Extreme Wind-Driven Fireproof Multiple Dwelling Fires

by Deputy Assistant Chief John Norman (retired)

Many fire companies throughout the City respond to fires in fireproof multiple dwellings (FPMDs) on a daily basis. Many of these buildings are parts of large complexes or developments and are familiar to the neighborhood Firefighters by the complex's name: the Rangel Houses, Starrett City, Battery Park City, Parkchester, Coop City or the Park Hill Houses, to name a few. Some are public housing developments, while others are privately owned. They run the gamut from low-income to luxury buildings.

Frequently, the fire companies respond to these buildings so often that they are intimately familiar with all the complexities that the building and its occupants present. Other buildings are rarely entered, other than for inspection purposes, which may occur only every three to five years. The common feature they all share is their fireproof (Class 1) construction.

Fireproof multiple dwellings have many of the same problems as non-fireproof versions: large numbers of occupants, difficulties in stretching hose-lines, difficulties with stairs and the like. The New York City Building Code requires two-hour separations between apartments and between each apartment and the public hall in these buildings. Thus, if the door to the apartment is closed, the threat to the rest of the occupants usually is minimized until Firefighters can extinguish the fire.

Normally, the only danger of extension is to the floor above. This area must be checked early, but typically, there is little threat to anyone outside the fire apartment. In fact, occupants *inside* the fire apartment can survive quite well with a closed door between them and the fire and their windows open. The fire load in these structures is confined to the contents of the apartment and most fires are relatively routine affairs, though they can be very punishing on the attack team due to high heat radiated back at the members by the concrete floors and ceilings.

The interior public hallway most often is windowless, resulting in heavy smoke conditions and high CO levels in the halls and stairs that can linger for a long time after a fire is knocked down. That is the typical "project fire." But that is *not* the kind of fire discussed in this article.

photo by Joseph Sperber

FF James Williams, Ladder 121, perished at this third-floor fire in 1996. Conditions initially permitted the forcible entry team to enter standing up, but changed so suddenly that members were overrun.

The extreme wind-driven fire

The fires described here are the fires that make it physically impossible to extinguish using FDNY's standard fire attack practices--the wind-driven FPMD fires, which occur when the fire is vented to the outside with the apartment door open and wind blows into and through the fire apartment. New York City has experienced severe fires in these kinds of buildings periodically since the 1970s. (See Table 1.)

In the late 1990s, four New York City Firefighters and numerous civilians were killed in these extreme wind-driven fires. The cause of this condition is not fully understood at this time, but it is predominantly due to wind blowing flame back into the building through windows that have vented. Very high wind conditions certainly magnify the problem, but stack effect, building interior layouts and airflow characteristics also are suspected as part of the problem, as is outside air temperature.

As shown in Table 1, the vast majority of these severe fires have occurred between the months of November and March. Neither the height of the building nor the location of the fire floor is a reliable indicator of the likelihood of a wind-driven fire occurring. Past fires have occurred on the third floor of a 13-story building, on the top floor of a 10-story and intermediate floors of buildings as tall as 50 stories. (See Table 2.)

The Department's Firefighting Procedures Manual, "Multiple Dwellings Fires," which first was written in 1979, describes these fires as "blowtorch" fires and describes tactics to be implemented when encountering this condition. The blowtorch description is quite accurate. Consider the oxy-acetylene torch Firefighters use for steel-cutting: when the torch is lit initially, with just the acetylene burning in a lazy, smoky, yellow flame, its temperature is approximately 1300 degrees, about the same as a normal room fire. It is not until the torch's oxygen valve is opened to add the oxygen to the burning acetylene that the flame reaches the 5300-degree temperature that melts steel.

This same phenomenon can occur under the right circumstances during a room fire in a FPMD. Wind striking the face of a building is funneled in through an open window, greatly increasing the amount of oxygen in contact with the fuel, resulting in a dramatic increase in the heat release rate of the burning fuel. The

Table 1

Some past high-intensity, wind-driven, fireproof multiple dwelling fires:

- January 23, 1980--Lindsay Park Houses, Brooklyn--one DOA in apartment across hall
- February 11, 1989--98-23 Horace Harding Expressway, Queens--three DOA
- November 2, 1994--Park Avenue, Bronx--two DOA
- January 5, 1996--40-20 Beach Channel Drive, Queens--one FF DOA
- January 7, 1997--1 Lincoln Plaza, Manhattan
- December 18, 1998--77 Vandalia Avenue, Brooklyn--three FFs DOA
- September 9, 2004--20 Confucious Plaza, Manhattan--12 FFs burned
- January 26, 2006--40-20 Beach Channel Drive, Queens--three FFs burned
- February 26, 2006--20 Mosholu Parkway, Bronx--three FFs burned

resulting flame then is pushed ahead by the wind, venting out of the initial room, filling the apartment and public hall with flame. The wind-driven flames blast out of the apartment door at extremely high velocity and pressure. This phenomenon must have an exhaust outlet or else the airflow cannot exist. If the apartment door is closed and no windows exist within the apartment on the downwind side, the high airflow cannot occur and the extreme temperatures do not exist.

Unfortunately, during a fire in a high-rise building, there are numerous possibilities that allow the airflow to occur. Windows in the hallway may be open or fail due to heat. In several cases, windows that were open in apartments across the public hall, more than 100 feet from the fire apartment, provided the necessary exhaust outlet when the occupants opened their apartment door to flee. Of course, when the Fire Department deploys a hose-line onto the fire floor from the attack stairway, the door to the stairway becomes blocked open and the staircase itself becomes a flue-like chimney. This situation is worsened if the bulkhead door at the top of the attack staircase is open, a practice that routinely is used under less severe conditions to lessen the contamination of the staircase. Any of these conditions may be the "triggering event" that prompts windows to fail in the fire apartment to allow the inrush of air across the seat of the fire, causing an explosion of flames, overrunning unsuspecting Firefighters approaching the seat of the blaze.

It is hard for anyone who has not experienced one of these severe fires to appreciate the radically different conditions that they create, especially if the member has experienced a number of "routine" FPMD fires. There is no frame of reference with which to compare them. Firefighters are used to seeing rapid improvement in conditions when attacking with even a single $1^3/_4$-inch line in an apartment of this size. Yet these fires are unaffected by two or even three $2^1/_2$-inch lines operating in the super-heated halls.

Another crucial difference that most are unaware of, but that has been illustrated clearly in several past fires, as well as during recent full-scale fire testing conducted by the National Institute of Standards and Technology (NIST), is the nearly explosive fire spread that occurs. At several fires, surviving Firefighters have reported what appeared to be light fire conditions within the fire apartment, allowing members to enter while standing up. After some trigger event, conditions deteriorated so extremely rapidly that they were forced to crawl for their lives and were saved only by the proximity of an area of refuge behind a closed fire door.

During recent tests held in Chicago, in conjunction with NIST, the Chicago and Toledo, Ohio, Fire Departments and the FDNY and participated in by Assistant Chief Thomas Galvin, Battalion Chiefs Jerry Tracy (Battalion 49) and George Healy (Battalion 51, covering) and Lieutenant John Ceriello (Bureau of Training), a fire was videotaped traveling from the bedroom of origin, across a living room, a kitchen/foyer and blasting out into the public hallway in 13 seconds after a window in the fire room was simulated as failing and permitting a 20-mile-per-hour wind to enter. A crawling Firefighter likely never would have reached even the foyer before being overrun by fire under these conditions.

The exact nature of the triggering event cannot be predicted for every fire. At most FPMD fires, windows have failed and doors are open, but no wind blows in, simply because the wind just happens to be blowing away from the building. In several extreme fires, the fire intensified when a window failed *after* Firefighters gained entry to the apartment, in which case, the apartment door was open, allowing airflow into the hall and attack stair.

That appears to have been the case at the 1996 fire at 40-20 Beach Channel Drive, where FF James Williams died. At the 1998 fire on Vandalia Avenue, where Lieutenant Joseph Cavalieri and FFs James Bohan and Christopher Bopp died, the window already had failed prior to entry, the hall door was opened, yet no rapid intensification occurred until a minute or two after entry, possibly when an occupant of an apartment across the hall (downwind) of the fire apartment opened the door to the public hall to see what the commotion was about.

The windows in this apartment may have been open prior to the occupant opening the door. The exact triggering event of this fire venting could not be pinpointed, since this occupant is believed to have opened the door at about the same time that members on the roof opened the bulkhead on the attack stair and a window in the public hall also was vented at some unknown point. Any of these openings could have allowed the airflow through the apartment out into the public hall, overrunning and killing the three members of the forcible entry team.

Ladder company operations

It is absolutely critical to evaluate the effect that any ventilation efforts will have prior to breaking any windows. If any wind is blowing toward the affected windows, don't vent them until the fire area is thoroughly cooled and under control. This will prevent smoldering furniture from being fanned into open flame and driving Firefighters out of the area. At several of these extreme fires, $2^1/_2$-inch hand-lines had been operating at the door to the fire area when conditions intensified so severely as to drive Firefighters off the fire floor.

When venting from inside the fire apartment, make a small experimental opening, preferably a single small window pane. If wind blows in, wait until the hose-line has thoroughly controlled the fire. When venting from the floor above, be sure to await orders from the ladder company Officer inside the fire apartment and ensure that at least the apartment door to the apartment above is open to duplicate the conditions that will be experienced on the fire floor. Otherwise, members won't know the real effect of wind on the fire floor. Firefighting Procedures, Multiple Dwelling Fires, section 6.1.2 b, clearly states: "The ladder Officer in the fire apartment conducting a search and examination should be the only one to initiate the request for additional ventilation. All other ventilation must be strictly limited and controlled by the Incident Commander."

This limitation is intended to avoid introducing a "triggering event" while an interior attack is underway. One problem is that the fire does not read or comply with FDNY's firefighting procedures; fire can cause a window to fail at any time. The members operating inside the fire area *must* maintain control over the door to the apartment. Should a window fail, closing the apartment door is the only readily available means of stopping the inflow of air and blowtorch of flame.

One member of the forcible entry team should be assigned to remain at the apartment door, with his/her hand on the doorknob,

Table 2

Building and Fire Data:

- 30 Montrose Avenue, Brooklyn--11th floor/16-story building
- 98-23 Horace Harding Expressway, Queens--14th floor/16-story building
- Park Avenue, Bronx--18th floor/20-story building
- 40-20 Beach Channel Drive, Queens--third floor/13-story building
- 1 Lincoln Plaza, Manhattan--28th floor/42-story building
- 77 Vandalia Avenue, Brooklyn--10th floor/10-story building
- 20 Confucious Plaza, Manhattan--37th floor/44-story building
- 40-20 Beach Channel Drive, Queens--sixth floor/13-story building
- 20 Mosholu Parkway, Bronx--24th and 25th floors/41-story building

Similarly light fire conditions existed in this hallway on Vandalia Avenue in Brooklyn, where members removed an elderly neighbor prior to conditions suddenly changing and filling the entire 145-foot hall with flame, killing Lieutenant Joseph Cavalieri and FFs Christopher Bopp and James Bohan.

Temperatures had to have reached 3000 degrees to cause this damage to the pre-cast concrete ceiling at the Vandalia Avenue fire apartment. This occurred within the 25 minutes it took a hand-line to be advanced the 45 feet to the door of the apartment.

photos by Deputy Assistant Chief John Norman (retired)

ready to pull it closed if a blast of air is driven toward him/her. Immediately notify all members operating in the apartment of the changing conditions and ensure they reach an area of refuge. (It is possible that members searching rooms out of the path of the fire between the failed window and the door may not be aware of the changing conditions.)

Alternative strategies

Units faced with such severe conditions have had very poor results when using standard tactics. In most of the past incidents of this type, an interior hand-line attack typically involves eight to 12 engine companies operating in relays, since Firefighters can spend only a minute or two in the hall before the members are burned by the high temperature soaking through their protective clothing. No real progress is made in advancing on the fire, despite the terrible beating the personnel are taking, until the fire has consumed the bulk of the combustibles in the fire area and has begun to decay.

Multiple $2^1/_2$-inch hand-lines operating from the staircases have been unable to advance due to the flame blowing at them. The problem is that the flame that is blasting down the hall is simply burning gas, similar to a very intense propane or natural gas flame. The water from hand-lines has virtually no effect on this gas flame. The only way the water can have any effect is to cool the seat of the burning material, but that is out of the reach of the stream, down the hall, inside the involved apartment. The hand-lines have no effect because all the water they throw is not reaching the fuel, where it can cool and stop further flame production. The typical result is that the only objects left in the apartment are those made of steel, since even aluminum objects are found as pools of metal on the floor. The fire has burnt itself out.

Unusual fire situations, such as the extreme, wind-driven fire, require unusual tactics. One option that might be possible involves breaching a hole from an adjoining apartment. If possible, enter the hallway leading to the fire apartment and enter the closest apartment door on the same side as the fire apartment. If this is the adjoining apartment to the fire apartment, breach a hole into the fire apartment and operate the nozzle directly into the fire area. If this isn't the fire apartment, continue across it, breaching walls, until access is gained to the apartment adjoining the fire apartment. When breaching holes, always attempt to breach as close to the exterior wall that faces the wind as possible. This will lessen the possibility that the wind will drive fire back at Firefighters through the hole they created.

Do not attempt to enter apartments on the opposite side of the building to the fire apartment. The heat and flame front blowing out of the fire apartment may cause failure of the fire-rated walls (hallway and apartment separations) to the apartment to which Firefighters have gained refuge.

If the fire is within reach of an outside stream, another possible tactic may be to knock the fire down from outside, something that is nearly taboo in an occupied dwelling. In these extreme fires, there are no live civilians in the fire apartment unless they are in sheltered areas. The flame is blasting down the hall, threatening other civilians, as well as Firefighters.

In lower-floor fires, an aerial stream can be deployed quickly to knock down this fire. Keep in mind that this is not a heavy fire load that is creating the problem; rather, it is the wind blowing in, adding oxygen, similar to a bellows stoking a fire. When the attack stream is directed from the windward side of the fire, the flows from a $1^3/_4$-inch stream may prove effective. A Tower Ladder stream may be required. At the 2006 fire at 40-20 Beach Channel Drive, a $1^3/_4$-inch hand-line operated by members on an aerial lad-

der knocked down all visible fire on the sixth floor after a 2 1/2-inch line was driven out of the interior.

Nearly all fireproof multiple dwellings are high-use buildings though and if the fire is on the upper floors, setting up an exterior stream is a challenge. The most practical answer is to use a Navy fog applicator, which the Special Operations Command has been testing in conjunction with the Bureau of Training. To use the applicator pipe on the wind-driven fire, simply remove the outer stream tip from any controlling nozzle and attach the applicator to a hand-line on the floor below the fire. Order all of the attack personnel out of the halls on the fire floor (they probably haven't gotten far out of the stairwell, anyway); then close the stairway doors. Place the Navy applicator out the window, directly below the window on the fire floor *into* which the wind is blowing. Hang the applicator tip just over the windowsill of the fire apartment and start the water. The applicator's modified sprinkler head produces a fog stream that is easily carried through the apartment and down the hallway by the force of the wind blowing through the window.

The model the FDNY is experimenting with (1 1/2-inch pipe) flows about 160 gpm at 50 psi nozzle pressure. Removing the sprinkler head and replacing it with a 1 1/8-inch tip can increase this flow to 250 gpm, but Firefighters lose the benefit of the wind carrying the spray throughout the apartment and hall.

The FDNY has developed a third option: stopping the flow of wind into the fire apartment. This is accomplished by draping a fire-resistive curtain in front of the offending window from the floor or roof above. This "fire window blanket" has shown much promise in test fires, where witnesses described the blanket's effectiveness, "Like somebody turned off the switch to the fire."

The blanket the FDNY currently uses is 10 feet high x 12 feet wide, sufficient to cover the majority of residential windows. It is constructed of a material known as "Hotstop-M," which will withstand direct exposure to 1500 degrees for an unlimited time and 2000 degrees for up to 15 minutes. It comes with 20-foot-long Kevlar ropes sewn on each corner, allowing it to be lowered into position from two floors above the fire and pulled tight by the lower ropes from the floor below the fire. It is weighted with lengths of chain sewn into the lower edge to help it fall into position, even in the face of very high winds. It is crucial to place the blanket in front of the windows into which the wind is blowing (the entry window), in order to stop the wind from feeding the fire. It is not advisable to place the blanket in front of the exhaust outlet window where flame is venting out; the idea is to let this flame escape, rather than increase pressure in the apartment, possibly driving fire further into the building.

Placement in front of the entry window has been shown to reduce wind velocity within the apartment from 20 miles an hour to less than one mile an hour. Placement in front of the exhaust window would not have any beneficial effect. Currently, blankets are carried only by Special Operations units, but plans are being developed to issue blankets to every Battalion and selected ladder companies. Currently, research is underway on a new generation of material for the blanket fabric and consideration is being given to creating a smaller, lighter version to allow the roof Firefighter of the second-to-arrive ladder company to carry a blanket for early use.

Members are urged to review the following references:
- "Wind-Driven Queens Fire Provokes Several *Maydays*," by Deputy Chief James D. Daly, Jr., in the 3rd/2006 issue of *WNYF*.
- "Wall Breach Facilitates Extinguishment of Manhattan Three-Alarm Fire," by Assistant Chief Patrick McNally and Deputy Chief Robert Carroll, in the 1st/2005 issue of *WNYF*.
- Training Bulletin, Tools 3, The Fire Window Blanket and Addendum #1.
- Firefighting Procedures, Multiple Dwelling Fires.

photo by FF Nate DeMarse, Squad 61

With fire blowing through four windows on each of the two separate floors involved in this Bronx blaze, FDNY members would have benefited from having the fire window blanket deployed in front of them. Lines operating from adjoining apartments through holes breached in walls controlled the fire.

A fourth option might be to reverse the flow of gases, driving them back toward the fire apartment by using positive pressure ventilation (PPV) fans, set up two or three floors below the fire floor to blow fresh air into the staircase. This technique was one of the more promising efforts investigated during the NIST testing in Chicago in which FDNY members participated. The top bulkhead and all other doors in this staircase (except where the fans are blowing in, of course) should remain closed when pressurizing the stairwell. Using the PPV to reverse the flow of air, it may be possible to advance in clear conditions from the attack stairway, pushing heat and fire down the hall ahead of the lines, back toward the door to the fire apartment. This option requires coordination and resources to implement successfully, but offers potential benefits in reduced injuries to Firefighters. Additional FDNY testing of PPV for use in FPMDs is planned for the spring of 2007.

Multiple dwellings of all kinds present Firefighters with their greatest life hazards. As such, a tremendous effort is expended in fighting these fires. At each multiple-dwelling fire, take a close, critical look at all phases of the operation. Are these efforts being channeled properly or are they wasting precious resources of personnel, water and equipment that could be better used to save lives? That is the bottom line at multiple-dwelling fires.

I express my thanks to the members of the FPMD working group who have contributed their time and experience to making FDNY operations safer and more successful: Assistant Chiefs Thomas Galvin and Allen Hay, Deputy Assistant Chief William Siegel, Battalion Chiefs Jerry Tracy, Michael McGrath, George Healy and Michael Puzziferri and Lieutenant John Ceriello.

About the Author...

Deputy Assistant Chief John Norman (retired), Special Operations Command, was a 27-year veteran of the FDNY. He co-taught the Foam Coordinators course at the Bureau of Training for more than 15 years. He has had extensive training in flammable liquid and gas fire suppression at training classes around the country. He has served with Engine 290, Ladder 103, Rescue 3, Haz-Mat 1, Rescue 2, Rescue 1 and Battalion 16. He was a frequent contributor to WNYF.