

Wind Driven Fires

The fire department has always been a very traditional organisation. The tendency is to do things the way we've done them in the past. That experiential oriented approach is the core idea of the way we do things as a fire department. It is our strength. The downside of this approach is that we evolve rather slowly and we need incidents or accidents to adapt to new situations.

Rare fire behaviour like rapid fire progress is responsible for an important part of the LODD's within fire departments. Because of this many departments are rarely or never confronted with the reality that we are lacking in understanding certain fire behaviour. We seldom have to confront this reality. Combined with our traditional approach this makes that after a deadly accident there is little or no learning and that we don't know afterwards how to do better in the future.

*"Failing to maintain tradition is failing to learn from the past,
Failing to break with tradition is failing to learn from today.*

The fire departments in the major cities of the world have so many fires to deal with that they come across certain phenomenon more often. The Fire Department New York (FDNY) had several LODD's in the nineties in a number of similar incidents.

1 Standard tactics for an apartment fire.

All over the world the same strategies and tactics are used to fight an apartment fire. The attack crew goes up the staircase or takes the elevator to the first or second floor below the fire floor. There they connect a line to the standpipe and they proceed to attack the fire. For this they will climb up the staircase and go through the hallway on the fire floor up to the door of the apartment with the (suspected) fire. Through the door it is then quite easy to make an efficient fire attack.

The idea behind is that the staircase and the door of the apartment will resist the fire long enough to allow the first team to get to the door of the apartment. In this regard, the fire attack crew is protected by fire rated doors before they launch the attack. When they open the door of the apartment they will "push" the fire out of the apartment with their fire attack.

2 The Vandalia avenue fire.

On December 18th 1998 a fire is reported on the 10th floor of a building along the Vandalia Avenue in New York. At arrival the firefighters can see an orange glow inside the apartment. The fire fighters go to work and find their way to the fire floor. They encounter intense heat and heavy smoke. When arriving at the apartment they open the door to attack the fire. Immediately after opening the door the fire fighters are engulfed in flames. They can just send out a mayday, but they are not able to escape the flames and heat. Attempts to rescue the fallen fire fighters were futile. The rescue teams could not leave the staircases due to the very high temperatures encountered in the hallway.

During the investigation afterwards it was noticed that the facade of the apartment was subject to a strong wind (up to 40km/h).

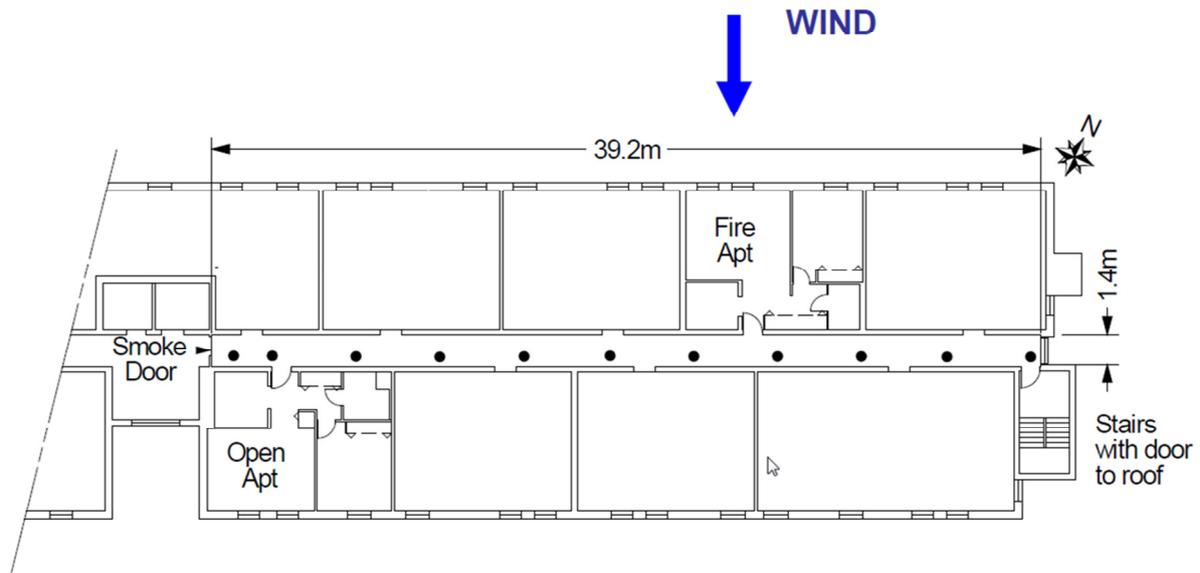


Figure 1 Overview of the 10th floor. (Graph: Dan Madrykowski)

3 Wind driven fires.

In the years preceding this fire and the years after it there were several similar fires in New York. Each time there was a fire in apartment building when the building was subject to strong winds. Attacking the fire by traditional tactics and strategy each time lead to the loss of the primary attack crew.

Within the FDNY some people started to ask questions about these LODD's. There had to be a better way of fighting these fires? These persons were brought into contact with two engineers within the National Institute of Standards and Technology (NIST) that were investigating fire behaviour.

3.1 Lab tests

3.1.1 Test installation

In the NIST lab they rebuild the apartment at full scale. It got furniture that you would expect in a normal apartment. The apartment gave out on a hallway so that the situation would be identical to the situation on Vandalia Avenue.

They used a big fan from a swamp boat so that they could simulate a correct quantity of wind. This configuration was set on fire eight times, with and without wind. Several new tactics were tested.

3.1.2 Test results

It became quickly obvious that the fire developed very quickly in the beginning. Once the window broke there was plenty of oxygen available to the fire. The problem for this fire

was the evacuation of smoke and fire gasses. Because of the excess of smoke & fire gasses the apartment is pressurized. This pressure inside the apartment and the pressure created by the wind on the façade maintain a vulnerable balance. In other words, the fire is kept contained inside the apartment by the wind.

If at a certain moment the door of the apartment is opened the overpressure will cause a flow through the open door. The wind will push large amounts flammable gasses into the hallway. Together with the large amounts of oxygen this mixture will ignite immediately. With the opening of the door, an inferno is created in the hallway, with temperatures shooting up to 1500°C. It speaks for itself that fire fighters have no chance of survival in these conditions.

3.2 Governors Island, NY

After the lab tests they looked to find a suitable building to repeat the test in real circumstances. On Governors Island in the state New York a building with seven floors was found. In this building 14 burns were conducted. A large overpressure ventilator was installed onto an aerial platform to simulate the pressure generated by the wind on the facade.

The results turned out to be about the same as the result from the lab tests. When the door to the apartment is opened, the fire develops in a couple of seconds to a fully developed fire. A similar evolution of the fire was noticed when the window broke while the door was already open.

3.3 Alarm signals

One of the lessons learned from the multiple deadly accidents is that the wind plays a crucial role. It therefore is extremely important that an incident commander (IC) notices if there is an important wind blowing towards the building.

We've seen that fire gasses can't escape from the apartment because of the wind. In reality it might be noticed that fire gasses and flames are pulsating out of the window of the burning apartment. Another possibility is that smoke and fire gasses are evacuated through the window in an asymmetric way. This is clearly visible and is the most important alarm sign to a wind driven fire. Figure 2 shows a picture of the experiments on Governors Island. You can see the big ventilator that is simulating the wind. The wind is the reason why the smoke and fire gasses can't escape the normal way out of the apartment through the window. In the picture we can see that flames are exiting out in the lower right quadrant of the window. This is abnormal fire behaviour. On the Internet there are many movies to be seen on which you can study this signal of wind driven fire. NIST distributes a DVD with all the results of the wind driven fire research project.



Figure 2 Asymmetrical evacuation of fire gasses (*picture: Scott Stillborn – OFS Photographer*)

4 An alternative approach?

Through these tests it has been shown scientifically that there are fires out there that you can't extinguish safely with our classic strategy and tactics. The most important factor that differentiates these fires from others is the wind. Therefore these fires are named "wind driven fires". While designing the tests the investigators were already thinking about alternative ways to attack these fires.

4.1 Minimal quantities of water

During the tests in the lab and the tests on Governor Island a straight stream was used to cool the fire gasses in the apartment. In this way the fire was unable to reach higher temperatures.

Throughout the project the "Floor Below Nozzle" was developed. This is a nozzle that is mounted at the end of a tube. The tube has a 45° bend at the end. Because of this shape it is possible to apply water to the apartment on fire from the apartment the floor below (see figure 3). This nozzle is mainly developed for high-rise applications. Using a straight

stream from the ladder truck, aiming at the ceiling of the apartment, would have the same effect. But most ladder trucks can only reach about 40m (120ft) up.

Some other nozzle types were also tested. Good results were achieved with the Bresnan Nozzle (see figure 4), a type of water mist producing ball that is lowered down the façade until it hangs in front of the window.

This new tactic implies that at first we try to get the heat release rate under control with an external attack before we engage teams to do an internal attack. It is obvious that a tight chain of command and excellent coordination are of the utmost importance.



Figure 3 Floor below nozzle (*picture NIST*)



Figure 4 Bresnan nozzle (*picture Elkhart Brass*)

4.2 Wind control devices (WCD's)

Another tactic was to stop the wind from having any effect on the fire. Therefore 'Wind Control Devices' were designed. You could say that these are in essence giant fire blankets. These are put in place in front of the window by fire fighters above and below the fire. By doing so, the wind can no longer affect the fire in the apartment. The overpressure generated by the wind disappears and the ventilation of the fire is stopped. This way the fire reduces in intensity and the heat release rate decreases.

But even with the effect of the wind neutralised, the fire still continues to burn with a high intensity. Therefore it is still needed to engage in a classic internal attack to extinguish the fire. For reasons of comfort and safety the fire fighters in the US use the positive pressure attack (PPA). Their internal attack is supported by several tactical placed ventilators. As a consequence it is again very important that there is a perfect coordination. A strong chain of command and reliable communications are imperative.

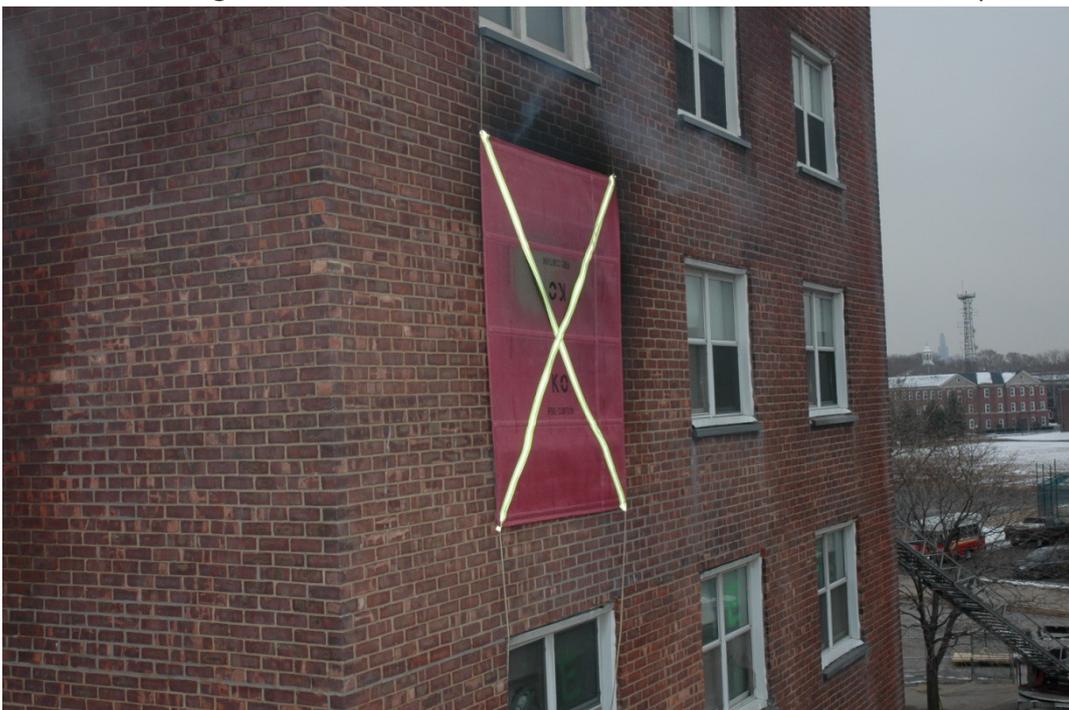


Figure 5 Use of a Wind Control Device (*picture: NIST*)

The NYFD has implemented both new tactics into their daily operational procedures. Several engines are equipped with the floor below nozzle and WCD's. On top there is an important training program so that fire fighters can acquire these new tactics. In New York, one hopes that no more fire fighters will die while battling a wind driven fire. It is now time for the Belgian fire fighters to learn the lessons that had such a high cost from our colleagues of Fire Department New York.

5 Sources

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