High Rise Operations Conference
HROC 2021

County Fire Tactics

Program/Booklet Contents

Classroom – Operations manual

Instructor

Michael Terpak has been in the fire service for 45 years spending the last 36 years with the Jersey City Fire Department where he recently retired as a Deputy Chief and City-Wide Tour Commander. Throughout his career he has worked in the city's Lafayette and Greenville areas with Engines 10 & 17, Ladder 12, Rescue 1, Chief of the city's 2nd. Battalion and the former Chief in-charge of the city's Training Division. In addition to the above, he was also the *High-Rise Training Coordinator for Jersey City*. Terpak travels extensively around the country lecturing on fire/rescue topics and is the founder of Promotional Prep, a New Jersey based consulting firm designed to prepare firefighters and fire officers studying for promotional exams.

Chief Terpak, who also holds a BS degree in Fire Safety Administration from the City University of New Jersey, is an adjunct professor for the Fire Science Technology program at Sussex County Community College, and is the author of six best-selling books, "*Fire Ground Size-Up, 1st and 2nd. editions"*, "*Assessment Center Strategy and Tactics", "Fire Ground Operational Guides"* "*Assessment Center Management and Supervision" and "Fire Officer Oral Assessment Study Guides."*

The NEW 2nd. Edition of "Fire Ground Size-Up" is now available at fireengineeringbooks.com!

He can be contacted at (973) 512-3679, firegroundsizeupmt@gmail.com
as well as firegroundsizeup.com or promotionalprep.com.

Introduction

Fires in occupied high-rise buildings have and will continue to present some of the most unique and greatest challenges to today's fire service. For anyone who has ever operated in buildings of this design, most, if not all will agree that the challenges are directly related to the design and height of the building. When operations are not able to be ground based, all resources and their assigned tactics must proceed up to the designated area and operate from within. This extended time, often referred to as lead or reflex time, can become quite significant. If we add the difficulties of going to work in what is essentially a sealed building containing hundreds to thousands of people, the uniqueness of a fire in a high-rise building requires us to be well educated and trained to handle what may lie ahead.

Definitions and Design

High-Rise buildings: It is from the factors listed below that we arrive at a list of characteristics that will define a high-rise building:

- The building's height is more than 75'.
- The building is beyond the reach of fire department aerial apparatus.
- The building presents conditions and challenges from a stack effect within the structure.
- The building presents conditions and challenges from a reverse stack effect within the structure.
- The building presents conditions and challenges from the stratification of smoke and heat within the structure.
- The building's height and size present unreasonable evacuation.
- There is a great dependency on the building's internal fire protection systems.
- The building's height, size and design present limitations with ventilation, and smoke control and movement.
- The building will present challenges with extreme heat.
- Fire department operations cannot be considered ground based.
- A fire in a high-rise building requires a major fire department response.

HIGH-RISE BUILDING DESIGN

As with any structure, it is critical that we know as much as we can about how our buildings are designed and built. To put further clarity on the challenges, we need to now identify and discuss how the structural components of high-rise building are designed and erected. What follows is another brief look at high-rise building design.

Steel Skeleton structures: In Class 1 buildings of this design, the structural steel members within the design are protected by encasing the steel in either concrete, gypsum/sheet rock, or sprayed-on non-combustible fibers. Each one of the materials listed above is installed to protect and insulate the steel from exposure to fire.

Cast-in-place structures: Cast-in-place high-rise structures literally defines how the structure is erected. Each floor is framed and poured on site one floor at a time in what eventually will be a monolithic design. As carpenters construct the wooden formwork in the shape of columns, girders, and floor decks to accept the concrete, workers assemble a network of steel reinforcing rods to create a support system to bond with the concrete and provide the building with the needed tensile strength. Prior to each "*pour*", a network of supports created from timber columns and steel jacks are constructed to brace and support the formwork from below. This is where just a few of the many concerns to firefighters begin. The wooden formwork once erected is nothing more than a neatly arranged lumberyard in the sky.

Compartmentalization

Compartmentalization is the concept of dividing up a floor area to limit a fire's spread. It is an essential ally in a fire department's attempt to control a fire. In the older high-rise building as well as in today's residential high-rises, large open areas are for the most part nonexistent. On the other hand, in the newer more modern high-rise office building their presence is a common sight. The open floor plans of the commercial office high-rise structure are a necessity for the congregation of workers on the floor. Within the large open floor spaces of the building, generally all you will find are cubicles and partition walls that will be erected to provide some privacy for an employee workstation or conference room.

Core construction

Core construction is the concept of containing all the building services, utilities, elevators, and stairs within a designated area or core. Looking at a floor plan, it resembles or looks like a box (*core*) within a larger box (*open floor*). Core construction for the commercial office high-rise will generally consist of either a side or center core design, with the latter being more common. The concept behind the core design of a building is that it allows the utilities and services to be placed within a designated area leaving the outer floor space open and unobstructed for the employees and their supervisors.

Although we do not consider a residential high-rise building as having an identifiable core, you will still find certain areas or rooms where the utilities are grouped together. The most obvious being elevator banks and stacked rooms/closets for phone and cable and common area electrical panels.

Curtain Walls

Exterior skin of glass, aluminum, stucco etc. panels. (*fill in from class information*)

- How attached: Bolted/welded to curtain wall anchors.
- Concerns: Their attachment and floor gap/space.

HVAC systems

Probably the most influencing building system that will plague the fire service in the modern high-rise building is the HVAC system. The modern high-rise building is a self enclosed environment, which means that the building will be required to provide a clean, warm, and cool air environment for the building's tenants. The HVAC system in a building is designed to process and treat air to specified temperatures, humidity, and cleanliness before distributing it throughout the intended spaces of the building. After the air is delivered to the designed areas within the building, it is collected and returned for processing and then reused through the same designed areas. The system type, design, and its serviceable areas are the predominant concerns for the Incident Commander at a high-rise fire.

In the residential high-rise building, the concern is much more limited than when compared to the commercial office high-rise. In the residential high-rise you will find that each living unit will have its own individual system of providing heat and air conditioning, with a central system generally found servicing only the common areas. In the modern office high-rise, the design will be much different. To get a better understanding of the system designs and where found, review the following.

Non-Central Air system: This is a small and limited system. It will only provide air to one floor or designated area. You can find several "*non-central*" air systems servicing the hallways and lobby of a residential high/mid/low-rise, as well as limited systems designed to serve a particular floor or area of a commercial office high-rise.

Central Air system: This is a more common system within the commercial office high-rise. This system will supply air to several floors within the building. Due to the number of floors and square footage that needs to be heated, cooled, and cleaned within the building, you will find designated areas referred to as mechanical equipment rooms or MER's. Based on the square footage and number of floors served by the system, you will often find entire floor(s) within the building designated as MER floors.

Elevators

Elevators and elevator use are referred to by many as a "*necessary evil*" in high-rise firefighting. Elevators are the only practical means of moving large numbers of resources to the upper floors of a building that is on fire. Their use does present several concerns and challenges, but attempting to walk 30, 40 plus floors seems impractical.

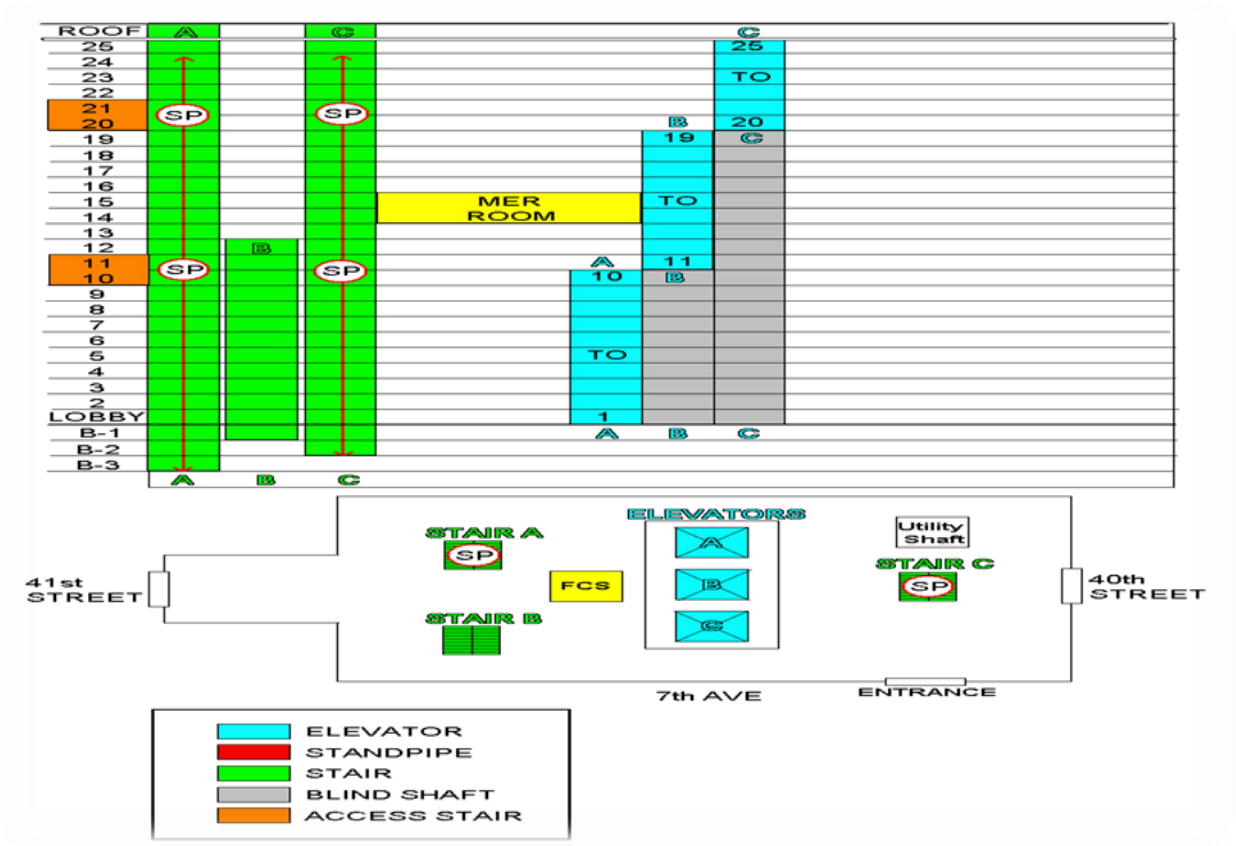
Type – *Passenger and Freight*: First let us review the thought of using of a freight elevator to move firefighters and equipment. *Freight elevator* use in a high-rise fire is a viable option that is dependent upon several factors. First is the age and code at the time of installation. Older freight elevators were not required to have Phase 1 and 2 firefighter service features that we find within a passenger elevator. Independent control of the car is limited. For these reasons alone, members should not use an "*older*" designed freight elevator. Newer designed freight/service elevators, however, are going to be much different. New and recently installed freight elevators are required to have the same protection and design features as a passenger elevator. Think about the advantages. An over-sized elevator car that is designed to handle additional weight with Phase 1 and 2 fire fighter control features becomes an attractive option for the fire department. If the pre-incident information for the building you are going to work in shows that a newer designed freight elevator exists, give them early consideration, but also consider the following. First, it is important to note that freight elevators have access or are exposed to each floor in the building. This can be considered both a pro and a con. Second, more times than not, fires that begin in commercial office high-rise buildings start in or near the freight/service elevator car lobby and floor areas, notably in piles of collected rubbish. As much as I like to consider the freight elevators for our Logistics assignments, you must identify them as a safe option first.

Passenger designed elevators will vary in number and floor accessibility based on the building's height and square footage. With that comes the additional concern of the size of the car itself. Older high-rise buildings will for the most part have elevator cars that are smaller in size when compared to a new more modern designed high-rise. This becomes a concern when we attempt to put firefighters and equipment in a car. The smaller cars found in our older residential and commercial high-rises will limit the number of members and equipment to be transported. Newer elevator cars will be larger in their overall square footage.

STUDENT NOTES: *Fill in the following from the class information.*

- **Bank/floor accessibility:**
- **When to use and where to go:**
- **Missing floor numbers:**
- **Smart Elevators:**

Using Lobby – Building Information Cards



For EBIC information, Contact Chief Jack Murphy at fmjack1948@gmail.com or jmurphy@ebisg.com

Stairs

In high buildings there can be several different types of stairs within the building. The two most common that will extend throughout the height of the building are the return-type and the scissor stair.

- ***Return stairs****:* Return stairs, or as they are also called the "U" or "V' return stairs, acquire their name simply from their shape or return within the shaft. Entry and exits are made relatively in the same area with a ½ landing between floors where the "U" or "V" changes direction. This stair design will be the most common.
- ***Scissor stairs****:* Scissor stairs consist of two sets of stairs in a common stair shaft. Within this design, the access point for each set of stairs in the shaft is usually at opposite locations on adjacent floors. Most often what you will find is that each stair will serve opposite floors. One set of stairs will serve odd-numbered floors while another will serve the even numbered floors. With that being said, scissor stairs can be further defined by whether they are *"closed or open."* What we mean by that is in a *closed design*, each set of stairs, although in a common stair shaft, is separated from each other. With an *open scissor stair*, the stairs actually share the shaft whereby you could traverse from one stair over the railing to the other stair easily.
- ***Fire/Smoke Tower*****:** A stair design of great value to the fire service and the building's occupants is a stair called a "*Fire Tower*" or a "*Smoke Tower*" stair. A fire tower is a stairway that has access to outside air. An open-air balcony/vestibule and shaft protected by self closing doors separates the stairs from the hallways on each floor. The design and concept behind the open-air balcony/vestibule and shaft are that any smoke exiting an apartment and hallway will be drawn up and out via the external opening without contaminating the stairwell.
- ***Access stairs****:* Access, convenience, or tenant stairs as they may be called are actually unenclosed private stairs. Found in many commercial high-rise buildings, this stair design allows employees to have access to multiple floors without entering the public stairs or elevators of the center core with the rest of the general population. The design can be either an open straight run, return or of a spiral design. Their placement is specifically designed as a convenience, with the driving force being to lessen the time it takes for an

employee to traverse from one floor to another, much like the smart elevator.

The privacy stair concept can also extend over to the residential high-rise building. It is here where you can often find individual apartments containing multiple floors. Often referred to as a duplex (*two-floors*) or a triplex (*three floors*) apartment, a major concern of a multi-floored apartment will be there is often "*only one access door into the apartment from the public hallway."* In the event the fire is on the apartment's lower level, you could literally be forced to enter the apartment from the second level door and battling down to what will look and feel like fighting a basement fire in the sky. Knowing they exist is the key here.

- ***Pressurized Stairs*:** In the newer more modern designed high-rise, firefighters will find stairs that are pressurized via a built-in supply and exhaust system. To simplify the design, the intent is to maintain a positive pressure within the stairwell to retard smoke from entering the stairwell in the event a door on the fire floor is opened. If all the doors in the stairwell remain closed and if equal pressurization is reached, some of the air within the stairwell is exhausted to correct the air pressure within the stairwell. Too much pressurization or air in a stairwell could make it difficult to open doors. Likewise, if too many doors are left or chocked open, the stairwell pressure can be negated. Stairwell pressurization is a critical tactic that must be considered within the fire department's arsenal. Whether it is part of the building's design or we, through the use of positive pressure fans attempt to pressurize the stairwell ourselves, it use must be understood.

Stair Use and Designation during Operations

In most high-rise buildings, you will often find that two stairs will traverse the entire height of the building. The size and square footage of the building may warrant additional public stairs within, but the above seems to be common. Their location and floor accessibility will vary from building to building. The obvious concern with stairs within a high-rise building is going to be our immediate need to identify and designate a stair for fire department operations and the other for occupant evacuation.

Fire Attack Stair: The designating and announcing to all responding companies which stair in the building will be used for attacking the fire is the responsibility of the first arriving fire department units on the fire floor. Selecting the safest and most effective stair to utilize for this

purpose will be dependent upon of factors or questions that will need to be quickly answered. They are:

- Location of the fire in relation the stair?
- Does the stair being considered have a standpipe riser within?
- The type of stair? A "*Fire/Smoke Tower*" stair as an example.
- Is it a pressurized stair?
- Which stairways are the occupants currently evacuating from?

After an Attack Stair has been identified, and prior to opening the door to the fire floor to begin the attack, it is critical that members ensure that the stairwell above them is clear from escaping building occupants. Once the door to the fire floor is open, the staircase above will quickly become contaminated with smoke and heat. We (JCFD), as well as several fire departments across the country have approached this concern in several ways.

How to Clear the Attack Stairwell: (*List the options below*)

1.

2.

3.

4.

5.

Evacuation Stair: Fire Departments must take the same aggressive approach with the designating and announcing of the Evacuation Stair as they do with designating and announcing the Attack Stair. The primary function of this stairwell is to provide a smoke free area for building occupants to descend. Building and incident information to consider in identifying and utilizing a designated stair as an Evacuation stair includes:

- *Fire/Smoke tower/stairwell:* This stair type was designed for the purpose of providing a smoke free environment throughout the vertical height of the building. If they are present, utilize them for this purpose.
- *Remote stair*: Barring the presence of a Fire/Smoke stair, next consideration is to select the stair most remote from the fire. Once information is received on where the fire is located on the floor, Incident Commanders will generally assign the closest stair to the

fire as the Attack Stair, with the most remote from the fire as the Evacuation Stair. It makes good sense.

- *Public Address System*: While advising building occupants which stair they need to avoid, repeated messages from public address system advising which stair they need to use for building evacuation is a must. Again, by advising the building occupants through an in-house communication system you can reach a larger number of occupants more quickly.
- *Do not open the door:* At no time during the evacuation process can any fire department members open the door from the evacuation stair onto the fire floor. In the event a member or a confused civilian does so, the stairwell will become contaminated with smoke compromising the safety of any civilians within.

Initial Operating Procedures

Upon arrival of the first arriving Engine/Ladder or Chief:

- Look up for any fire and smoke showing.
- Attempt to view all sides of the building.
- During the evening and during cloud/fog, rain, snow events, use your TIC - Look Up.
- Report any visible smoke or fire showing from an upper floor.
- **Note:** The wind at street level may not be an adequate indicator of the wind at an upper level.
- Establish Command - Most departments including my own will establish command in the lobby unless the location of the fire or other factors prohibit its use.
- Upon entering the lobby, obtain as much information as possible from the Fire Safety Manager, Building Security, Building Engineer, and fire alarm panel. Review the following.

Lobby/Building intelligence

From Building Staff:

* *Location of the smoke/fire, if known.*
* *Phone calls from tenants/occupants to the lobby and information being reported.*
* *If any access stairs serve or leave from the reported fire floor.*
* *Evacuation procedures implemented, if any.*

Recommended Evacuation guide: C/1 - Residential HR: defend in-place

C/1 - Commercial HR: 3 floors (FF/FA/FB)

NOTES:

* *Current status of HVAC system.*
* *Elevator status.*
* *Elevator banks and the floors they service.*
* *If necessary, location of fire service keys for elevator use.*
* *Verify automatic stair doors are unlocked.*
* *Identify stair pressurization activation (if present)*
* *Type of stairs within the building.*
* *Cross reference the above with your Building Information Cards.*
* *View Security Cameras.*

From the Alarm panel:

* *Type of alarm* - Is it a smoke detector, water flow, manual pull station?
* *Multiple devices, are there multiple devices activated?* Examples: Smoke and water flow in the same area, as compared to water flow and no smoke in the same area. Each example tells you something different.
* *Multiple locations* - Are there multiple devices sounding on multiple levels?
* *Alarm location* - If an alarm is indicating the elevator machinery room, be prepared for a shunt trip of the building's elevators or at least the banks served by that equipment room.
* *Is the building fire pump activated?* This information may or may not be available from this location.

*** Note:** As companies work their way up, periodically view the panel for any changing or new information. Many of our newer high-rise building have computer generated information that can provide a history on the alarm activation. If you have multiple sources indicating smoke throughout, look at the alarm history and identify the initial alarm location. This is probably where your fire is, or at least originated from.

Now, the above may seem overwhelming, and at times it can be. What greatly helps us is a dedicated Fire Safety Manager at the front desk who will offer all if not most of this information before you need to ask for it. If your city or town does not require this position, then the responsibility regarding obtaining any/all information belongs to the first arriving fire officer.

First arriving Engine and Ladder Company

If a Chief Officer is not one of the first arriving units to arrive, the first due engine and ladder company need to quickly review the information and then start up! Once information is obtained and initial direction is given to building personnel, resources need to start moving up. Once the engine and ladder arrive on the building's upper floors, they can inform all the fire's location, the designated attack stair, start the hose stretch, and immediately return an elevator car to the lobby. If the first due chief officer is delayed, the first due engine and ladder can simply *"pass command*" to the second arriving engine or ladder company so they can coordinate the remainder of the responding units. The coordination of the remaining companies responding in will be enhanced based on the information provided by the first due engine and ladder company up stairs.

Note: *After much research and actual use, if the Battalion Chief is delayed in Jersey City, the first due engine and ladder will pass command to the second arriving ladder company. With 4 engines and two ladder companies "initially" responding into the incident, our goal is to get 2 engine companies and a ladder company up stairs as soon as possible to go to work.*

How do we get up there?

- If the fire is within six floors of the lobby or sky lobby, walk up the stairs.
- If the reported smoke or fire are 7 floors above the lobby or sky lobby, members are to use a fire service equipped elevator and proceed up to "*two floors*" below the lowest floor

reporting smoke or fire. Again, we need to be mindful of duplex and triplex style apartments as well as the weather (*Reverse Stack effect*). All of which may require you to add a 3rd. floor as a buffer when exiting the elevator.

- If you accessed the upper floors via an elevator, confirm the fire floor/location then return the elevator to the lobby with a radio equipped firefighter. *(In Jersey City, it is a member of the Ladder Company*.) Having a firefighter return with the elevator car ensures control from within the car and immediate vertical movement of additional resources.
- In a residential high-rise building, the Ladder Company should recon the floor below to assess the stack/reverse stack effect (*movement of air*) from the stair well on to or out of the floor. If you are not within a neutral pressure plane, the stack/reverse stack can greatly affect the movement of air in and out of the stairwell. When responding and arriving at a residential high-rise building with information indicating which apartment is on fire, view and if possible, even enter into the apartment on the floor below. (*Example: fire reported in 23 B, view 22 B*) This will help members find the apartment on the fire floor, get an idea on the apartment's lay-out as well as allow you to select the best/closet stair for the fire attack.
- Select a stairway with a standpipe that will provide the best attack on the fire. This will require that a stairway be designated as an Attack Stair and announced to Command.
- Report heat and smoke conditions on the fire floor.
- The Ladder Company officer must initiate a disciplined approach on the fire floor as it relates to stair/hallway door control. Controlling/limiting the fire's potential movement is critical.
- The Ladder Company will need to determine the life hazard on the fire floor and if possible, initiate the primary search of the hallway, fire apartment, etc.
- Floor plan and square footage may require a more disciplined search with search ropes and air management. This should be a requirement in your commercial office high-rise buildings.
- Hookup to the standpipe outlet on the floor below the fire floor and stretch up to the fire floor/apartment. Ensure that the riser outlet is not obstructed or restricted in any way.
- *Standpipe Operations:* Much has been written and discussed over the years on equipment use, size hose line and nozzle type. So, here is mine.

Standpipe Operations

Once the Attack Stair had been designated and announced:

- Flush system
- Attach gate valve/elbow and in-line pressure gauge to the riser. But before you do……..

- If present, remove or adjust any pressure restriction valves (PRV) or pressure restriction devices (PRD). *Fill in the following from class information.*
- Pressure reducing valves:
- Pressure reducing devices:
- Be prepared to stretch three to four lengths of either 2 inch or 2-1/2-inch hose with a smooth bore nozzle.
- Assess the hallway. Determine and inform your members if you are doing a "*wet stretch*" or a "*dry stretch*." This is important!

✓ ***Wet Stretch*** - If there is smoke in the hallway due to the probability of the fire apartment door being left open or ajar, members must flake their hose in the staircase, charge the hose line in the stair well, flow the hose line to set the pressure, then stretch down the hallway to the fire apartment and extinguish the fire.

✓ ***Dry Stretch*** - If there is no smoke in the hallway and it appears the fire apartment door is still closed, stretch dry down the hallway to the door. Call for water from the riser/control firefighter. Flow the hose line to set the pressure. Force the door in conjunction with the first arriving ladder company. Extinguish the fire.

- While the engine company(s) is/are preparing the stretch, a ladder company member(s) must attempt to clear the Attack Stairway for at least 3-5 floors above the fire floor of any building occupants who maybe in the stairwell.
- When hose line is being flowed, set riser outlet pressure based on the following:
  150 feet of 2.0-inch hose with a 1-inch smooth bore nozzle = 85 psi
  150 feet of 2.5-inch hose with a 1-1/8 tip smooth bore nozzle = 70 psi
- Provide Command with a CAN report. (*Conditions, Actions, Needs*)

First due Engine Company Chauffeur/Engineer

- Establish/obtain a water supply and augment the standpipe/sprinkler system as per standard operational guidelines. *See a suggested guide in "Supplying the FDC."*
- Determine if fire pump is activated. When feasible, determine pump-operating pressure.
- Stretch a minimum of two, 2-1/2-inch hose lines into F.D.C. or one hose line into the FDC and the other into the first-floor outlet.
- For all high-pressure pumping, (*above 250 psi*) hose lines must be connected to the right side of the apparatus away from the apparatus pump/control panel.
- Be mindful of falling glass from the upper floors.
- *Tandem Pumping*: Under a two-engine company, two stage pump concept, a single engine company establishes water at a nearby hydrant and then pushes water through a 5-inch supply line to another engine company supplying the building's fire department connections. We refer to this as the Supply Pumper and the Operating Pumper. In a tandem pumping concept, the engine company at the water source should operate in volume (*pump impellers in parallel position*) and the engine company operating at the FDC should be in pressure *(pump impellers in series position*). This is considered by many of the hydraulic experts in the fire service as one of the most efficient means of establishing and moving "*big*" water.
- Still within the Tandem Pumping concept, if we are attempting to supply and push water above the 12 th. floor in a high-rise structure, we require both engine companies to operate in pressure. (*pump impellers in series position).* This will greatly assist with the height challenges.

Supplying the FDC

The building's fire pumps are an asset in structures of this design and type, but they too have limitations that we in the fire service must be prepared to deal with. Prior to 1993, NFPA 14 required the building's fire pumps to deliver their rated capacity at a pressure of 50 psi at the highest floor hose outlet. A relief valve placed within the system is required at the fire pump, limiting that pressure to 15 psi above that required to deliver its rated capacity at 50 psi. This allows for a maximum total of 65 psi to the highest floor outlet. In high-rise buildings designed and built since 1993, NFPA 14 now requires 100 psi at the required flow rate at the most remote outlet. But is this a true figure that can be counted on at the end of the nozzle? Namely because of the above listed restrictions, the building's fire pumps may not be capable of supplying adequate flows to hose lines, especially if inadequate and improper hose diameters and nozzles are being used. In addition, it is also important to note that the building's primary water supply to the standpipe system may be a gravity tank. In this situation there may be inadequate head pressures supplied to the upper floor outlets supplied by the gravity tank. In newer and more recent installations, gravity tanks are required to have a booster pump to supply the floor in which they are located, as well as several floors immediately below.

When do we supply the FDC?

Information from the fire floor: Regardless of the area or building, if upon arrival we have fire showing from several windows on the upper floor, your anticipation of the water supply needs on the fire floor will require you to start water up. So, do so, but make sure you are actually moving water, so you do not burn out your pumps. If other situations where nothing is showing, pump chauffeurs can stretch into the FDC and wait for the call for water from the fire floor before engaging their pumps. But let us consider all the following before going any further.

Pressure from a municipal water supply augmented by the buildings fire pump may *"initially"* be enough for the fire department's needs. Barring any mechanical failures of the system, we should expect to be able to stretch and operate two hose lines from a newer designed and maintained system without use of FD augmented water. But as you know, things do not always work the way we hoped. So, we need to ask and answer two important questions: When do we supply the system and if we do, how do we assess if we are actually moving water and not burning out our pumps?

It is important to understand that the municipal water augmented by the fire pump will exert pressure in the system. If an engine company attempts to supply the FDC, they will need to exceed the pressure generated by the municipal water, the fire pump, and any head pressure in the piping in the system. If the fire department pumper is not moving water to overcome the system side, you will rapidly cause the apparatus pump to overheat. For this reason, some fire departments require their engine companies to stretch their hose lines into the FDC and await further orders before flowing water. A viable option. However, if you approach a high-rise building with fire showing in the sky, your education and experience is telling you that the members are going to need "*good water*" on the fire floor to supply multiple hose lines. At this point, the option of waiting for the frantic call for more water, no longer makes sense. In the situation described, engine company chauffeurs should start water into the FDC following floor/flow chart as listed below. But once they do, they need to constantly assess the water's movement. So, we instruct and advise our members to use the following as their guide.

- ***Circulating the water:*** As soon as the pump on your apparatus is engaged, the internal pump components are turning creating heat due to close tolerances designed into the engineering of the pump. Standard operating procedures should include circulating water by fully opening the tank to pump valve and opening the tank fill a third to half-way. By doing this, the water is moved from the on-board tank to the pump making a circle back to the tank. Throughout the water's movement, it forms a thin cushion between the moving and stationary parts of the pump and absorbs heat being created by the moving parts. Hydraulics experts suggest that you need to move at least 100 gpm to prevent a pump from overheating. This will help meet that goal.
- ***Moving water to the FDC*****:** Once the pump is engaged and supplying water to the FDC, slowly close the discharge valve(s) to the hose lines that are flowing water into the FDC. If you are moving water in and up into the building, the pressures on the individual "*discharge*" valve(s) will drop, and the residual pressure on the pump's "*intake*" gauge will rise because less water is flowing through the pump. If all pressures remain the same as you begin to close the discharge valves, you are NOT moving water! So, what do we do here? Shut down the pump? No, not necessarily. Doing this may create a significant delay in re-establishing enough water to the buildings upper floor if/when needed, possibly forcing a retreat by attack crews, and even injuring members.

- ***Storm Sewer Assessment Line (SSAL):*** This is an oldie but a goody. Stretch an additional 2-1/2 hose line with no nozzle into a nearby storm sewer. Do not forget to secure the hose line before charging it. Flow water through the storm sewer line. Again, all you need to move is 100 gpm. At the same time, charge the hose lines that are supplying the FDC. Once there is a demand at the FDC you will notice a drop-in discharge pressure on the 2-1/2 hose line in the sewer. If the water stops moving to the FDC, the storm sewer hose line will increase in pressure.
- ***Steamer connection****:* Continually check/feel the steamer connection on the pump panel for excessive heat. If it is hot to the touch, you are starting to boil water!

Once a need for water from the fire department engine companies is clearly identified, supply both hose lines starting at 100 psi plus 5 psi for each story above grade. Keep in mind that some building floor heights will range from to 10 to 12 feet. As a reminder, the recommendation of 5 psi per floor is based on the calculation that it takes 4.34 psi to raise a column of water 10 feet. Also keep in mind that some building lobbies and mezzanines are equal the height of a three-story building. *The height/floor/feet references must be added into your math. This piece of building intelligence is critical.*

FIRE FLOORS	PRESSURES
1 - 10	100 - 150
11 - 20	150 - 200
21 - 30	200 - 250
31 - 40	250 - 300
41 - 50	300 - 350
51 - 60	350 - 400
61 - 70	400 - 450
71 - 80	450 - 500
81 - 90	500 - 550

First Arriving Chief Officer

- Review building/alarm information as noted above.
- Assume/establish Command.
- If the first due engine and ladder have already started up, establish contact, and obtain the following information:

✓ *Fire floor/apartment location.*

✓ *Attack stair being used.*

✓ *Status/progress of the first deployed hose line.*

✓ *Status on the search.*

✓ *Occupant hallway/stairway/evacuation issues.*

✓ *Smoke/ventilation challenges.*

✓ *Any other immediate needs or concerns.*

- Confirm/establish command and tactical radio frequencies for the incident.
- Start up the second due engine and ladder company via the FFer controlled elevator.
- Have the second ladder company return "*another*" FFer controlled elevator to the lobby.
- Assign remaining companies on the initial alarm to fill operational duties.
- Transmit an additional alarm(s) and prepared to fully staff Operations, Logistic, and Search/Evacuation positions and duties with your additional resources.
- *See a comprehensive Command and Control Plan for the Chief in the following section.*

Initial assignments - Second due Engine Company

- Report to the Lobby Command Post for accountability and assignment.
- Determine if the fire floor has been verified by the first due engine and ladder company.
- Proceed to the location of the first due engine company via a fire service elevator, or if the fire is within six floors of the lobby or sky lobby, walk up.
- Assist the first due engine company with the initial hose stretch. This is also critical. Additional members may be required to ensure that the first hose line is stretched to its intended location. All efforts must focus around getting water on the fire.
- The second due engine company officer's job/duty is to ensure adequate flow to the initial hose line from standpipe outlet by viewing the in-line pressure gauge. If additional

pressure is needed, advise the Operations Officer and/or Command.

- If not needed with initial hose stretch, stretch a backup hose line. The second stretched hose line must ensure the safety of those members operating on the fire floor.
- Provide a CAN report to the Operations Officer and/or Command.

Initial assignments - Second due Ladder Company

- Report into the lobby command post.
- Proceed to the floor below the fire via the fire service elevator.
- Return another/second FFer controlled elevator to the lobby.
- Confer with first due ladder company on areas to be searched, location of the fire, ventilation control needs/options.
- Coordinate operations on the fire floor with the first due ladder company.
- Report core type *(if present*) other stair types, and their locations.
- Primary search on floor and staircases above the fire.
- Check for fire extension as well as CO on the floor above the fire.

Command and Control

1. *Establish the Command Post.* This may vary from fire-to-fire department, but either the first or second arriving engine company should establish command prior to the arrival of the chief officer. If your procedure is for the first arriving engine and ladder company to quickly gather information and start up, they must advise arriving units and pass command to the second arriving engine or ladder company prior to the arrival of a chief officer.

Our suggestion is to establish command in the lobby of your high-rise buildings. The Incident Commander must secure control and operation of the lobby area and the building's fire command center. If present, this is where you will have access to the building's fire safety director, the building engineer as well as to the building's systems.

2. *Determining and verifying the fire floor*. Knowing the actual floor where the fire is located is initially the most important piece of information the fire ground commander must receive. This piece of information will influence all other decisions from the command post. Upon arrival, companies should seek preliminary information from the alarm activation, the fire safety manager, building management, or building security. Initially, this information may be sketchy unless fire is showing from the exterior.

3. *Gain control of the building systems.* It is vital when fire department operations can no longer be considered ground based, that we gain control of all building systems that could influence fire and smoke conditions as well as fire department operations. Upon arrival, we must access and control these systems. But as the incident grows in size and complexity, these same areas can be managed and overseen by the Logistic members within your command structure. Building systems that must be controlled include the following:

- *HVAC system(s)* – The fire department must determine the status of all the HVAC systems in the building. This is to include Mechanical Equipment Room (MER) floor(s) and zones they supply. Any systems that have not been automatically shut down must be manually shut down. This is to include supply and return fans of each affected area.
- *Elevators* – The fire department must ensure that all the building's elevators are recalled to the lobby or sky lobby through Phase 1 operations. It also critical to note and identify which elevators serve what floors. Fire department members should attempt to identify which elevator bank(s) are covered by an emergency generator service in the event of a power loss. Only elevators with fire service operations should be used.
- *Fire pumps/standpipe systems/sprinkler systems* – Determine the location of the fire pump room. A fire department member must accompany a building engineer to the fire pump room to assist with their operation, as well as establish communications with the Operations or Command Post. The fire pumps must be operated in coordination with the Operations or Incident Commander's requests.
- *Communications* – Communications at any fire scene is critical for an effective, efficient, and safe outcome. In a building of great height, it becomes more of a concern. It is important to gain access to all means available. Whether they are fire department radios, hard wire communications, in-house telephones, or cell phones, establishing a primary

and secondary communications link for all designated areas is critical. Focus efforts around establishing *command and tactical radio frequencies* for the incident.

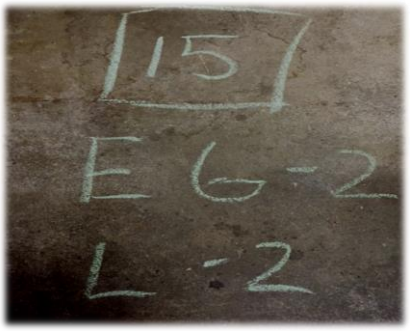
4. *Establish and Staff Fire Operations position.* The Operations Officer will establish this position generally one or two floors below the fire floor. The variation between one or two or more floors below is dictated by tenable conditions which may be affected by a reverse stack effect within the building. It becomes the responsibility of the Operations Chief to establish a communications link with the incident command post. Their initial report should include:

- *The location and size of the fire.*
- *The attack stair being used.*
- *The progress of the first deployed hose line.*
- *The status of the search.*
- *Vent/smoke movement challenges.*
- *Any additional resources needed.*

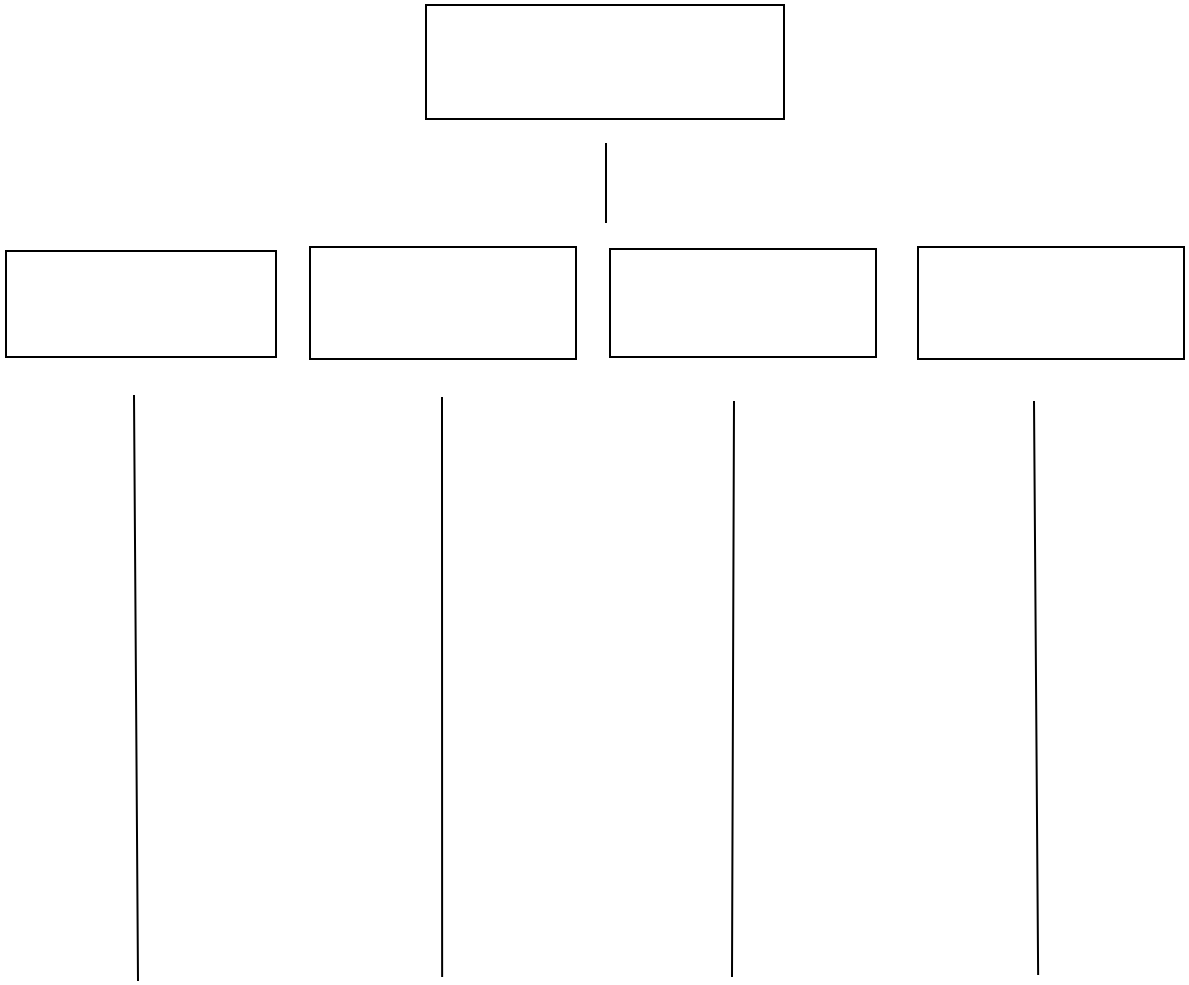
The initial fire attack should begin with a minimum of an engine and ladder company, preferably with two engines and a ladder company. As the incident continues, the chief in charge of Operations (*fire attack*) must control and coordinate all units operating on the fire floor and floor above. In addition to the fire attack, this officer must also be prepared to coordinate any attempts at pressurizing the attack stairs, controlling the ventilation and smoke movement, as well as the search of the fire floor and floor above. He/she must also advise command of any problems encountered as well as anticipated and establish communications with the staging area once it has been established.

On a personal note, unless you have an aide or assistant with you, the assigning and tracking of resources on the fire floor and floor above can be taxing. Shy of having a clip board and work sheet handy, we suggested our Battalion Chiefs keep a piece of chalk in the pockets of their coats. Yes, I said chalk. A large piece of construction chalk a mason would use makes a difference. Simply writing on the wall in stairwell the companies assigned to you and where you are placing them helps with management and accountability. Do not laugh, it works!

See the next page.



Starting to manage your incident.



5. *Begin the evacuation process*. Begin by evacuating those people who are in immediate danger. Those priority areas will include the fire floor and the floor above if necessary. I say if necessary because in our residential high-rise fires it is often best to leave well enough alone and direct residents to protect in place. Stay in their apartments! However, as nice as this sounds, in many instances' occupants will have begun self-initiated evacuation by leaving an area by any means possible. Until control can be obtained and people properly directed, members must be alert to the possibility of civilians who entered the attack stair.

6. *Establish Staging Area(s).* As operations and the fire floor will dictate, an Interior Staging area should be established one floor below the Operations Post. This area should be of adequate space to hold units and equipment in reserve and have direct accessibility to the operations floor and fire area. In addition to the Interior Staging Area, and Outside Staging Area should also be established in a designated area outside and away from your building.

7. *Establish and staff a Logistics Section.* Due to the demand that these buildings will present, a compliment of members should be assigned and become directly responsible for supporting all the incident's needs. This is a large area of responsibility that requires a significant assignment and delegation of resources. With this responsibility, several departments researched including my own have a dedicated list of responsibilities. But with that said, due to the amount of work that needs to be done in this area, we further defined the Logistics needs into two distinct groups: *The Lobby Support Group and the Fire Support Group*.

Lobby Support Group

- Control all building access and egress points.
- Control, close doors into the lobby and staircases which could affect the buildings air movement. *(stack and reverse effect*)
- Divide lobby - Stage awaiting FD units. Direct occupants/evacuees to safe areas/exits.
- Assist with firefighter accountability.
- Gain control and accountability of the building's elevators.
- Gain control of building communications.
- Establish additional communication links for use by FD members.
- Make public address announcements as directed by the Incident Commander.

- Assign members to monitor and report on building and alarm detection/suppression systems.
- Direct personnel to correct stair/elevators.

Fire Support Group

- Assemble all the necessary tools and equipment that will be needed.
- Immediate needs should focus around additional SCBA cylinders, positive pressure fans, additional hose, and high-rise nozzles (HRN) as a minimum.
- Gain control and accountability of an elevator to assist with equipment movement.
- Establish a Stairwell Support Team in the event elevators become inoperative.
- Ensure that all the necessary equipment is getting to the designated staging area.
- Be ready to operate tools and equipment and pressurize the Attack Stair as directed by the Incident Commander and Operations officer.
- ***Pressurizing stairs*:** In the event your high-rise building does not have ability to pressurize its own stair wells, fire departments have introduced procedures into their operations to place portable, positive pressure fans at the base as well as into stairwells to control smoke movement. As in any operation, there needs to be guidelines that must be followed.
- Establish contact with the building engineer, security, maintenance, and the fire safety manager. Coordinate these people with the Incident Commanders questions and needs. Examples will include control of the buildings HVAC system(s), the status and operation of the buildings fire pumps, etc.

8. ***Establish and staff a Search and Evacuation Position*** - The officer and members assigned to this position are generally responsible for the floors and staircases above *"the floor above the fire"* all the way up to the roof. That means if the fire is on the 25th floor, the S&E will be responsible for floors 27 to the roof. Depending upon the height of the building and the stack effect at the time of the fire, this can initially be an overwhelming list of duties. Research and our own procedures suggest that you place the S&E post five floors above the fire. Again, fire conditions and the buildings stack effect can affect this location. But we must add at this point is the type of high-rise buildings. Due to the lack of compartmentation of a commercial office high-

rise building, assigning firefighters above the fire must come with additional considerations. With that being said, the first question that needs to be asked and answered prior to the establishment of the post is, "*what are the fire conditions on the floor*"? Sending members above an out-of-control fire in a large open floor space designed building must come with great consideration. Initial attempts should focus around clearing the Attack stairwell and assigning resources to move "*big water*" onto the fire floor to slow/control the fire. The next question must be, *what is the safest way to move resources up above*? For the answer to this question, we must go back to the elevators within the building. Specifically, how many do we have? What floors do they serve? What bank has a blind shaft that can safely take us past the fire floor?
Now at this point, I know what you are saying; "*what if we don't have the luxury of a blind shaft that can take us past the fire floor"?* If this is the case, then you are obviously going to need to use the stairs, but which one? The obvious answer would need to be the Evacuation Stair. A controlled Evacuation Stair will allow members to move up in a smoke free environment. The fact remains, we are responsible for the entire building. We need to assign members to the floors and stairwells above the fire as soon as it possible.

9. ***Establishment of an EMS and Rehabilitation post*** – This area is assigned to your Emergency Medical personnel and established at least one floor below the interior staging post. Depending upon the access and the spaces provided, it is generally not advisable to place this same post within the staging area. Confusion will be eliminated, and responsibilities will be more defined if they are separate from one another.

10. ***Establish a Safety Officer(s) and a Rapid Intervention Company(s).*** Depending upon the size and complexity of the incident, a minimum of one, preferably two safety officers with several assistants may need to be established. Initially, interior safety should be established at the Operations Post to assess fire conditions and operations on the fire floor and floor above. An exterior safety officer should also be established to monitor exterior hazards to firefighters and to escaping building occupants. Some departments may substitute this individual with a Street Vent Coordinator or use these individuals in coordination with each other.
It is also critical that *at least one* company, preferably more, be established as a rapid intervention company. Their location should be at the Operations Post in the event of a lost or trapped firefighter needs assistance.

11. ***Establish a Street Vent Coordinator.*** This is one of those positions where you wish you had the extra people to establish the position. Their assignment and responsibilities are directly related to the life safety concerns of the incident. Being able to control the evacuation away from the affected exposed side, as well as observe and report wind and fire conditions could greatly affect the outcome of the incident.

12. ***Establish a Planning Officer***. This is a key position in the management of a high-rise building fire. In several cities researched, once a higher-ranking chief (*Deputy Chief*) arrives and assumes command at the scene of a high-rise fire, he often re-assigns the Battalion Chief to the Planning Section. This makes good sense simply because the Battalion Chief will have already initiated an attack plan, reviewed, and evaluated building systems, and already consulted building staff on several issues. Keeping the Battalion Chief with you and assigning him as the Planning Chief with several additional duties listed below helps streamline the information and continued movement of the initial attack plan. But once again this all depends upon staffing. In Jersey City more times than not, I will move the Battalion Chief upstairs in a residential high-rise fire after there is an adequate exchange of information. I am more inclined to keeping the first arriving Battalion Chief at the Command Post with me and assigning him the Planning position when arriving and working at a fire in a commercial high-rise.

Planning Chief responsibilities

- The gathering, analyzing, updating, and processing of information. This will include the HVAC system, fire pumps, communications, building evacuations, etc.
- To do the above responsibility efficiently and effectively, the Planning Officer will need to meet and consult with building technical specialist. This will include building engineers, Fire Safety manager, building security, etc.
- Identifying resources operating, staged, and needed.
- Evaluating the current strategy
- Developing an alternative strategy. (*Plan B*)
- Reviewing and preparing the HVAC strategy and plan.
- The maintaining and displaying of situation status.

- When necessary, the preparation and implementation of rotating and replacing resources for an extended operational period(s).
- The preparation and implementation of a demobilization plan.

Smoke Management/Control – Stack, Reverse Stack, and Stratification

Smoke/Air and Stack effect

Experience continually reminds us that as smoke is given off from a fire, it moves up and away from its source seeking vertical openings in the building. This vertical climb is generally limited by the openings in the building and the heat being given off by the fire itself. But as tall as the structure may be, and as open as the vertical arteries are, smoke, heat and air flow could be influenced by several factors.

***Stack effect*:** Stack effect is the vertical movement of air, heat and smoke in high-rise structures that is influenced by the temperature differentials between the inside and the outside of a sealed building. Depending upon the temperature differences, the height of the building, the air tightness/leakage of the exterior walls, and the temperature being generated by the fire, smoke can travel extended distances vertically throughout the building. We see the stack effect magnified in a high-rise building most notably during the colder weather when the outside temperature impinging on the exterior of the building is much colder than the temperature on the inside of the building. Also termed "*winter stack*", the exterior cold temperatures provide no resistance or impact on the warmer inside temperatures. If anything, they enhance its vertical movement. Once the inside of the structure is heated, smoke and carbon monoxide from a fire jumps on a vertical raceway of convected heat within the building traveling many floors above the fire's origin. This becomes quickly evident to those who take notice of the air "*whistling*" rushing past them and "*into the building*" as they open doors and enter the lobby from the street level during any cold weather. This influx of air, also referred to as *"make-up air"* can even prevent elevator and stairwell doors from fully closing without the assistance of a firefighters. Air rushing into the building at a lower level creates a negative pressure below the buildings neutral pressure plane and positive pressure above the neutral pressure plane.

To define this area within the building as simply as I can, the "*neutral pressure plane"* is an area (several *floors*) where the inside and outside pressure is the same or as close as the temperature differentials will allow. In many air flow assessments, this area is generally considered to be in the middle of the building's height. What generally happens in this area is the pressures somewhat equalize limiting air flow. But as we further define this, the movement of air above and below the neutral pressure plane is further influenced by the core or stair design within the building. As an example, during the winter months, air on the floors below the neutral pressure plan will be drawn off the floors and into the building's center core moving vertically up the elevator shafts and staircases. In the same building, air above the neutral pressure plan will push air out of the building's core and onto the building's upper floors. As you can gather by now, we are referring to a center core designed or commercial office high rise structure. The design of a commercial office high-rise tends to present us with more challenges above and below the neutral pressure plane when compared to our residential high-rise designed structures.

Reverse Stack effect: Smoke within a structure can also unfortunately be pulled down and stratify below the actual fire floor. This condition, referred to as "*reverse stack effect*" or "*summer stack"* is more predominate in the summer months. During these times, warmer outside temperatures on the exterior attempts to heat up the building's interior. Because it is warm outside, building designers and engineers will cool the building's interior to more comfortable levels for the workers and tenants. The cooler temperatures on the inside of the structure will immediately slow down the vertical climb of the heated smoke creating stratification, and in many instances a reversal of smoke and its accompanying CO below the actual fire floor. This again becomes evident when you enter the door from the lobby and a rush of air pushes past you, but this time out into the street, not back into the building as it would during the winter. If we were to go back to our commercial office high-rise building once more, during the summer months, air on the floors above the neutral pressure plan will be drawn into the buildings core into your elevator shafts and staircases. Air below the neutral pressure plan will push air out of the buildings core and onto the building's lower floors.

Fire departments need to have a comprehensive awareness and understanding of how air moves within a high-rise building without complicating it any more than it already is. I say this not only to anticipate the challenges that will be found within the building, but also to take steps

to control the air movement and to minimize its effect. Incident Commanders must expect smoke, carbon monoxide and the accompanying by-products of smoke to concentrate on the building's upper floors during cold weather periods. Additionally, you also need to expect smoke to be drawn down past the actual fire flow during warm weather periods. Controlling lobby and stairwell doors and roof openings, to having a clear understanding of stair pressurization and HVAC design, are just a few of the initial concerns that need to be addressed.

Stratification

As we have already discussed, the height of the building can play a significant role on the building's stack effect. The higher the building, generally the greater the stack effect. But just as conditions can move smoke and deadly gas to the upper floors of a high-rise building, others may limit the vertical movement. When the fire's smoke and gases leave the initial fire area, they are for the most part, hot, buoyant, and under pressure. As these products leave the fire area, the products of combustion could lose their buoyancy and cool as they come in contact with the entrained air and the building's walls and ceilings. This cooling, and ultimate layering of the smoke is referred to as "*stratification*." These pocket areas of layered smoke could consume entire floors remote from the actual fire floor. Many civilians and firefighters have been caught in heavy smoke conditions ten, fifteen to twenty-plus floors above the actual fire floor. Current and future Company and Chief officers must be students of stratification, stack, and reverse stack. Each of which will changes the rules of engagement.

Stay Safe!

The enclosed student hand out is an excerpt from Chapters 9 & 10 from the text "Fire Ground Size-Up" 2nd. Edition.