that occupants in sleeping areas are able to hear the alarm signal. The paragraph requires the system to provide signals meeting the greater sound level of the following three criteria:

- Sound level of at least 15 dBA above the average ambient sound level
- Sound level 5 dBA above the maximum sound level having a duration of at least 60 seconds
- Sound level of at least 70 dBA
The sound level is to be measured at the pillow level in the occupied area.

The results of the OFM post-fire test of the building’s fire alarm system (i.e., a sound level of only 50 dBA in the bedrooms) revealed that the alarm appliances for that system would not have met the performance requirements of NFPA 72.

Only 5 percent of the NRCC survey respondents indicated that they heard emergency instructions being given over the EVAC system. Nearly half of the respondents who indicated they heard the EVAC system stated that the information was unintelligible. NFPA 72 does not currently have requirements regarding the intelligibility of EVAC system signals.

**NFPA 101, Life Safety Code**

The Life Safety Code (101: 19-1.3) defines an apartment building as a building containing three or more living units with independent cooking and bathroom facilities, whether designated as an apartment house, tenement, garden apartment, or by any other name. Since this definition describes the North York high-rise apartment building and the building was not new at the time of the fire, the requirements of Life Safety Code Chapter 19, which addresses existing apartment buildings, will be used for this analysis.

The Life Safety Code requirements for apartment buildings were written in terms of the following four options (101:191.1):

Option 1: Buildings without fire suppression or detection systems
Option 2: Buildings provided with a complete automatic fire detection and notification system
Option 3: Buildings provided with automatic sprinkler protection in selected areas
Option 4: Buildings protected throughout by an approved, automatic sprinkler system

The North York apartment building did not have automatic sprinklers or a complete fire detection system, so requirements for Option 1 will be used during this analysis.

The Life Safety Code has no special construction requirements for this type of residential occupancy (101:19-1.4).

Paragraph 101: 19-2.2.2.2 requires that no door in any means of egress be locked against egress when the building is occupied. No doors in the North York high-rise building were locked against re-entry. As a result, residents who attempted to escape and encountered smoke beyond their comfort level were able to re-enter the occupant floors, where they were able to seek refuge.
The Life Safety Code requires that every living unit have access to at least two separate exits remotely located from each other (101: 19-2.4). The entrances for the two scissors stairways met this requirement because those doors were located at the opposite ends of the exit access corridor on each floor. The following are other details of the egress system design that were consistent with Life Safety Code requirements:

- No common path of travel exceed 35 ft (10.7 m) (101: 19-2.5.2)
- No dead-end corridor exceed 50 ft (15 m) (101: 19-2.5.3)
- Travel distance within a living unit to a corridor door did not exceed 75 ft (23 m), the limit for an Option 1 building (101: 19-2.6.1)
- Travel distance from a living unit entrance door to the nearest exit did not exceed 100 ft (30 m), the limit for an Option 1 building (101: 19-2.6.2)

The exit discharge from Stairway 2 was consistent with Life Safety Code requirements. On the ground level, Stairway 2 led directly to an exit passageway, which allowed occupants to move through a protected passage in order to reach an exit discharge on the Doris Avenue side of the building.

On the other hand, the exit discharge for Stairway 1 was not consistent with Life Safety Code requirements. This stairway discharged into a short corridor that allowed occupants to go to three areas after passing through doors within the exit enclosure. The occupants could go to a stairway leading to lower levels, to the link corridor leading to the mall, to the elevator lobby and entrance foyer. The elevator lobby and entrance foyer were not protected with automatic sprinklers. Paragraph 101: 19-5.7.2(b) only allows an exit to discharge through areas on the level of discharge when that area is protected by an approved automatic sprinkler system and the area is separated from the nonsprinklered portion of the building by fire resistance-rated construction. Therefore, the discharge from Stairway 1 was not consistent with Life Safety Code requirements. This deviation from the Life Safety Code requirements did not have an effect on the outcome of the fire. It was discussed to highlight an important Life Safety Code requirement for exit discharge design.

The Life Safety Code requires emergency lighting in all buildings with more than 12 living units or more than three stories in height. Emergency lighting had been installed in the North York apartment high-rise. The responses to the NRCC questionnaire revealed that some respondents believed the lights were “off”, some believed that the lights were “on”, and many had no comment. Approximately 67 percent (146) of the respondents reported that the emergency lights were “on” in corridors as compared to approximately 35 percent (77 respondents) reporting that lights were “on” in the stairways. Since the emergency lights used the normal lighting fixtures, the respondents who reported lights were “on” could have been seeing the building’s normal lighting system operating and not the emergency lighting system. The emergency power for 2 Forest Laneway is supplied by generators in the commercial part of the building. These generators only start if power is lost to the building. These generators did not start during this fire since the power was nev-
er lost to the building. Some emergency lighting units and exit signs did not work during the fire because circuits supplying them were damaged at the point where the wires connect to the devices. This caused a short circuit which tripped the breaker for that circuit. Therefore, it was not known whether the emergency lighting system operated properly in this fire.

Paragraph 101: 19-2.10 requires that the means of egress have exit signs when there is more than one exit. The exits in this building were marked by lighted exit signs.

High-rise buildings using the previously described Option 1 are required by the Life Safety Code to have smokeproof enclosures (101: 19-2.11). The scissors stairways in this building were not smokeproof enclosures, so the building was not consistent with this Life Safety Code requirement. Smoke spread into both stairways, preventing many residents from evacuating. The design of a smokeproof enclosure would have minimized the smoke spread into the enclosure and would have maintained tenable conditions in the stairway enclosure for a longer period of time.

An important basic concept in fire protection design is limiting vertical movement of fire and smoke. In step with that concept, the Life Safety Code requires every stairway, elevator shaft, and other vertical opening to be enclosed with proper protection for the openings into the enclosure (101: 19-3.1.1). The vertical shafts in the North York building were enclosed. However, doors and dampers did not close completely, allowing large amounts of smoke to spread vertically through the stairways and supply ducts. In addition, smoke also spread through the elevator shafts even though doors to these shafts remained closed.

In order to control fire growth potential, the Life Safety Code contains requirements for the interior finish on walls and ceilings in exit enclosures, lobbies and corridors, and all other spaces (101: 19-3.3.1). The flame spread rating for interior finish materials in the common areas affected by the fire, that is, the exit access corridor and the exit stairways met the Life Safety Code requirements. Since the vast majority of the damage occurred in Apartment 509, it appeared that the fuels in this area were the primary fuels for the fire. Though carpeting, wallpaper, baseboard trim, and door surfaces burned in the corridor, the fire supported by these materials was secondary to that coming out of the apartment.

The Life Safety Code requires that apartment buildings with more than three stories or with more than 11 living units be provided with a fire alarm system (101: 19-3.4.1). The Life Safety Code also requires that the fire alarm system be initiated by manual means (101: 19-3.4.2.1) and that it notify occupants by an internal audible alarm signal (101: 19-3.4.3.1). The fire alarm system is required to be connected to an annunciator panel, and that panel is required to be placed in a location approved by the authority having jurisdiction (101: 19-3.4.3.2). The building's fire alarm system was consistent with these requirements. Of the 219 respondents to the NRCC survey, 125 (57.1 percent) reported that their first cue of an unusual situation was hearing the fire alarm. Once aware of the abnormal situation, occupants performed a variety of activities leading to their confirmation that a fire existed.
For most respondents, this confirmation occurred when they saw (37 percent) or smelled (27.4 percent) smoke.

The Life Safety Code requires that an approved single-station or multiple-station smoke detector be installed in every living unit within the apartment building (101: 19-3.4.4.1). A single-station, battery-operated smoke detector had been installed in Apartment 509, but it had no effect on the outcome of the fire because the occupant sensed the fire before the smoke detector operated. (It is unknown if a functional battery was installed in this detector.)

Paragraph 101: 19-3.5.6 requires that all existing high-rise buildings be protected by an approved, supervised automatic sprinkler system unless every dwelling unit has access to an exterior exit or an engineered life safety system has been approved by the authority having jurisdiction. This building was not equipped with a sprinkler system. The fire, which started in a couch and could have been readily controlled or extinguished by an automatic sprinkler, was able to grow to a point where the smoke it produced killed six people in the exit stairways. Accordingly, the lack of an automatic sprinkler system in the room of fire origin may be considered a significant factor contributing to the fire and to the deaths of the occupants.

Portable fire extinguishers were provided throughout the building even though the Life Safety Code requires them only in hazardous areas (101: 19-3.5.7). One of the residents attempted to use an extinguisher. Unfortunately, the fire had become large enough to prevent the resident from using it.

The Life Safety Code requires exit access corridors to be constructed of fire barriers with a fire resistance rating of not less than 30 minutes (101: 19-3.6.1). The two layers of 1/2 inch (12.7 mm) type X gypsum wallboard covering both sides of the corridor walls most probably would have provided protection meeting this Life Safety Code requirement. Regardless of their actual fire resistance rating, the walls withstood a large amount of fire and prevented the fire from entering other apartments on the 5th floor.

Doors between living units and corridors also can play a significant role in controlling fire spread. For this reason, the Life Safety Code has the following requirements for doors:

- Doors shall be self-closing (101: 19-3.6.2)
- Doors shall be equipped with latches for keeping doors tightly closed (101: 19-3.6.2)
- Doors that open from living units into corridors shall be not less than 20 minutes with exception of previously approved 1 3/4-in. (4.4-cm) thick solid bonded wood core doors (101: 19-3.6.3)

The doors between the apartments and the corridor in this building were nonrated, solid-core doors. Like the corridor walls, the doors withstood a large amount of fire and prevented the fire from entering other apartments on the 5th floor when the doors were in the closed position.
The door to the room of fire origin remained open after occupants evacuated because the door did not have a self-closing device. The open door allowed fire and smoke to spread into the corridor and eventually into the exit stairways. As a result, the lack of an automatic door closing device, equipment required by the Life Safety Code, allowed the door to remain open. This critical deviation from the code was a significant factor contributing to the fire spread and ultimately contributing to the deaths of the occupants.

The Life Safety Code requires smoke barriers in exit access corridors to establish at least two compartments approximately equal in size (101: 19-3.7.1). Compliance with this requirement can reduce smoke spread within an exit access corridor and can provide some occupants with additional time to evacuate. A smoke barrier door was not installed in this building, so the smoke quickly filled the entire corridor, trapping 5th-floor apartment occupants who did not escape early in the scenario.

Since one group of fire fighters entered the corridor from the stairway farthest from the fire area, they would have had to open a smoke barrier door at that time in order to advance to the apartment of fire origin. The value of a smoke barrier door would have been compromised, but it still would have reduced the amount spreading to the west side of the 5th floor. This also would have eliminated the need to advance a hoseline from the 4th floor through a door to Stairway 1. Since this door was closest to the area of origin, the smoke and fire was able to spread directly up the stairwell. Smoke barrier doors in the corridors on floors above the fire would have reduced the horizontal smoke spread once smoke seeping out of Stairway 2 entered the corridor.
V. DISCUSSION

Fire protection features constructed into a residential high-rise building and the preparation of occupants for fire emergencies can minimize the threat to the occupants during fire emergencies. The absence of critical fire protection equipment, ineffective emergency communication equipment, and poorly trained staff and residents collectively allowed the January 6, 1995, fire, which involved just one apartment, to threaten residents throughout the residential high-rise building in North York. The fact that six people died in exit stairways makes this fire extremely troubling. By understanding how the building's fire protection features, fire development, smoke movement, and human behavior contributed to the outcome of the North York incident, fire safety professionals may be able to take appropriate steps to avert tragedies like that which occurred in North York on January 6, 1995.

Had this existing building been equipped with a properly designed, installed, and maintained automatic sprinkler system as required by the Life Safety Code, this fire would not have progressed to the level that it did. The August 1996, NFPA study of U.S. experience with sprinklers confirmed the NFPA's long-standing confidence in sprinkler systems. That study found that sprinklers were highly effective elements of total systems designs for fire protection in buildings. When sprinklers were present, the chances of dying in a fire and the average property loss per fire were cut by one-half to two-thirds, compared with fires where sprinklers were not present. Sprinklers have not produced satisfactory results when one or more of following conditions were present: (1) partial, antiquated, poorly maintained, or inappropriate systems; (2) explosions or flash fires that overpower the system before it can react; or (3) fire very close to the people or to sensitive, valuable property such that fatal injury or expensive damage, respectively, can occur before a system can react. Barring the aforementioned conditions, no other conditions were identified that would have detracted from the successful operation of a sprinkler system had one been installed.

In the absence of automatic sprinklers, the passive fire protection features built into the building played an increasing role with respect to the survival of residents. Most of the passive fire protection features — such as floor, wall, and ceiling assemblies — had the ability to resist fire and performed extremely well. Their value was compromised by the lack of a simple and relatively inexpensive self-closing device on the entrance door to the apartment of fire origin. With the fire not being contained to the apartment of origin, the natural buoyancy of the smoke and stack effect forces rapidly transported the products of combustion to other areas higher in the building.

As the severity of the fire increased and the smoke spread through the building, the survival of residents became more dependent on the ability of staff and residents to respond to the cues they were receiving. Since the staff were not trained to use the building's EVAC system, they were not able to provide residents with key information during the early stages of the incident. When the EVAC system was used...
later in the fire, the messages that were provided were not understood by many residents. The residents who did not escape early in the fire selected responses based on their knowledge of the situation, and these decisions were further influenced by the individuals’ past experiences and training. There were no documented instances of panic behavior, and some occupants even moved through smoke that was increasing in severity. The decision to evacuate exposed residents to smoke in the exit stairways, which ultimately caused the death of six residents who were attempting to escape and forced many other residents to seek refuge. In this fire, residents actually faced less of a threat by remaining in their apartments or by going to the apartment’s balcony.

The January 6, 1995, fire in North York showed that information can be a key to survival during a high-rise fire. The staff and occupants need to be trained so they understand the many options that will be available to them during a fire emergency. In addition, an EVAC system that will provide a reliable means for clear communication must be installed, maintained, and tested. The users of EVAC systems will have to be trained and prepared to provide the building population with instructions that can be followed or with accurate information. The people receiving the information might then be able to make reasonable decisions that can minimize their risk.

Based on the NFPA’s investigation and analysis of this fire, the following significant factors were considered as having contributed to the loss of life and property in the January 6, 1995, fire in the North York residential high-rise building:

- Lack of automatic sprinkler protection
- Lack of door self-closing devices on apartment entrance doors
- Vertical smoke movement due to stack effect
- Staff who were not trained with respect to managing fire emergencies in the building for which they were responsible
- Voice communication equipment that could not transmit messages that were understood by residents
- Lack of resident training

From May 23, 1995, to October 1995, The province of Ontario coroner’s office held a formal inquest of the North York fire. At the completion of that inquest the jury submitted recommendations to the Ontario Office of the Fire Marshal. The jury’s recommendations have been listed in Section VIII. The Ontario Office of the Fire Marshal has taken action on all of the recommendations submitted by the jury.

As a direct result of the January 6, 1995, fire in the North York residential high-rise fire, NFPA formed a task group to study fire protection and life safety philosophy for high-rise buildings. The task group was examining the current approaches for staff and resident training, the existing means for communicating during fire emergencies, and other factors affecting the safety of residents in high-rise buildings. The
task group was also examining the current emphasis on building evacuation verses the option and benefits of seeking refuge in the building during fire emergencies in high-rise buildings. At the time this report was prepared, the task group had not completed its activities, and their report was not available.
VI. ADDITIONAL NFPA INFORMATION

Since 1969, NFPA has prepared one fire investigation report, one alert bulletin and six journal articles as a result of NFPA investigations of other fires in apartment high-rise buildings. The following are the references for the report, bulletin and articles:

NFPA Fire Investigation Reports


- “Three Major Fires in Elderly Housing, Will this be common in the 1990s?,” *NFPA: ALERT BULLETIN,* Number 90-1, February 1990.

NFPA Journal and Fire Journal Articles


VII. NFPA CODE SECTIONS


**NFPA 1, Fire Prevention Code, 1993 edition**

1: 6-2.1 General.
The design, installation, and maintenance of standpipe systems shall be in accordance with this section and NFPA 14, Standard for the Installation of Standpipe and Hose Systems.

1: 6-2.2 Tests.

1: 6-2.2.1 New buildings more than three stories in height or new buildings over 50 ft (15.25 m) in height above grade and containing intermediate stories or balconies shall be equipped with a standpipe system installed in accordance with the provisions of this section and NFPA 14.

1: 6-2.2.2 Where additions are made to existing systems, piping shall be tested hydrostatically at not less than 200 psi (13.8 bars) pressure for 2 hr, or at 50 psi (3.5 bars) in excess of the normal pressure when the normal pressure is in excess of 150 psi (10.3 bars). The hydrostatic test pressure shall be measured at the low elevation point of the individual system or zone being tested. The inside standpipe piping shall show no leakage. (14: 8-1.1)

1: 6-2.2.3 In a standpipe system, any piping that normally remains dry shall be hydrostatically tested at 50 psi (3.4 bars) above the normal pressure at intervals of not less than 5 years. (14: 8-1.4)

1: 6-2.4.4 Before it is restored to service and before water is turned into it, a standpipe system that has been out of service a number of years shall be tested with air at a pressure not exceeding 25 psi (1.7 bars) to determine its tightness. The standpipe system shall also be hydrostatically tested at 50 psi (3.4 bars) above the normal pressure. (14: 8-1.5)

1: 6-2.3 Periodic Inspection.

1: 6-2.3.1 The valves in the main connection to the automatic sources of water supply shall be open at all times. The hose valves shall be frequently examined to see that they are tight. (14: 8-2.3)

1: 6-2.3.2 Inspections shall be made frequently to assure that the hose on Class II and Class III systems is in proper position on the racks and that all of the equipment is in place and in good condition. The hose, including gaskets, shall be removed
and inspected and the hose reracked or reeled at intervals in accordance with NFPA 1962, Standard for the Care, Use, and Maintenance of Fire Hose Including Connections and Nozzles. Where couplings are polished, care shall be taken to see that polish used does not touch fabric of hose. (14: 8-2.4)

1: 6-2.3.3 When a standpipe system or any portion thereof is out of service for any reason, notice shall be given to the local fire department and a sign shall be posted on each fire department connection indicating what portion of the system is out of service. (14: 8-2.5)

**NFPA 72, Fire Alarm Code, 1996 edition**

72: 6-3.2 Public Mode Audible Requirements.

72: 6-3.2.2 To ensure that audible public mode signals are clearly heard, they shall have a sound level at least 15 dBA above the average ambient sound level or 5 dBA above the maximum sound level having a duration of at least 60 seconds, whichever is greater, measured 5 ft (1.5 m) above the floor in the occupied area.

72: 6-3.4 Sleeping Areas.
Where audible appliances are installed to signal sleeping areas, they shall have a sound level of at least 15 dBA above the average ambient sound level or 5 dBA above the maximum sound level having a duration of at least 60 seconds or a sound level of at least 70 dBA, whichever is greater, measured at the pillow level in the occupied area.


101: 5-7.2 A maximum of 50 percent of the required number of exits, but not exceeding 50 percent of the required egress capacities shall be permitted to discharge through areas on the level of exit discharge, provided:

(a) Such discharge leads to a free and unobstructed way to the exterior of the building, and such way is readily visible and identifiable from the point of discharge from the exit; and
(b) The level of discharge is protected throughout by an approved, automatic sprinkler system or the portion of the level of discharge used for this purpose is protected by an approved, automatic sprinkler system and separated from the nonsprinklered portion of the floor by fire resistance rated construction meeting the requirements for the enclosure of exits (see 5-1.3.1); and
Exception to (b): If the discharge area is a vestibule or foyer meeting all of the following:
1. The depth from the exterior of the building shall be not more than 10 ft (3 m) and the length shall be not more than 30 ft (9.1 m), and
2. The foyer shall be separated from the remainder of the level of discharge by construction providing protection at least the equivalent of wired glass in steel frames, and
3. The foyer serves only as means of egress and includes an exit directly to the outside

(c) The entire area on the level of discharge shall be separated from areas below by construction having a fire resistance–rating not less than that required for the exit enclosure.

Exception to (c): Levels below the level of discharge shall be permitted to be open to the level of discharge in an atrium in accordance with 6-2.4.6.

Exception to (a), (b), & (c): One hundred percent of the exits shall be permitted to discharge through areas on the level of exit discharge in detention and correctional occupancies as provided in Chapters 14 and 15.

SECTION 19-1 GENERAL REQUIREMENTS

101: 19-1.1 Application.
The requirements of this chapter apply to existing buildings or portions thereof currently occupied as apartment occupancies. (See also 18-1.1.) In addition, the building shall meet the requirements of one of the following options:

Option 1: Buildings without fire suppression or detection systems;
Option 2: Buildings provided with a complete automatic fire detection and notification system;
Option 3: Buildings provided with automatic sprinkler protection in selected areas;
Option 4: Buildings protected throughout by an approved, automatic sprinkler system.

101: 19-1.3 Definitions.
Terms applicable to this chapter are defined in Chapter 3 of this Code; where necessary, other terms will be defined in the text as they occur.

Apartment Buildings. Buildings containing three or more living units with independent cooking and bathroom facilities, whether designated as apartment houses, tenements, garden apartments, or by any other name.

101: 19-1.4 Classification of Occupancy.
(see 19-1.3.)
101: 19-1.6 Minimum Construction Requirements.
(No special requirements.)

101: 19-2.2 Means of Egress Components.

101: 19-2.2.2 No door in any means of egress shall be locked against egress when the building is occupied.

Exception No. 1: Delayed egress locks complying with 5-2.1.6.1 shall be permitted, provided not more than one such device is located in any one egress path.

Exception No. 2: Doors in the means of egress shall be permitted to be equipped with an approved entrance and an access control system complying with 5-2.1.6.2.

101: 19-2.10 Areas of Refuge.
Areas of refuge complying with 5-2.12 shall be permitted.

Exception: In buildings protected throughout by an approved, supervised automatic sprinkler system in accordance with 19-3.5, the two accessible rooms or spaces separated from each other by smoke-resistive partitions in accordance with the 5-1.2 definition of area of refuge shall not be required.

101: 19-2.3 Capacity of Means of Egress.

101: 19-2.3.1 The capacity of means of egress shall be in accordance with Section 5-3.

101: 19-2.4 Number of Exits.
(See also Section 5-4.) Every living unit shall have access to at least two separate exits remotely located from each other as required by 5-5.1.

Exception No. 1: Any living unit shall be permitted to have a single exit provided:
(a) That living unit has an exit door opening directly to the street or yard at ground level, or
(b) That living unit has direct access to an outside stair complying with 5-2.2 that serves a maximum of two units both of which are located on the same floor, or
(c) That living unit has direct access to an interior stair serving only that unit and separated from all other portions of the building by fire barriers having a minimum 1-hour fire resistance rating with no opening therein.

Exception No. 2: Any building protected throughout by an approved, supervised automatic sprinkler system installed in accordance with 19-3.5.1 having four or fewer stories shall be permitted to have a single exit under the following conditions:
(a) The stairway is separated from the rest of the building by barriers having a minimum 1-hour fire resistance rating with self-closing minimum 1-hour fire protection rated—doors protecting all openings between the stairway enclosure and the building, and
(b) The stairway does not serve more than one-half story below the level of exit discharge, and
(c) All corridors serving as access to exits have a minimum 20-minute fire resistance rating, and
(d) There is not more than 35 ft (10.7 m) of travel distance from the entrance door of any living unit to an exit, and
(e) Twenty-minute fire-resistance rated horizontal and vertical separation between living units is provided.

Exception No. 3: Any building of three stories or less in its entirety shall be permitted to have a single exit under the following conditions:
(a) The stairway is separated from the rest of the building by barriers having a minimum 1-hour fire resistance rating with self-closing minimum 1-hour fire protection-rated doors protecting all openings between the stair enclosure and the building, and
(b) The stairway does not serve more than one-half story below the level of exit discharge, and
(c) All corridors serving as access to exits have a minimum 20-minute fire resistance rating, and
(d) There is not more than 35 ft (10.7 m) of travel distance from the entrance door of any living unit to an exit, and
(e) Twenty-minute fire resistance-rated horizontal and vertical separation between living units is provided.

Exception No. 4: A building of any height with not more than four living units per floor, with a smokeproof enclosure or outside stair in accordance with the requirements of 5-2.3 as the exit, and such exit is immediately accessible to all living units served thereby, shall be permitted to have a single exit. [“Immediately accessible” means there shall not be more than 20 ft (6.1 m) of travel distance from the entrance door of any living unit to an exit.]

101: 19-2.5 Arrangement of Means of Egress.

101: 19-2.5.2 No common path of travel shall exceed 35 ft (10.7 m). Travel within a dwelling unit shall not be included when calculating common path of travel. Exception: In buildings protected throughout by an approved, supervised automatic sprinkler system in accordance with 19-3.5, common path of travel shall not exceed 50 ft (15 m).

101: 19-2.5.3 No dead-end corridor shall exceed 50 ft (15 m).

101: 19-2.6 Travel Distance to Exits.

101: 19-2.6.1 Travel distance within a living unit (apartment) to a corridor door shall not exceed the following limits:
(a) For buildings using Option 1 or 3 — 75 ft (23 m).
(b) For buildings using Option 2 or 4 — 125 ft (38 m).
101: 19-2.6.2 The travel distance from a living unit (apartment) entrance door to the nearest exit shall not exceed the following limits:
   (a) For buildings using Option 1 — 100 ft (30 m).
   (b) For buildings using Option 2 or 3 — 150 ft (45 m).
   (c) For buildings using Option 4 — 200 ft (60 m).

Exception: Travel distance to exits shall not exceed 200 ft (60 m) for exterior ways of exit access arranged in accordance with 5-5.3.

101: 19-2.7 Discharge from Exits.

101: 19-2.7.1 Exit discharge shall comply with Section 5-7.

101: 19-2.8 Illumination of Means of Egress.
Means of egress shall be illuminated in accordance with Section 5-8.

101: 19-2.9 Emergency Lighting.
Emergency lighting in accordance with Section 5-9 shall be provided in all buildings with more than 12 living units or more than three stories in height.

Exception: Where every living unit has a direct exit to the outside of the building at grade level.

101: 19-2.10 Marking of Means of Egress.
Means of egress shall have signs in accordance with Section 5-10 in all buildings requiring more than one exit.

101: 19-2.11* Special Means of Egress Features.
In high-rise buildings using Option 1, 2, or 3, smokeproof enclosures shall be provided in accordance with 5-2.3.

SECTION 19-3 PROTECTION

101: 19-3.1 Protection of Vertical Openings.

101: 19-3.1.1 Every stairway, elevator shaft, and other vertical opening shall be enclosed or protected in accordance with 6-2.4 or provide means of satisfying the requirements of Section 2-9.

Exception No. 1: Stairway enclosures shall not be required where a one-story stair connects two levels within a single dwelling unit, guest room, or guest suite.

Exception No. 2: An atrium in accordance with 6-2.4.6 shall be permitted.
Exception No. 3: In buildings using Option 4, the fire resistance of walls shall be not less than 3/4 hour for buildings of one to three stories and 1 hour for buildings more than three stories; and the fire protection rating of doors shall be not less than 3/4 hour for buildings up to three stories and 1 hour for buildings more than three stories.

Exception No. 4: Unprotected vertical openings connecting not more than three floors shall be permitted in accordance with the conditions of 6-2.4.5.

Exception No. 5: In any building protected throughout by an automatic sprinkler system in accordance with 19-3.5, and where exits and required ways of travel there-to are adequately safeguarded against fire and smoke within the building, or where every individual room has direct access to an exterior exit without passing through any public corridor, the protection of vertical openings not part of required exits shall not be required.

101: 19-3.3 Interior Finish.

101: 19-3.3.1 Interior Wall and Ceiling Finish. Interior finish on walls and ceilings in accordance with Section 6-5 shall be as follows:
   (a) Exit enclosures — Class A or Class B.
   (b) Lobbies and corridors — Class A or Class B.
   (c) All other spaces — Class A, Class B, or Class C.

101: 19-3.3.2 Interior Floor Finish.
In buildings using Option 1 or 2, interior floor finish in corridors and exits shall be Class I or Class II in accordance with Section 6-5.

Exception: Previously installed and approved floor coverings.

101: 19-3.4 Detection, Alarm, and Communications Systems.

101: 19-3.4.1 General.
Apartment buildings with more than three stories or with more than 11 living units shall be provided with a fire alarm system in accordance with Section 7-6, except as modified by 19-3.4.2 through 19-3.4.4.

Exception: Where each living unit is separated from other contiguous living units by fire barriers (see Section 6-2) having a fire resistance rating not less than 3/4 hour, and where each living unit has either its own independent exit or its own independent stairway or ramp discharging at grade.

101: 19-3.4.2 Initiation.

101: 19-3.4.2.1 Initiation of the required fire alarm system shall be by manual means in accordance with 7-6.2.
101: **19-3.4.3** Notification.

**101: 19-3.4.3.1** Occupant notification shall be by an internal audible alarm signal in accordance with 7-6.3. Visible signals shall be installed in units designed for the hearing impaired.

*Exception: Existing approved presignal systems shall be permitted in accordance with Exception No. 1 to 7-6.3.2.*

**101: 19-3.4.3.2** An annunciator panel connected with the required fire alarm system shall be provided. The location of the annunciator panel shall be approved by the authority having jurisdiction.

*Exception: Buildings not more than two stories in height and having not more than 50 living units.*

**101: 19-3.4.4** Detection.

**101: 19-3.4.4.1** Approved single-station or multiple-station smoke detectors shall be installed in accordance with 7-6.2.9 in every living unit within the apartment building regardless of the number of stories or number of apartments. When activated, the detector shall initiate an alarm that is audible in the sleeping rooms of that unit. This individual unit detector shall be in addition to any sprinkler system or other detection system that might be installed in the building.

*Exception: The single-station smoke detector shall not be required where the building is equipped throughout with an existing total automatic smoke detection system.*

**101: 19-3.5** Extinguishment Requirements.

**101: 19-3.5.6** All high-rise buildings shall be protected throughout by an approved, supervised automatic sprinkler system installed in accordance with 19-3.5.1.

*Exception No. 1: Where every living unit has exterior exit access in accordance with 5-5.3.*

*Exception No. 2: Buildings in which an engineered life safety system has been approved by the authority having jurisdiction.*

**101: 19-3.5.7** Portable fire extinguishers shall be provided in hazardous areas. Where provided, portable fire extinguishers shall be installed and maintained as specified in 7-7.4.1.

**101: 19-3.6** Corridors.
101: 19-3.6.1 Exit access corridors shall be constructed of fire barriers in accordance with 6-2.3 having a fire resistance rating of not less than 30 minutes.

101: 19-3.6.2 Doors between living units and corridors shall be self-closing. Doors shall be equipped with latches for keeping doors tightly closed.

101: 19-3.6.3 The fire protection rating of doors that open from living units onto corridors shall be not less than 20 minutes.

Exception No. 1: Previously approved 1 3/4-in. (4.4-cm) thick solid bonded wood-core doors.

Exception No. 2: In buildings using Option 3 or 4, doors shall be so constructed as to resist the passage of smoke.

101: 19-3.7 Subdivision of Building Spaces.

101: 19-3.7.1 Smoke Barriers.
Smoke barriers in accordance with Section 6-3 shall be provided in exit access corridors to establish at least two compartments approximately equal in size. The maximum length of each smoke compartment measured along the corridor shall not exceed 200 ft (60 m). Smoke dampers shall not be required.

Exception No. 1: Buildings using Option 4.

Exception No. 2: Exterior exit access in accordance with 5-5.3 that provides access to two exits.

Exception No. 3: Buildings complying with one of the Exceptions to 19-2.4.1.

Exception No. 4: Buildings with exits not more than 50 ft (15 m) apart.

Exception No. 5: Where each dwelling unit has direct access to the exterior at grade.

**SECTION 19-4 SPECIAL PROVISIONS**

101: 19-4.2 High-Rise Buildings.
(See 19-2.11 and 19-3.5.6.)

101: 19-4.3 Operating Features.
(See Chapter 31.)
SECTION 19-5 BUILDING SERVICES

101: 31-6.5 Emergency Instructions for Residents of Apartment Buildings.
Emergency instructions shall be provided to each living unit on a yearly basis indicating the location of alarms, egress paths, and actions to be taken, both in response to a fire in the living unit and in response to the sounding of the alarm system.
VIII. Coroner's Jury Recommendations
Following the January 6, 1995, Fire at
2 Forest Laneway, North York

1. Any person who works on fire protection systems (fire alarm systems, annunciator panels, EVAC systems, emergency lighting systems, heat and smoke detection systems, sprinkler systems) shall be required to meet licensing requirements set by the Solicitor General of Ontario.

   Background: Due to the vital importance of life safety systems in high-rise apartment buildings, there is a need to ensure that fire protection systems are installed and maintained by licensed professionals. They also need to be supervised by trained personnel who can handle emergency fire situations.

2. Develop a mandatory, certification training course for building supervisory staff which includes the following subjects:

   - the use of emergency voice communication systems (EVAC)
   - fire alarm systems
   - sprinkler systems
   - smoke control measures
   - emergency power
   - elevator operations and control
   - fire safety planning
   - maintenance of door closures
   - understanding/scheduling of maintenance as detailed in the Ontario Fire Code.
   - This certificate should be renewable.

   Background: See recommendation #3

3. Develop a mandatory, certification fire safety training course for building security staff. This training is to be complimentary to the training received by building supervisory staff as they may not be present during a fire emergency situation. (please refer to recommendation #2)

   Background: same as above

4. The Fire Marshal for the Province of Ontario amend the “stay or go” policy for residents of high-rise buildings to one where residents be advised to stay in their units (unless their unit is on fire) until directed to do otherwise by the Fire Department. Public education programs must be reviewed to ensure consistency with this new philosophy.
Background: There is a need to change the public’s understanding of what to do in case of a fire in a residential high-rise building. This also involves changing the fire services’ philosophy regarding the “stay or go” policy for residents of high-rise buildings.

5. The development/modification of various signage as follows:

- in individual suites, i.e. “do not use stairwells as an escape route if smoke is present/stay in your suite/call 911 and await further instructions. There is no escape via the roof,”

- mechanical room doors, i.e. “do not use as an escape route/doors are locked at all times,”

- post in stairwells on either side of the door, i.e. “if smoke is present, do not use these stairs/close and properly latch the door/return to your suit if possible or seek refuge in another suite/await further instructions,”

- in order to prevent residents from attempting to advance in the stairwell beyond the last residential floor, post warning sign, i.e. “Danger/Do not enter/No exit to roof”,

- post emergency procedures in the lobby, laundry rooms, inside the elevators, and on the wall in the elevator lobby.

Background: In support of recommendation #4

6. The Ontario Fire Marshal be responsible for developing a fire safety video to be distributed to high-rise building owners. The video is to be viewed by tenants concurrent with the signing of their lease agreement. Consider the “Fire in the Sky” video by David Suzuki.

Background: Occupants of residential high rise buildings need to be better informed as to what to do during fire emergencies.

7. That once the fire situation has been fully assessed, fire departments communicate with the various media and provide specific information. This will allow accurate updates to be broadcast. This is also intended to enhance the ongoing communications conducted by the fire department personnel at the scene.

Background: It has been demonstrated through this and other major fire incidents, that occupants seek information from the media. In order to alleviate the stress and anxieties of the occupants and public, during such an incident.

8. Greater emphasis be placed on fire prevention and public education in all courses taught by the Ontario Fire College.
Background: Due to the unique problems encountered in residential high-rise buildings.

9. The Ontario Fire Marshal in conjunction with ALL fire departments develop a provincial guideline.

Background: Greater emphasis on search and rescue in fire fighting at residential high rise buildings MUST BE MADE.

10. The Ontario Fire Marshal in conjunction with all Fire Departments develop a provincial guideline for residential high-rise building fire fighting. Emphasis should be placed on the following:

- search and rescue of the fire floor, the floor above and below, and all stairwells should be the number one priority
- smoke control
- the use of stairwells and elevators during fire emergencies
- incident command system **(please refer to recommendation #13 below for further details)
- pre-fire planning of individual buildings
- emergency communication systems (EVAC)
- radio communication
- the use of hard wired firefighter telephones (where available) should be standard practice
- drills, training exercises and other forms of rehearsal (dry run and full scale) of THREE ALARM/or GENERAL ALARMS

Background: A standardized approach for fire fighting in residential high-rise buildings needs to be developed and employed.

11. This training program should be mandatory for all firefighters and include testing and passing qualifications. The contents of this program should be reviewed on an annual basis and updated as necessary.

Background: The OFM cannot mandate this recommendation however the intent of the recommendation will be transmitted to the fire service in a future Messenger article.
12. Mandatory conditions for promotion to and within the officer ranks within Fire Departments must also be developed.

Background: The OFM cannot mandate this recommendation however the intent of the recommendation will be transmitted to the fire service in a future Messenger article.

13. Refer to manual

Background: As noted under Recommendation #9, the OFM will be developing a high-rise seminar to address the issues raised. The seminars will result in a more consistent and comprehensive approach to dealing with fires in high-rise structures.

14. The Ontario Fire Marshall should require all Fire Departments in the province have their communication suppliers provide a Factware coverage test prior to using their radio communication systems.

Background: To ensure clear, uninterrupted communications to all firefighters.

15. Pre-fire planning guidelines be standardized for all fire departments throughout Ontario.

Background: To ensure that all pertinent pre-plan information is documented which will assist firefighters in effectively dealing with each individual residential high-rise building.

16. A standardized pre-plan information sheet should be developed. Please refer to North York Fire Department’s “Apartment Building Pre-Fire Plan & Information Sheet”.

The following information should be added:

- unusual building characteristics such as scissors stairwells
- unusual floor numbering
- access problems such as locked stairwells
- location of firefighter phone jacks
- vehicle access
- Note: The space under the “Special Data” section should be enlarged.

Background: The OFM cannot mandate this recommendation however the intent of the recommendation will be transmitted to the fire service in a future Messenger article.
17. Pre-fire plans be reviewed/approved by the Platoon Chief every one to two years and the information input into Fire Department data base.

Background: same as #16.

18. Time should be allowed for all firefighters to review and train on the pre-fire plans for the residential high-rise buildings in their first call areas.

Background: The OFM cannot mandate this recommendation however the intent of the recommendation will be transmitted to the fire service in a future Messenger article.

19. The Ontario Building Code be amended to require a pre-fire plan building plan as a pre-condition of being granted an occupancy permit.

Background: To enable fire departments to effectively develop pre-fire plans for new residential high-rise buildings prior to their occupancy.

20. The Ministry of Municipal Affairs & MMAH require a fire safety plan be completed and approved as a pre-condition of being granted an occupancy permit. This recommendation was previously made in the Webber Report #15.6.

Background: To ensure that owners develop fire safety plans for new residential high-rise buildings prior to their occupancy.

21. That penalties be substantially increased for non-compliance with the Ontario Fire Code. This recommendation was previously made in the Webber Report #2.11.

Background: To ensure that the Ontario Fire Code is complied with by all residential high-rise building owners.

22. Residential high-rise building owners should have the sole responsibility for the installation, maintenance and upkeep of smoke detectors (including the replacement of batteries) in all individual suites.

Background: It has been demonstrated that a large percentage of occupants in 2 Forest Laneway did not properly maintain their smoke detectors.

23. Maintenance and replacement of batteries be done on a semi-annual basis.

Background: It has been demonstrated that a large percentage of occupants in 2 Forest Laneway did not properly maintain their smoke detectors.
24. All doors to stairwells in residential high-rise buildings be required to have the floor number in raised, fluorescent style on both sides of the door to make floor identification more visible.

   Background: To ensure occupants can clearly identify where they are in the stairwells.

25. The Fire Safety Plan be located in the main lobby and clearly visible to all fire personnel and building representatives. This location should have an easily recognizable logo and or label (yellow or red). However, this in no way negates the requirement for the building supervisor to be able to supply a current copy of the fire safety plan if requested.

   Background: To guarantee that firefighters can quickly locate the fire safety plan upon arrival at a residential high-rise building, a standard location for the fire safety plans must be enacted.

26. Owners and occupants of residential high-rise buildings should be compelled to participate in annual fire drills. These should be full scale drills involving the fire department, the building owners, managers and occupants and all persons should be walked through their respective roles.

   Background: Once fire safety information has been provided, one of the best ways to assess occupants’ understanding of what they are expected to do during a fire, is to carry out evacuation exercises. Regular drills are an excellent means to educate and to elevate occupants awareness of fire safety and evacuation procedures. A fire drill gives occupants the opportunity to recognize the sound of the alarm system, to assess the intelligibility of a PA system (if present), to located the closest exit, to experience using the stairwell and to identify stairwell exit locations. Building management at the same time can assess the efficiency of the evacuation procedures and identify potential problems with input from the local fire department.

27. Audibility and frequency levels of fire alarm bells in all areas of individual suites in ALL residential high-rise apartment buildings should be established.

   Background: During the inquest, the study conducted by the National Research Council demonstrated that the sound level of the fire alarm bells was insufficient to be heard by many occupants, especially the older ones and those in end units. Older occupants in any location were less likely to hear the fire alarm which could be due to the high-frequency of the alarm and the non-modulation of the signal.

28. The establishment of a standardized length of time for testing of fire alarm bells to properly assess if the system is functioning properly.
Background: In review of the testimony regarding the testing of the fire alarm bells, at this present time there is no standardized length of time the alarm bells are sounded during testing.

29. The Ontario Fire Code should be amended to include a requirement to inspect for obstructions all fire dampers in each residential high-rise building.

   Background: During the inquest, evidence was given there was a wire that may have impeded the operation of one of the fire dampers.

30. Amend 3.2.9. of the Ontario Building Code so that all new high-rise residential buildings should have automatic sprinkler systems installed throughout them including each individual suite. All existing high-rise residential buildings should also comply with recommendation within a reasonable time period.

   Background: To minimize the spread of smoke and flames beyond the suite of origin.

31. Scissors stairwells not be considered in the design of any new residential high-rise building.

   Background: Stairwells should be designed and built on opposite ends of buildings so that if a fire breaks out in one side of a building it cannot contaminate both exits such as occurred at 2 Forest Laneway. Through various testimony, it was also demonstrated that this configuration caused confusion for both occupants and firefighters.

32. Scissors stairwell configurations in existing residential high-rise buildings be coloured coded, i.e., a painted stripe on the wall throughout the stairwell, fluorescent strip on each step.

   Background: Stairwells should be designed and built on opposite ends of buildings so that if a fire breaks out in one side of a building it cannot contaminate both exits such as occurred at 2 Forest Laneway. Through various testimony, it was also demonstrated that this configuration caused confusion for both occupants and firefighters.

33. Each exit door, whether located in scissors or other configurations should be marked on each side of it, with number (fluorescent) and the side of the building it is located in.

   Background: Stairwells should be designed and built on opposite ends of buildings so that if a fire breaks out in one side of a building it cannot contaminate both exits such as occurred at 2 Forest Laneway. Through various testimony, it was also demonstrated that this configuration caused confusion for both occupants and firefighters.
34. A separate, one-way communication systems should be configured for stairwells.

   Background: There is a need to always have a method of communicating with persons in stairwells in the event the emergency communication system is compromised.

35. The Building Code be amended to require separate wiring of all fire safety devices, i.e., smoke alarms, sprinkler flow switches, communication system, heat detectors/sensors, smoke detectors, in all new residential high rise buildings.

   Background: In order to minimize a single point of failure, so that a fault or damage to one component should be limited only to that component and not the whole system.

36. There should be a minimum of two firefighter telephone jacks per floor located on opposite sides of the floor.

   Background: In the event of a fire on one side of a particular floor in a residential high-rise building that has an emergency communication system, firefighters may need an alternate method of communication from the same floor.

37. An investigation be conducted into developing a means of allowing a fire hose to go through or around a fire exit door without allowing smoke to enter the stairwell in existing residential high-rise buildings.

   Background: In order to minimize smoke contamination in residential high-rise building stairwells during fire fighting operations.

38. The installation of “vestibules” with fire hose cabinet inside adjacent to stairwells in all new residential high-rise buildings.

   Background: In order to minimize smoke contamination in residential high-rise building stairwells during fire fighting operations.

39. The installation of battery operated back-up lighting in the stairwell landing on each level which are inspected monthly.

   Background: To ensure all stairwells have proper lighting during any emergency condition.

40. An investigation be conducted into the feasibility of the installation of backdraft/gravity dampers on supply air ventilation systems for all existing or new residential high-rise buildings.
Background: During testimony, evidence was presented that smoke migrated into individual suites. To prevent “Cold Smoke” from entering the ventilation systems during any fire emergency.

41. For all new residential high rise buildings, fire damper/grill combinations to be tested and fire-rated as complete unit before installation.

Background: At 2 Forest Laneway, testimony was presented that the supply air ventilation grill adjacent to the fire damper melted before the fire damper could close properly.

42. All automatic roof (smoke) hatches in residential high-rise buildings be immediately disconnected. These devices should only be operated manually by authorized personnel.

Background: During this fire, the automatic roof hatch malfunctioned. As detailed the submitted report from Robert Harpur Fire Protection Engineer of the Office of the Ontario Fire Marshal, top venting of a shaft serves to shift the “neutral plan” toward the top of the shaft. If the area of the vent is large enough, the “neutral plane” can be at the top story.

43-54 Comment related to the City of North York Fire Department

55. This item relates to contingency planning in the case of the mobile repeater not being available. The OFM in conjunction with communications experts and fire service personnel will develop a “Communique” to make all fire services aware of these issues.

Background: There should be contingency plans to replace this component with something suitable.

56. The OFM in conjunction with communications experts and fire service personnel will develop a “Communique” to make all fire services aware of these issues.

Background: All fire departments utilizing Motorola equipment should contract with them to conduct a Factware coverage test to determine how many areas within their boundaries have a “notch”.

57. This recommendation will be addressed in the high-rise seminar referred to under recommendation #9.
58. The Province of Ontario in conjunction with all appropriate agencies, such as the Ontario Fire Marshal, Fire Departments, the media, landlord and tenant associations, builders and all other municipal and provincial government agencies involved in public safety should fund and implement public service announcements on television, radio and in the newspapers to keep the public informed of what their options are in a high-rise fire emergency.

Background: In review of evidence at this inquest, it is obvious that more public education is required and should be developed.

59. All Boards of Education in the Province of Ontario be directed to mandate the inclusion/addition of Fire Safety subjects, such as the National Fire Protection Association’s “Learn Not to Burn” and the “Arson Prevention Program for Children” to the school curriculums.

Background: We support this recommendation and have been promoting this for a number of years. This recommendation needs to be addressed by the Ministry of Education.

60. See Response to recommendation #3

61. Supervisory staff be issued with a distinctive coloured vest which is to be donned upon activation of any fire alarm.

Background: To readily identify supervisory staff to occupants and fire service personnel.

62. Owners provide a copy of the Fire Safety Plan to each tenant at the time the lease agreement is signed or renewed. A walk-through of all fire safety procedures and the viewing of the fire safety video (see recommendation #6) should take place at this time. Tenants must sign a form acknowledging receipt of the fire safety plan, confirming they understand the fire safety plan and fire safety procedures and their associated responsibilities.

Background: To provide fire safety information to occupants of residential high-rise buildings.

63. The Management/building representative must go with the fire department representative during the pre-fire planning/building familiarization process and review.

Background: access problems is shared between the owners and the fire departments.
64. **High rise apartment building owners to complete the retrofit requirement for door closers as soon as possible even though some owners have until October 1996, to comply with the Retrofit legislation.**

   **Background:** Strongly urge.

65. **Alarm monitoring companies should separately identify each building when they are requested to monitor a multi-building complex.**

   **Background:** To more specifically identify the exact location during any fire alarm activation.
Endnotes

1 The number 13 was not used for floor or apartment designation. As a result, the top floor of this 29-story structure was called the 30th floor and the highest number for the living units on each floor was 14 even though there were only 13 units on a floor.

2 Life Safety Code and 101 are registered trademarks of the National Fire Protection Association, Quincy, Massachusetts.

3 Building descriptions based upon NFPA 220, Standard on Types of Building Construction, 1992 Edition, use a roman numeral designating the general construction classification. In the NFPA 220 system, three Arabic numbers are also provided to describe fire resistance requirements for major structural components. Since no information regarding the fire resistance ratings of the structural components was available, the three Arabic numbers were not included in this description of the building.


6 NFPA 72, National Fire Alarm Code®, 1996 edition, lists the average ambient sound level for a residential occupancy as 35 dBA (Table A-6-3.2). The highest average ambient sound level listed in Table A-6-3.2 is 80 dBA, and the level is listed for industrial occupancies.


8 OFM investigators also had residents respond to a similar question and the information provided by respondents to their study was similar to the information received by the NRCC study. The NRCC study will be extensively referenced because that study provided a detailed analysis of the data received.

9 The NRCC study was based on the responses to a questionnaire that the NRCC sent to all residents in the building. Since the NRCC researchers could not determine the total number of building occupants, they calculated that approxi-
mately 545 people were in the building at the time of the fire. The 233 questionnaires that were returned came from 190 apartments (54 percent of the occupied apartments) and were the basis for the NRCC study. According to the NRCC report, this was a very good return rate. Most post-fire human behavior studies have had a return rate of about 30 percent. Of the 233 questionnaire respondents, only 219 were in the building at the time of the fire.

10 The North York Fire Department did not record data regarding telephone calls received over their direct line, which was the “emergency” line before the 911 system was used by the fire department.

11 The North York Fire Department operated using a “pairs only” policy. This meant the fire fighters worked as pairs rather than crews. This approach allowed the incident commander and sector commanders to draw personnel from all available companies and assign them tasks as required.


13 COHb means carboxyhemoglobin. The Occupational Safety and Health Administration (OSHA) Occupational Health Guideline for Carbon Monoxide states that COHb levels over 0.60 percent are usually fatal; 0.40 percent is associated with collapse and fainting; above 0.25 percent there may be changes on electrocardiograph test results; between 0.15 percent and 0.25 percent there may be headache and nausea.

14 NFPA 921, Guide for Fire and Explosion Investigations, 1995 edition, describes calcination as the phenomenon of a fire driving chemically bound water out of plaster or gypsum surfaces. When the surface is completely dehydrated, the gypsum will be converted to a crumbly solid.

15 Smoke passing through the cracks around a closed door will leave smoke stains on the door and frame. These stains can be used to indicate the direction of smoke movement. However, stains alone are not good indicators of the total smoke accumulation in a space, of the optical density at any point in time, of the volume of smoke that may have moved past by the door, or of the time over which the stains may have accumulated.


20 A VU meter is a modulation meter that has a movement that corresponds with the strength of the signal being transmitted by the public address system.


