Building Construction

#1 Reason for knowing building construction and terminology is SAFETY

- What class is building
- What is its fire load
- Potential void spaces
- Compartmentalization of fire
- Potential of Collapse
  - Structural Integrity
- Fire Travel
  - Where it is and Where Its Going
- Roof Type (Ventilation)
- Common Signs of Collapse

Building Construction Classifications

Basic knowledge of how buildings are constructed and how they will react when subjected to fire is of vital importance to every fire officer. A building that is on fire is physically being destroyed. The mission of the fire officer is to determine if it is possible to enter the structure, how long the structure can last under fire conditions, and what strengths the building can offer or what weaknesses may exist. Each type of building will react differently under fire conditions, and certain predictions can be made. As an example, a wood-frame building with a lightweight roof structure of truss rafters can be expected to lose its structural strength faster than a building with a roof structure of standard rafter and ridge board design.

Construction Classifications

Generally, it is not possible to distinguish construction classifications from the exterior of a building. Most often, even the experienced observer must look at the bearing members (wall, floor, and roof assemblies) in order to tell the construction classification. At the end of each section describing different construction classifications we will provide a brief summary describing cues and rules of thumb that correspond with that classification.

FIRE RESISTIVE - TYPE 1

Fire-resistive is a method of construction where all key structural elements that hold the building up will withstand normal fire conditions for a minimum of three hours. The structural elements generally will be reinforced concrete or steel with a fire protection covering applied. In addition the floors will be fire-resistive and designed to limit fire spread. This type of structure has demonstrated fire after fire that it can withstand complete devastation of the contents and still remain structurally sound. While the structural components are a very positive feature, there may be some concerns that a fire officer should be aware of. As an example, fire in many buildings may spread from floor to floor at the area where the outer wall of the building attaches to the floor segments. Many designs provide for a space between the floor and the wall. This area may be closed off with insulation or may be totally open. In addition, the windows are very often the vehicle for fire spread with fire leaping from floor to floor. To manage this problem some architects have staggered the windows or placed eyebrows over the tops of the windows.

Fire-resistive cues--bearing members are either reinforced, poured, or prestressed concrete assemblies or skeletal steel with the steel protected by sufficient layers of drywall or a sprayed-on, fire-resistive coating. Special fire suppression problems for fire officers would include open floor plans, which have large open areas without separations or compartmentation; limited opportunities for ventilating; and high heat levels inside the structure.

Type 1 Favorable Traits

- Most resistant to fire spread
- Structural components DO NOT add to fire spread
- Compartmentalization provided by walls and floors retard spread of fire
- Enclosed stairwells

Type 1 Negative Traits

- Extreme heat from fuel loads, tightness of construction and lack of ventilation during a fire
- Forcible entry usually more difficult
- Sometimes have large open spaces
- Ventilation is often difficult
- Collapse concerns:
  - Spalling of Concrete
  - Suspended Ceilings (collapse under fire and entanglement hazards)

Type 1 Fire Hazards

- Contents of the structure are the biggest fire concern
- Openings in Partitions
  - Doors blocked open or improperly working
  - Elevator shafts (fall hazards and spread of smoke and heat)
  - Utility Chases (fire spread)
- HVAC systems - spreading heat and smoke
- Auto exposure (fire from floor to floor via the outside)
- Drop Ceilings (entanglement, collapse, hidden fire, lots of unknown materials and systems in void above them)
- Compactor / Trash Chutes (common fire problem)

NON COMBUSTIBLE - TYPE 2

Noncombustible is identified as a method of construction where the structural components will not burn, but may be susceptible to early collapse under fire conditions. The walls may be constructed of steel or masonry with steel floor and roof structure. This steel will be unprotected from the products of combustion and may be vulnerable to early failure. This method of construction is very popular in commercial or industrial structures. While the structural elements will not contribute to the fuel load, unprotected steel will expand as it warms and eventually will not be able to support itself. As it expands, it has the capacity to push walls or to twist and destroy, and may drop the structural members that it was supporting.

The strength of this construction is in the load carrying capacity and the long areas that it can span without support posts. It is an easily constructed type of building with large steel beams or trusses put in place with cranes. Steel is easily attached to other components by bolting, riveting, or welding, and a frame can be assembled quickly. The weakness of this construction is in the reaction to fire conditions where the steel expands and weakens with the potential for collapse. This building is generally considered a candidate for early deterioration under fire conditions. A fire officer must pay close attention to this classification in order to protect the safety of firefighters.

Noncombustible cues--bearing members are made of noncombustible materials such as metal, concrete, stone, etc. Most often these buildings are skeletal steel assemblies where the steel is exposed and unprotected from the effects of fire.

Type 2 Favorable Traits

- Structural components DO NOT add to fire load in structure

Type 2 Negative Traits

- Unprotected steel - exposed and unprotected throughout the structure
  - Support Beams, Columns
  - Angle Iron
  - Lightweight Bar Joists

•Steel Deck Roofs

Type 2 Fire Hazards

•Contents of the structure are the biggest fire concern
•Heat from fire can cause failure of the structural support (bar joists)
•Flat, built up roofs (Failure of the roof = failure of the structure)
•Renovation can add significant combustible elements
•Large open spaces (unlimited fire and smoke spread, increased chance of getting lost or disoriented)
•Drop ceilings (entanglement, collapse, hidden fire, lots of unknown materials and systems in void above them)

ORDINARY - TYPE 3

Ordinary construction is a method of construction that has been termed "Main Street USA." This type of building also gained the name "taxpayer" because the owner would often operate a store on the first floor and live on the second floor. The business would pay the taxes on the property and the utilities while the owner lived in the building virtually free. This building has masonry exterior walls and the floors and roof are wood joist. The structural members for floor joists and roof rafters were often 3" by 10" and typically would span 12' to 14', supported by a post-and-beam arrangement for interior walls. Since many of the streets on which these buildings were constructed were narrow, an effort had to be made to limit collapse of the masonry wall. A technique called "fire cut" would be used, where the end of the floor joist or rafter going into a bearing wall would be cut on an angle so that the bottom of the rafter or joist would be longer than the top. The idea was that when the wood member burned off on the inner portion of the structure it would pull out of the wall and fall into the structure, rather than lifting the wall directly above it and pushing the masonry wall into the street. Through the years these buildings were typically renovated several times with ceilings being dropped, new voids created for new plumbing fixtures, and walls removed between occupancies in order to expand floor space.

The strength of these structures is in the masonry walls and the full-dimension lumber used to construct the floor and roof components. In addition, the floor and roof elements were installed with a fire cut so that they could drop out of the walls without bringing the walls into the street. The number of renovations that the building has had will often cause unexpected fire travel and multiple-floor involvement.

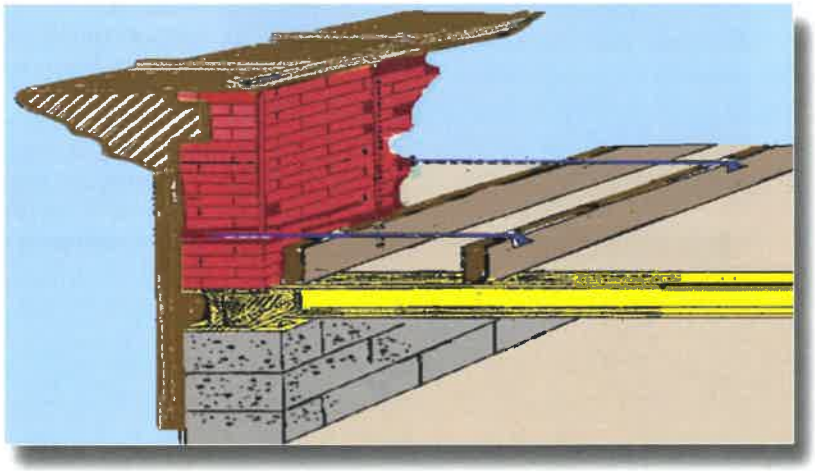
Ordinary (masonry wood joist) cues--these buildings have masonry walls. The floor and roof assemblies are wooden. The floor joists often sit in the masonry walls in sockets that hold the joist ends. To determine whether or not the joists have been firecut, one must normally go to the basement level and examine the first-floor joists where they sit in the wall socket.

Type 3 Favorable Traits

- Brick and concrete structural members will not contribute to the fire spread
- Smaller in square footage than many Type 1 or Type 2 buildings

Type 3 Negative Traits

- Alterations
  - Hybrid building?
    - Was a Type 3 and has been renovated with lightweight members, now is a combination Type 3 and Type 5, may have steel I-beams and lots of lightweight wood with thick brick exterior walls left from the original Type 3 construction
- Concealed void spaces (hidden fire)
- Parapet Walls (parapet wall collapse)
- Drop ceilings (entanglement, collapse, hidden fire, lots of unknown materials and systems in void above them)
- Multiple ceilings (due to energy efficiency and causes more VOIDS)



Type 3 Fire Hazards

- Open stairways (unlimited fire spread)
- Fire and smoke travel through concealed spaces (walls, floors and ceilings)
- Holes in finish materials (drywall, lathe/plaster, etc)
- Interior structural members are combustible
- Structural stability of the exterior walls when building is coming apart from a fire
- Vertical shafts (elevators, light or air shafts, garbage shafts)
- Cocklofts (ATTIC) - usually allows unimpeded fire spread and can be anywhere from 1 foot tall to 4-5 feet tall.

HEAVY TIMBER - TYPE 4

Heavy-timber (mill) is a method of construction utilizing substantial wood structural elements for floor and roof supports along with masonry exterior walls. This method was heavily used in the northeastern United States to construct mills. The mills would often be built near natural sources of waterpower, and would be constructed up to six stories in height. As the exterior walls were constructed of masonry material, they would be wider at the bottom than at the top; walls generally would be smaller for each floor that they were expected to carry. In many of these structures the walls at the ground floor could be up to 36" thick. The structural timber would be a minimum of 8" by 8" and, depending upon the load, they were spaced based upon the load they would be supporting. Under fire conditions the floors and support timbers burn slowly and remain strong for a considerable time. In many of these structures the floors were several inches thick to support heavy machinery and goods. To minimize water damage to floors below, the floors would be equipped with scuppers.

The strength of this type of building is in the size of the wooden structural members that held the floor and roof in place, in addition to the masonry walls. While these buildings often had firewalls with fire doors, they also posed massive fire problems due to large open areas with heavy fire loads, oil-soaked floors, and large quantities of combustible stock. In general, this classification is considered a strong building to work in during fire conditions, but one in which fire can quickly surpass a fire department's ability to suppress

Heavy timber (mill) cues--these buildings have masonry walls. The floors and roof assemblies are wood. The wooden members are much larger than nominal lumber sizes. Look for a minimum of 4" x 6" wood joists, 6" x 8" wood columns, and thick floor decking.

Type 4 Favorable Traits

- Surface to Mass Ratio
  - Large massive timber members slow the early spread and start of fire involving the building
- Lack of Constructed Void Spaces

Type 4 Negative Traits

- Once ignited the structural members add a significant amount of fuel load, heat and heavy fire conditions that rapidly consume the building.
- In buildings used for industrial or storage purposes, they will often have oil soaked floors, cork lined walls / ceilings and combustible stock.
- Large fires may produce flying brands, embers and extreme radiated heat making fire spread to other buildings a concern.

Type 4 Fire Hazards

- Massive amounts of combustible contents in its structural members
- Connections
- Produce large quantities of heat - fire spread and exposure concerns
- Hazardous contents
- Large fires = large collapse (collapse zones very important)

WOOD FRAME - TYPE 5

Wood-frame is a method of construction where the structural components are framed out of wood. The use of a combustible structural element poses a special concern as it will lose its load-carrying capacity as it burns; eventually gravity will take over and pull whatever it was supporting to the ground.

Post-and-beam is a method of wood-frame construction and is typically used in barn construction. A modern method is called "pole barn" construction, where large pressure-treated poles are set into the ground and the framework of the building is hung from these poles. The poles themselves will last considerably longer under fire conditions than the materials used for the roof or walls.

Balloon is a method of wood-frame construction that was popular when long structural materials were available. The common characteristic of this type of building is that the wall studs extend from the foundation of the structure to the roof. When it was time to attach the second floor, the floor joists were simply nailed to the wall studs. This created an open area the entire length of the wall's studs, and across the floors to the opposite side of the building as well. If a fire got into the walls, ceiling, or floor space it was free to go wherever it pleased. Firefighters often tell of being inside the basements of these buildings and shining a light at the foundation with a fellow firefighter in the attic reporting that they saw the light shining through. The interior walls were generally constructed of wood lath over wood studs with plaster attached; the lath was said to resemble kindling, and was arranged in a very desirable manner for rapid fire extension up through a stud channel.

This structure typically used full-dimension lumber, and had close spacing of structural elements. If a fire officer were not correctly reading the building, he/she could quickly become fooled as the fire worked the building in all directions. Extension must be checked aggressively in this type of structure.

Platform is an open method of construction that has been popular since the late 1940s. The structure is built one floor or story at a time. Each floor has a floor deck, sill plate, wall studs, and a plate at the top of the wall. For a fire to travel from one floor to another through the walls, it has a great deal of material in its path to burn through. More often a fire will find another route of extension. Fire may extend via ventilation shafts for dryer, bathroom, and kitchen vents. Areas around plumbing pipes or heating ducts also will be vulnerable to fire extension. Generally the interior wall construction will use drywall material which is inherently fire-resistive and provides for compartmentation of a fire. The weak components most often will be the floor or roof.

Lightweight methods of construction have become popular, with truss construction or a sandwich-beam method of floor or roof support. Generally wooden trusses will be made of smaller dimension lumber, and be held together with metal gusset plate fasteners. Under fire conditions the plates may loosen and the structural integrity of the entire component may be lost. Another technique in use today is the process of ripping a 3/8" or 1/2" groove into a two by four and inserting a piece of 3/8" or 1/2" plywood. The size of the plywood is dependent upon the area to be spanned. These are commonly found in floor joists or as rafters on a flat or limited pitch roof, and are even becoming popular in some strip-mall construction.

The strength of this method of construction is the floor-by-floor method of building. A weakness may very well be the lightweight floor or roof design.

Wood-frame cues--wood-frame buildings normally have a masonry foundation with all floor, wall, and roof assemblies composed of nominal-sized lumber. The great percentage of private, detached dwellings are wood-frame construction.

Type 5 Favorable Traits

These are how we earn our money.

Type 5 Negative Traits

- Open interior stairs (unimpeded fire and smoke spread).
- Collapse
  - Entire structure is readily combustible
  - Small wooden structural members, sometimes no larger than 1-1/2" x 3-1/2".

Type 5 Fire Hazards

- Open stairs
- Unlimited potential for fire extension (building is combustible)
- Balloon Framing
  - Open vertical voids, uninhibited fire spread vertically

- Finished attic spaces / knee walls
- Extension to exposures
  - Close proximity to other dwellings
- Building 'vs' Structure Fire
  - Structure Fire = Reduction in Mass
  - Reduction in Mass = Reduction in Gravity Resistance
  - Reduction in Gravity Resistance = COLLAPSE

Type V: Multi-Family

- Garden Apartments & Multi-Family
  - Check adjacent units/apartments for extension.
  - Common utility chases
  - Common attics
  - May not be sprinklered

Type V: Townhomes

- Townhouses
  - One unit top to bottom
  - Common attics
  - Garages
  - Voids
  - Common Open Interior Stair
  - Access

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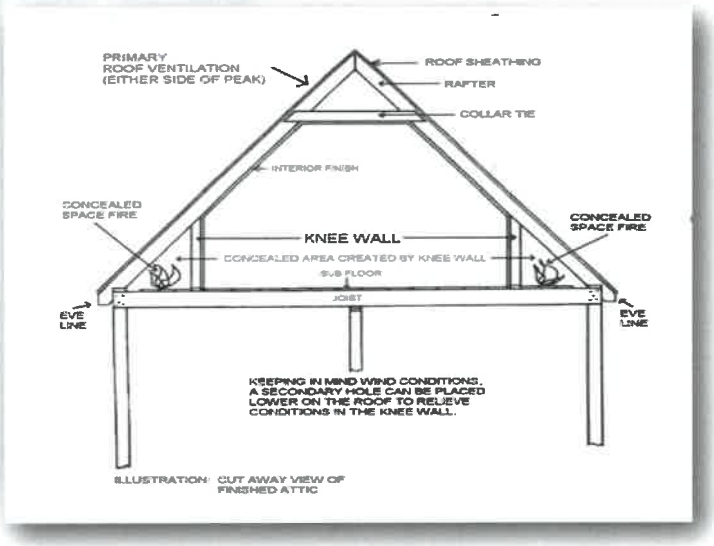
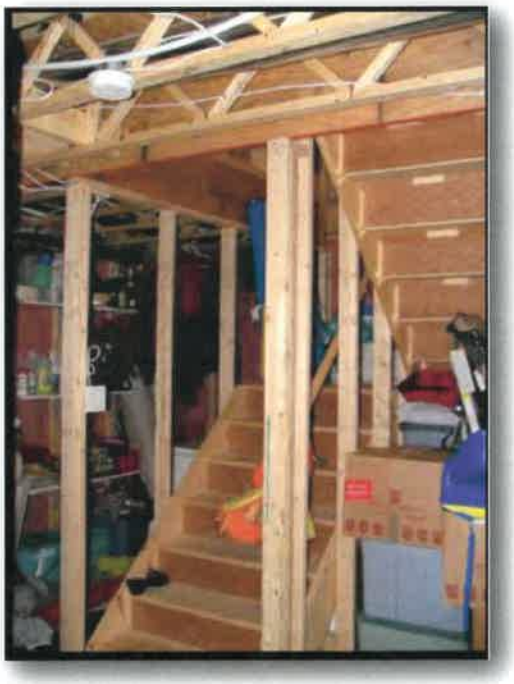
Balloon Framing Examples

Balloon Frame = Fire Extension



Open Unenclosed Stairs = RAPID Fire Extension



Attic / Knee Walls

A knee wall is a short stud wall. These walls can be found in different areas of the home, but are most common in the attic. The height of these walls can vary, but they are normally about three feet high. The studs can be covered with drywall, lath and plaster, and even paneling. Area are created behind these walls that are most often used for storage. Access panels are common so the occupant can gain entry to these areas. Knee walls will run the entire length of the building and will only be interrupted by the stairwell.

Knee walls can be found in buildings of ordinary and wood frame construction. There are two indicators relative to the building that can help you identify the possibility of knee walls during your size-up. One is the presence of a gable roof and the other is the pitch of the roof itself. There must be enough room under the roof to allow the occupants to use the attic for living space. The roof pitch is the amount of vertical rise in inches per foot of horizontal run.

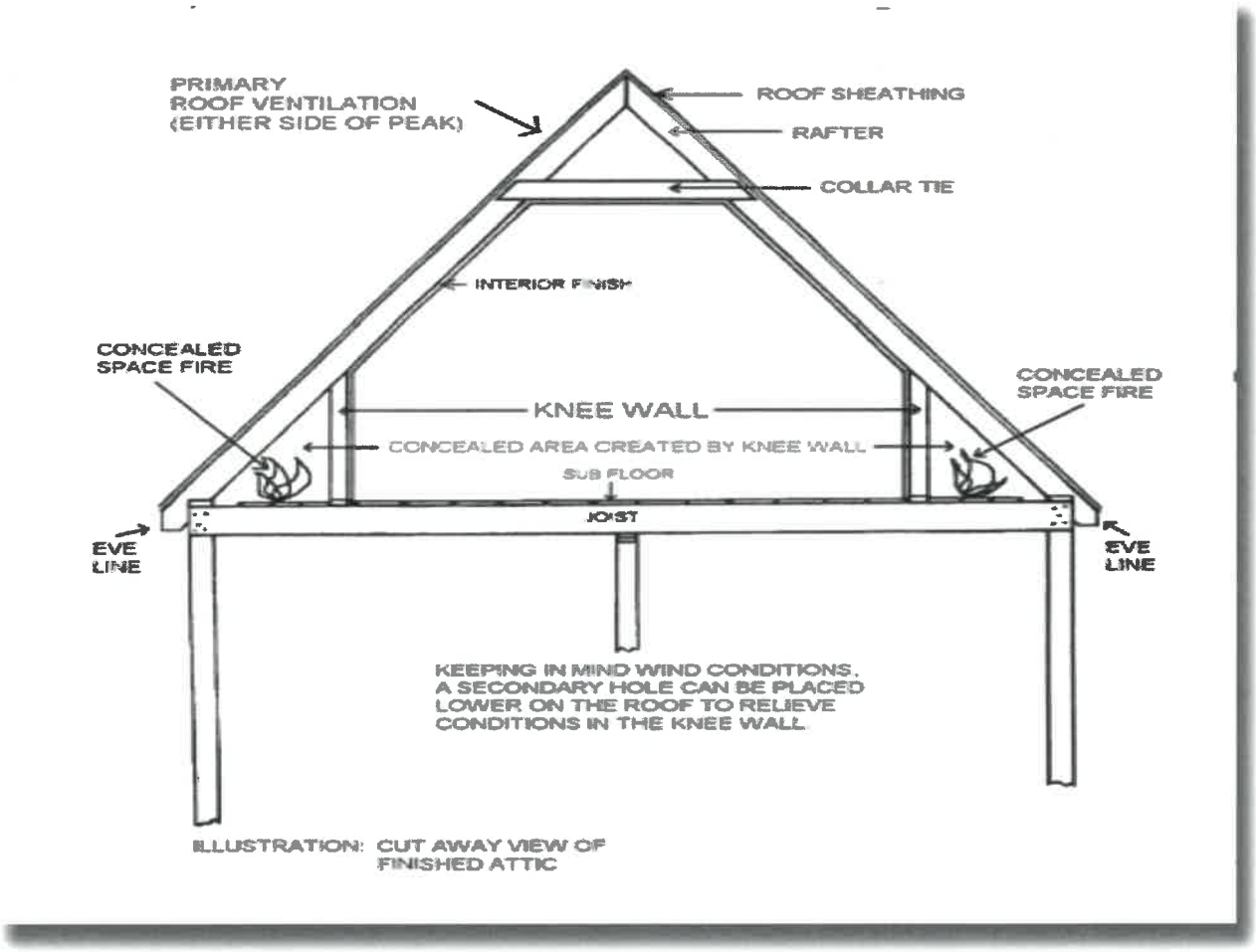
Our concern as firefighters is the vast amount of concealed space created by these walls. Fire can enter the knee-wall area from below through the channels created by joists or by the stud wall channels common to balloon-type construction. This occurs because the entire floor area behind the knee wall is not covered with sub-flooring. This was typically done as a cost-saving measure. Fire growth in both size and intensity can be expected if fire enters this area and its discovery is delayed. When you are assigned to check the attic for fire extension, it is imperative that you check the knee walls. Check both sides of the house and both sides of the stairwell. One important thing to remember: if you have fire in the knee walls, it is possible the fire is already in front of you, behind you and over your head. This occurs when the fire travels throughout the channel created by the knee wall and by the fire traveling up through the rafter channels toward the ridge of the roof. These areas are all identified in the following illustration.

The members conducting extinguishment in an attic area should realize that roof ventilation will help vent the room itself, but will not relieve the fire/smoke in the area behind the knee wall.

To alleviate a dangerous situation, the members who enter the attic area should:

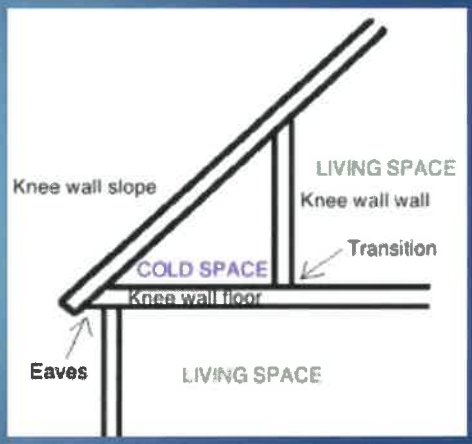
- Have a charged hose line with them.
- Have a radio report from the roof team of what type of conditions are showing on the roof and at the eve line. For example, the roof hole may have moderate smoke and/or fire conditions, but at the eve line (gutters) there may be a heavy push of smoke and/or fire; thus indicating the conditions behind the knee wall.
- When entering these attic areas, an inspection hole should be placed in the knee wall to check the conditions. If fire is encountered, extinguishment can be initiated and members will not have fire traveling behind them.
- If needed and with proper communication between the roof team and interior team, the lower section of the roof can be vented (playing the wind so as not to feed the fire).

Remember: In many of these types of dwellings the attic area is one of our primary concerns of search, **so the search and rescue team must have a charged hose line with them for their safety!** We cannot save lives and property if we become victims ourselves, so let's take a charged hose line with us.



Knee Wall Familiarization

- The term "knee wall" refers to the triangular void space that encloses the lower part of the roof behind an interior wall that is typically three to five feet tall.
- These void spaces can take up a relatively large percentage of the overall interior space in a dwelling and thus can support significant fire growth and lead to very high heat and flashover in the living space.



The Most Common Types of Buildings

While knowledge of the pros and cons of each type of construction type is important, on the fireground you likely will not have the time to initially assess the construction type of all buildings from the street - this may require investigation. In order to simplify this we will review the following:

What Are the Most Common Type of Buildings We Fight Fires In?

- **HOUSES**
  - Private Dwellings
  - Single Family Homes
  - Double Residences
- **MULTIPLE DWELLINGS**
  - Apartments
  - Apartment Buildings / Tenements
  - Dormitories / Hotels
  - Fraternity Houses
  - Townhouses

What are the Most Hazardous Types of Buildings We Fight Fire In - In Terms of FF Fatalities?

- **Stores**
  - Strip Malls
  - Taxpayers
  - Stand-alone buildings
  - Large retail stores
- **Offices**
  - Strip Complexes
  - Professional Buildings
- **Commercial**
  - Manufacturing
  - Storage

- **Other**
  - Churches
  - Mills
  - Multi-Use Buildings

CONSTRUCTION BASICS

Foundations

- Foundation with rock / mortar, concrete block / mortar
- Slab
- Full Basements

Flooring Systems

- Dimensional Wood Joists (2x8, 2x10, 2x12)
- Wood Truss
- Steel Truss
- Wood I-Beam
- Concrete
- Tile Covering
- Wood Covering
- Carpet Covering

LODD – Colerain Twp

- Colerain Twp. FD
  - Captain Robin Broxterman
  - FF Brian Schira

- Floor collapsed due to heavy fire in a basement –
  2" x 10" floor joists

IF THE FIRE IS BELOW YOU.... MOVE WITH CAUTION

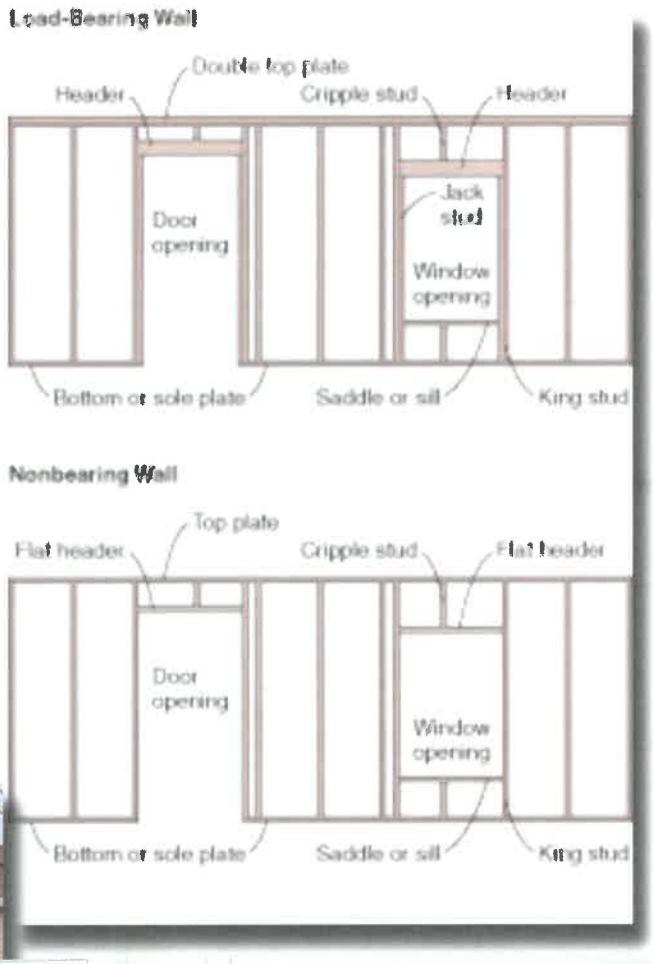
BENCHMARK

203.01

HR COMPANY IDENTIFIES PRESENCE OF LIGHTWEIGHT CONSTRUCTION

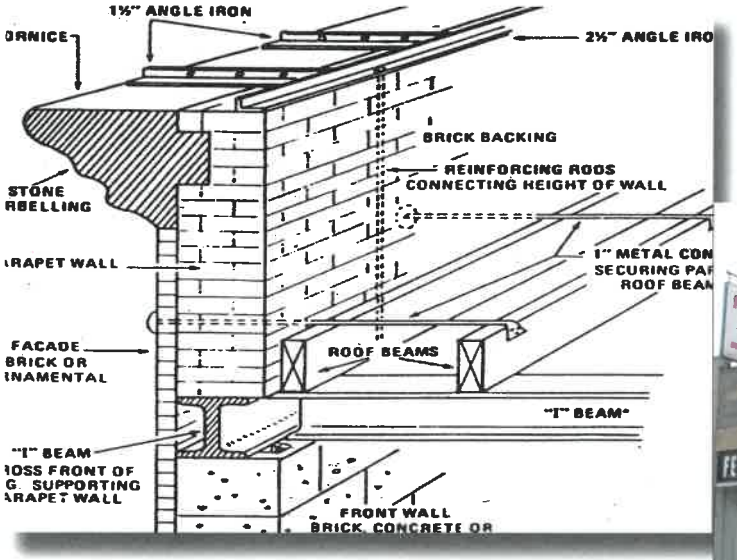
Walls - carry the weight of the building

- Structural Components
  - Platform
  - Balloon Framing
- Materials
  - Wood
  - Metal
  - Masonry
- Type
  - Load Bearing
  - Non Load Bearing
  - Party Wall
  - Fire Walls
  - Parapet Walls
- Sheathing / Covering



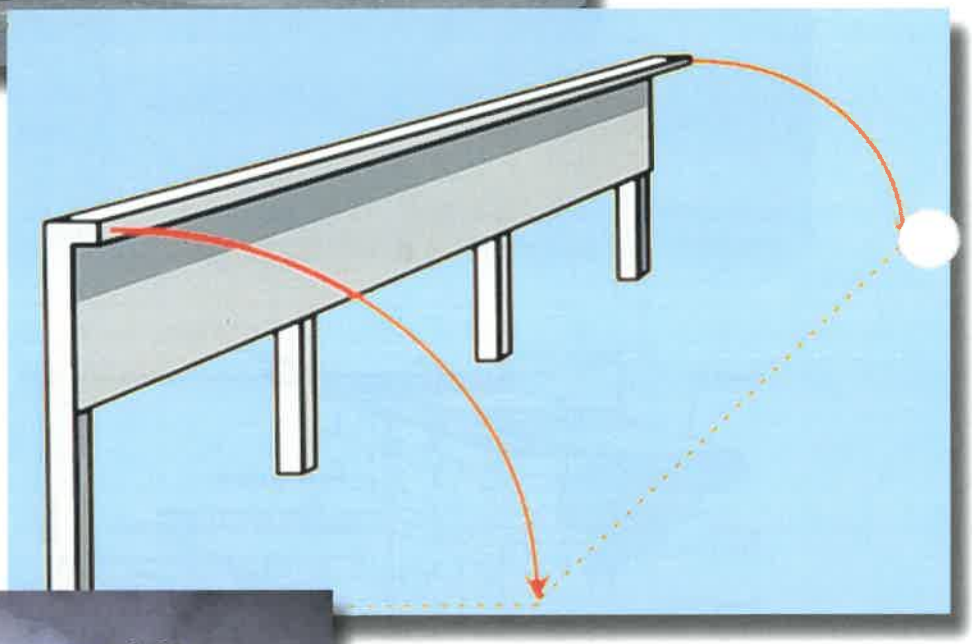
FIRE WALLS

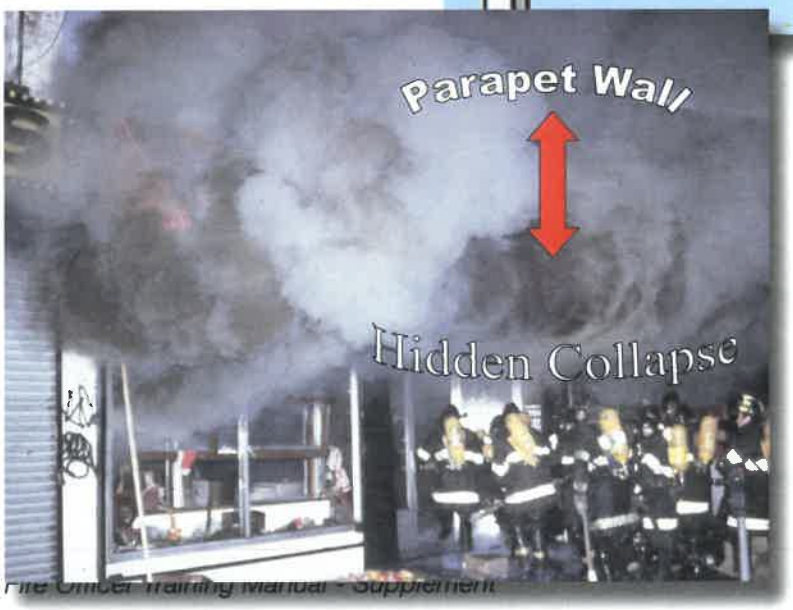
NO FIRE WALLS



PARAPET WALLS

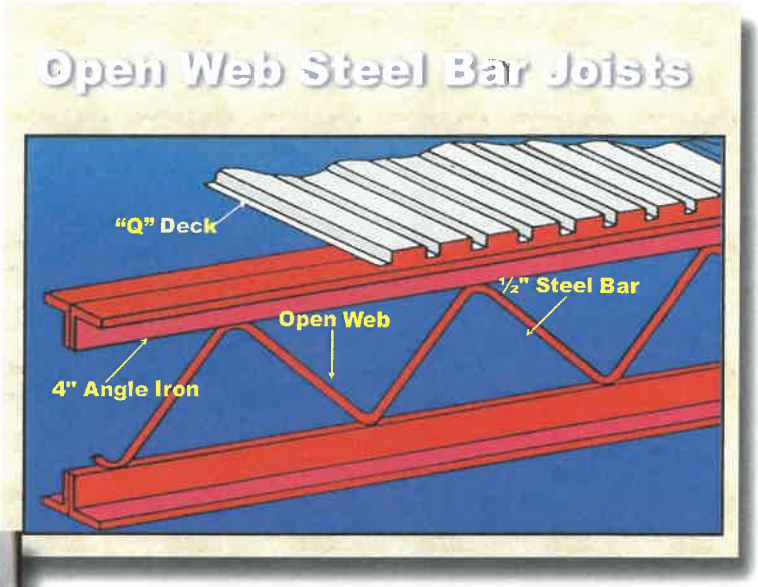
PARAPET WALL COLLAPSE

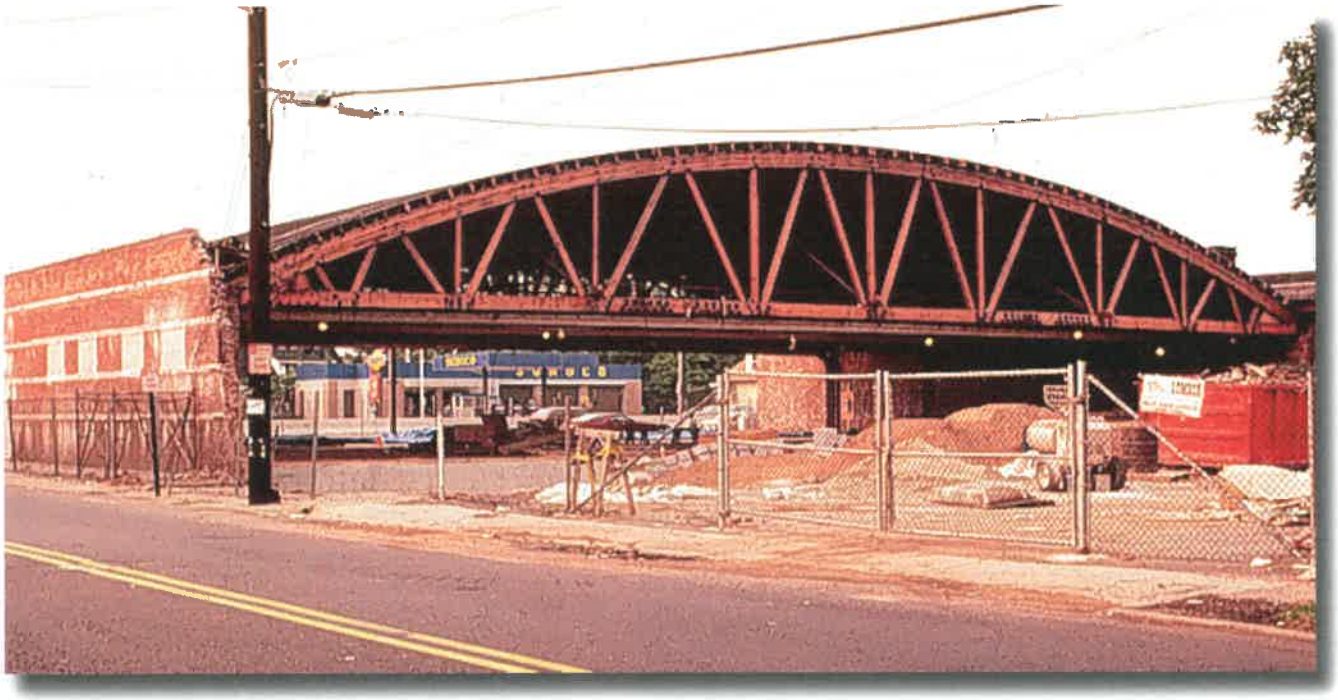




Roofing Systems

- Structural Components
  - Dimensional Lumber (Rafters)
  - Truss
    - Lightweight Wood
    - Aluminum / Metal
    - Wood Truss
    - Metal Bar Joist





TRUSS KILLS

1967 CLIFFSIDE,NJ-6 KILLED (OUTSIDE)
1978 FDNY WALDBAUM'S-6 KILLED(ABOVE)
1988 HACKENSACK,NJ-5 KILLED(UNDER)
1992 FT HAMILTON PKWY-2 INJ(OUTSIDE)

ROOF TYPES

Gable Roof

Gable Roof

Hip Roof

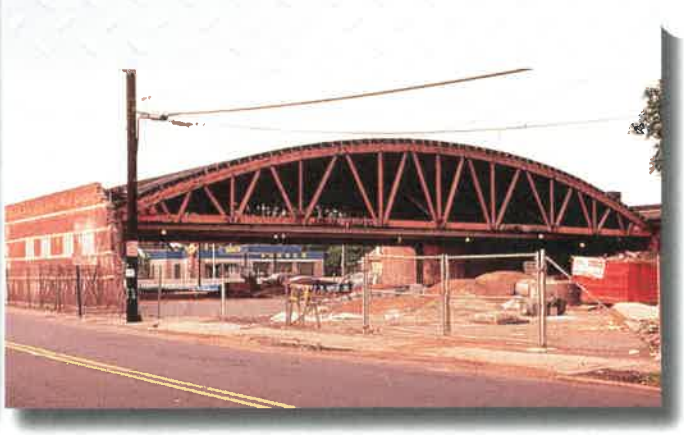
Mansard Roof

Gambrel Roof

Gambrel Roof

Lean-To

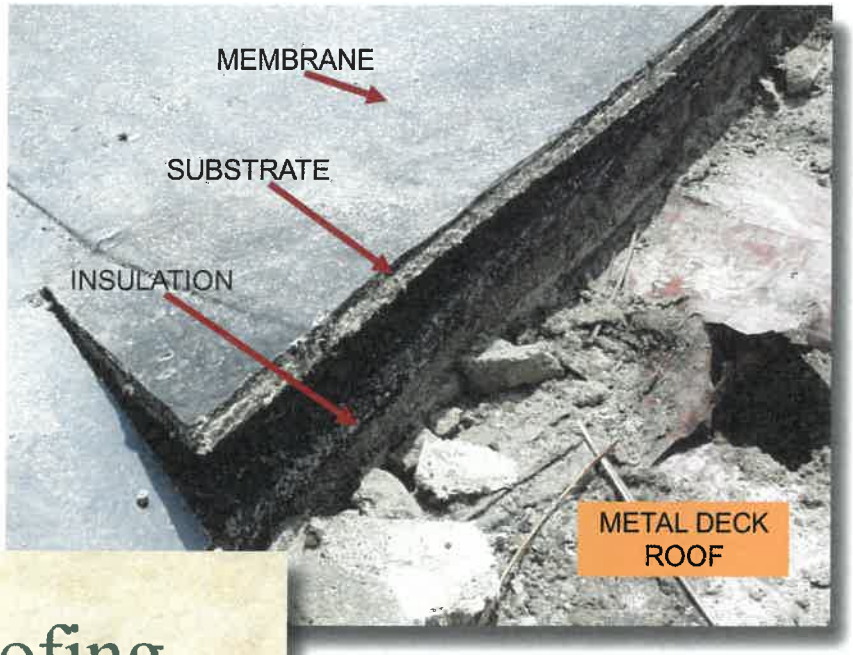
Bow String Truss



RAFTERS

TRUSSES

- Materials
  - Wood
  - Metal
- Sheathing / Covering
  - Materials
  - Methods

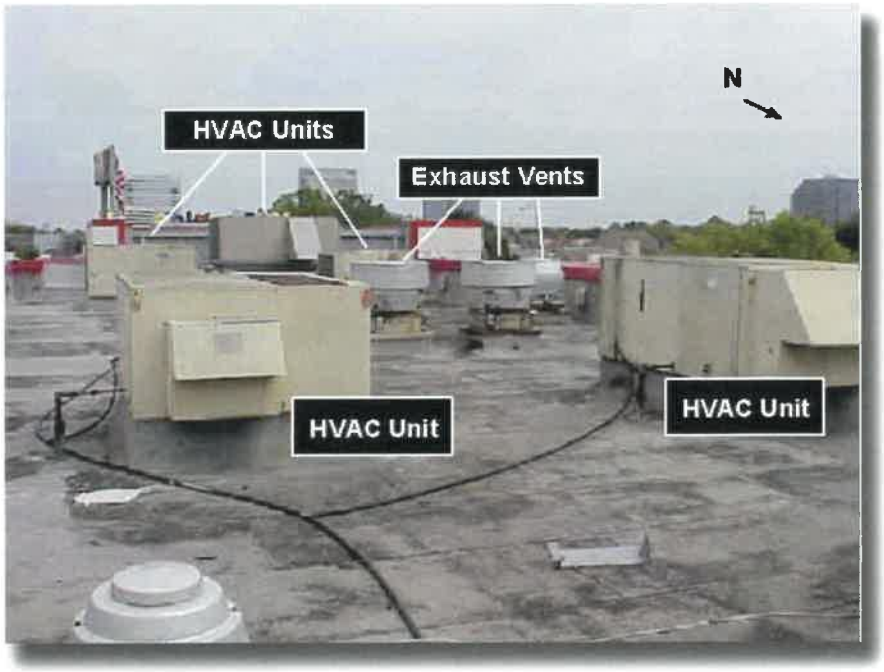


Membrane Roofing

COMMERCIAL FLAT ROOFS

You must determine rapidly if the fire is involving the TRUSS SPACE. Open up early and often. Remember these buildings are disposable and extremely likely to be unoccupied upon the fire departments arrival.

EARLY IN THE INCIDENT - COMMAND NEEDS REPORTS FROM THE LADDER COMPANY ABOUT THE PRESENCE OF THESE ITEMS ON THE ROOF



Building Collapse

The longer a building burns - the more likely it is to collapse. MASS = FIRE RESISTANCE. When "Mass" is taken away, fire resistance decreases and collapse likelihood increases.

What is Going On Here?

Should Someone Be Paying Attention?

PREDICTABLE?

Indicators of building collapse

- Cracks or separations in walls, floors, ceilings and roof structures.
- Evidence of existing structural instability (Tie rods, stars, etc)
- Loose bricks, blocks, or stones
- Deteriorated mortar
- Walls leaning
- Structural members distorted
- Fires beneath floors supporting heavy machinery
- Prolonged fire exposure to structural members
- Creaks and cracking noises
- Structural members pulling away from walls

Building Collapse

- Signs of collapse = immediate evacuation
- Collapse zone = 1 ½ times the height of the building
- Set up defensive operations at the corners of the building.

Collapse Indicators

Its Coming Down

Collapse Indicators

Collapse Indicators

Water weight

- Water weighs 8.33 lbs/gallon
- 7.6 gallons of water per cubic foot
- Cubic foot of water weighs 62.4 lbs.

Water Weight

- Flow 1000 gpm for 10 minutes into a structure.
- How much weight has been added?
- 1000 X 10 = 10,000 gallons of H20
- 10,000 gal. X 8.33 lb./Gal. = 83,300 lbs.
- (333 firefighters or 2 Engine Companies

Water Weight

- 40' X 25' structure
- 40' X 25' = 1000 sq. ft.
- 3" of water on the floor
- 1000 sq. ft. X .25 ft. H20 = 250 cu. ft. of H20
- 250 cu. ft. X 62.4 lb/cu. ft. = 15,600 lbs.
- 62.5 firefighters or 3 full-size pick-ups

More Things To Make You Scratch Your Noggin

I believe the word you're searching for is WTF?

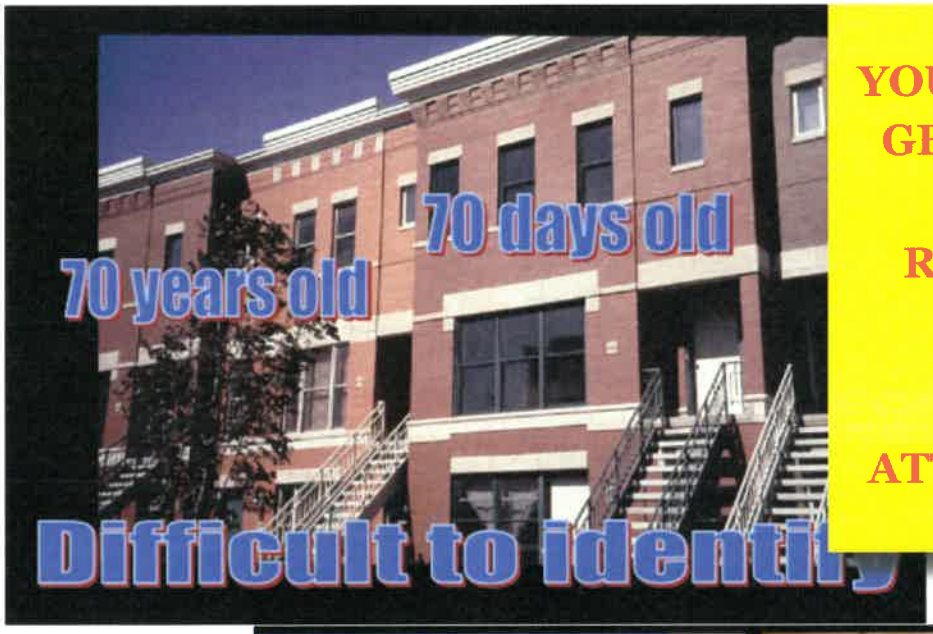
YOU HAVE TO GET OUT IN YOUR RUNNING AREA

"PAY ATTENTION"

How we understand the problem drives the solution

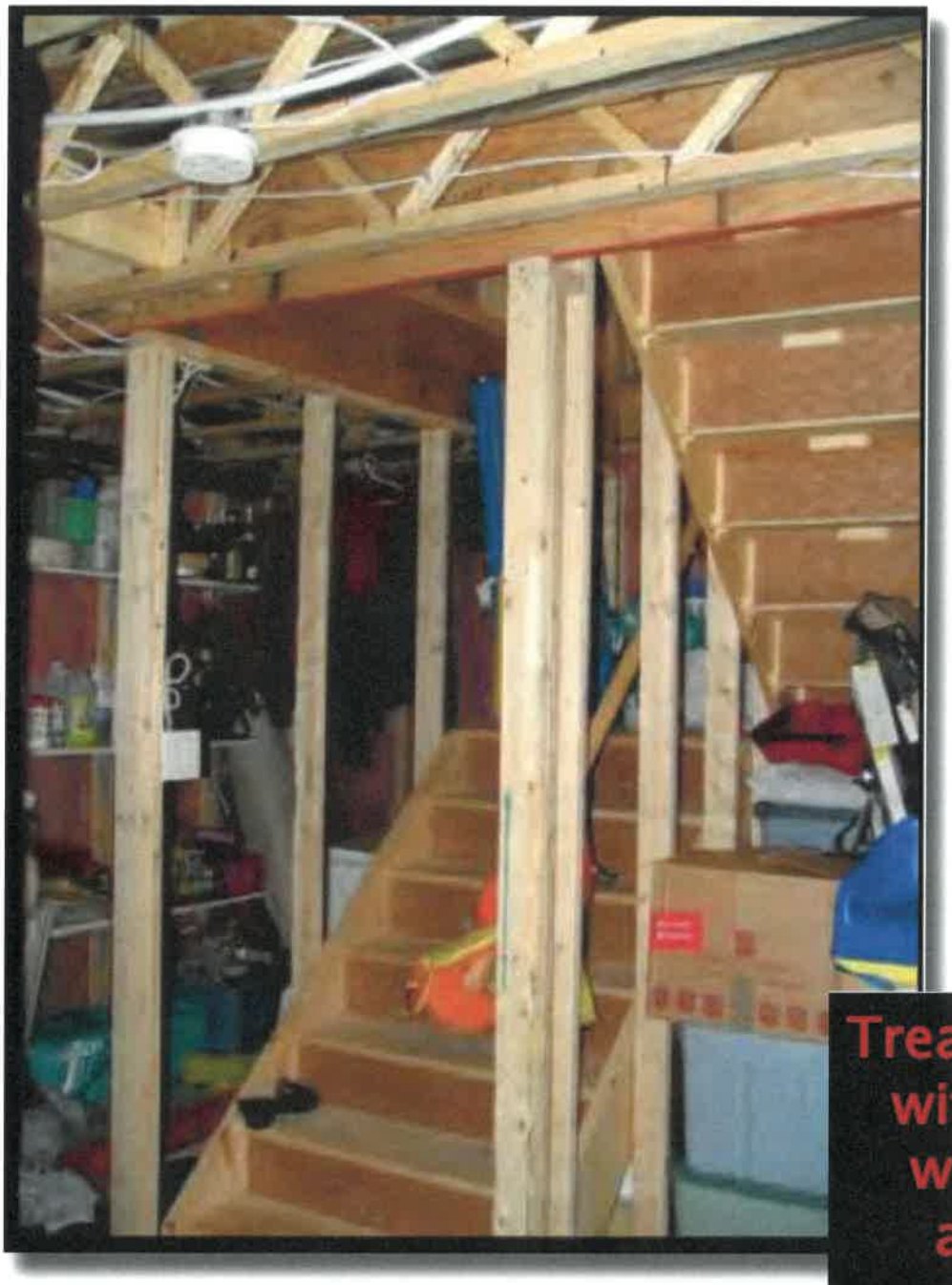
LWC is not a building type.

·Most of our strategies and tactics were designed to address the inherent challenges of various construction types and occupancy classifications.



YOU HAVE TO GET OUT IN YOUR RUNNING AREA

"PAY ATTENTION"



Treat all buildings with unprotected wood structural assemblies as inherently dangerous to firefighters.

YOU HAVE A SMALL WINDOW OF TIME TO GET A LINE INTO THIS SPACE BEFORE THE FIRE OVERTAKES THE CONSTRUCTION METHOD!

Rapid Fire Development

Attic Open Soffit and Ridge Vent

MODERN CONSTRUCTION = RAPID FIRE SPREAD INTO ATTIC SPACES

The Perfect Chimney

Open Soffit

Open Soffit

EXPECT ANY FIRE TRAVELING INTO THE ATTIC VIA AUTO EXPOSURE OR BURNING SIDING TO TAKE OVER THE ATTIC

Company Training

It Is Your Responsibility

As a Fire Officer, training is your responsibility at the company and district level. Training at these levels is really just "practice" as we typically aren't teaching new skills, tactics or strategies in the fire stations. Your duty to ensure proficiency and practice is one of the most important responsibilities a Fire Officer holds. Without practice, execution of skills becomes rusty and when needed firefighters under your command won't execute effectively in stressful environments.

Motivation

You must have some sort of motivation to train with your personnel. If we go around a room and ask people what is their motivation, you will get varying answers with these being the most common:

- **Pride**
  - Simply meaning - you don't want to look bad or perform bad when around others.
  - Pride will give you a little push to be better or do do things to make yourself better - most people don't like to fail or lose.
- **Duty**
  - At some point we all raised our hand and swore to protect and serve those within this City.
  - This is not to be taken lightly. If it's not us, then who? We are the professional personnel who are supposed to be ready at anytime for anything. Whenever someone calls 9-1-1, we are the responders who come to solve the problem.
- **Family**
  - Going home to your family. You are already away from them a 1/3 of your life, you want to make sure that your time off is spent healthy and happy with them.
  - You don't want your children to grow up without parents.
- **Crew**
  - Your crew is also your family. You spend a 1/3 of your life with them. You assume responsibility for their lives. You assume responsibility to ensure they go home to their families as well. Allot of people are relying on you to ensure your crew is on top of their game!
- **Cell Phones & YouTube**
  - Everyone has a camera today. You simply don't want to be the idiots on every fire service website or Facebook post doing something stupid.

Good Luck Reinforces Bad Behavior

When you don't practice and remain proficient, you often are successful due to "Good Luck" on a multitude of incidents. We use phrases like "We'll figure it out", "The fire went out", "Nobody got hurt". If we fail to learn from the past - we are doomed to repeat it. Eventually our "Good Luck" will run out.

When you signed up for this job you likely were part of a large pool of thousands of candidates who all were vying for the same position as you. You earn a modest pay for your amount of work with good benefits, retirement and time off. Let there be no mistake - this is a JOB! As a Fire Officer - you need to take your job seriously. Learning from past mistakes, past complacency issues, past injuries, past deaths all should provide motivation to be better at our jobs and at the "top of our game".

When we don't train and/or practice - we will eventually SUCK. Our job requires skills, these skills diminish over time and by not doing skills periodically - there is no way you will remain proficient over time. Skills as simple as: donning your PPE at the point of entry (facepiece, hood, helmet & gloves),

deploying fire lines, operating fire lines, search, ladders, forcible entry and firefighter rescue all require practice to maintain proficiency and continue to build muscle memory.

The worst thing that can happen with lack of practice is the unneeded death of one of the civilians we are sworn to protect or even a firefighter. While its easy to point out the negative on abilities and skills and their effect on operations - we often have difficulty quantifying the benefits of preparedness. How did being 10 seconds faster getting dressed make a difference and to who? Did getting the line into service prohibit flashover? collapse? fire spread? We are sure it does good - but how much good? We have to assume that every single time we are able to deploy the line to the front door, don our PPE, charge and bleed the line and advance into the fire in one to two minutes 'vs' three, four or five minutes - we are making viable rescue possible, prohibiting further fire spread, flashover, collapse and even injury to us while fighting the fire.

Keys to Success

- **Training & Practice have to be the priority**
  - This has to occur daily and should be the on the top of the list of things to do after ensuring the well being of personnel (food, water, etc).
  - Training needs to take priority over all other duties of the company (inspections, hydrants, chores, public education events, physical training).

- **Determine weaknesses and fix those weaknesses**
  - You can determine weaknesses through drill or on the fireground. When you notice a deficiency in either area - you must address it and work to make it better. This doesn't have to be punitive or even call a particular member out - just practice on skills needing work until they become 2nd nature.

- **Develop a good routine**
  - If your personnel expect you are going to drill everyday - they are less likely to complain about it. If you sporadically do it and do it at different times of the day all the time, a routine won't exist and people won't know what to expect on a daily basis. Firefighters like most humans are creatures of habit and the more you develop a good routine and habits - the better it will be taken by the rank and file.
    - If your crew knows that everyday you are going to get on track, check equipment, clean the firehouse, eat breakfast, do some required work, do a quick drill and make it to the store and have lunch on the counter around 12 noon everyday - they will buy into that allot more than sometimes drilling the morning, then in the afternoon, eating late, etc.

- **Develop mastery in basic firefighting skills**
  - *If you are on an Engine Company:*
    - Line Selection
    - Deployment
    - Flaking
    - Charging
    - Operating and Moving
    - Pump Operations
    - Master Streams
    - 2-1/2" Operations
    - Standpipe Operations
    - PPE / SCBA
    - SCBA Emergencies
    - Water Emergencies
  - *If you are on a Truck Company:*
    - Search
    - Victim Removal
    - Ladders
    - Forcible Entry

- RAT
- Aerial Operations
- Ladder Pipe

- **Set expectations**
  - If you want personnel to improve or meet a benchmark - then you have to communicate with them and ensure you hold them to that expectation.
    - Example: If you want them to be able to don their PPE at point of entry (Facepiece, Hood, Helmet and Gloves) in under 30 seconds, then you have to practice until they can and then practice so they maintain this ability. If you do it once per year, they won't maintain this ability.

- **You must do whatever your personnel are doing**
  - You can't have success if you state: "go deploy a hose line and then you stay and watch television". If your personnel are doing it, so should you. REMEMBER YOU ARE STILL A FIREFIGHTER AND STILL RESPOND TO THE SAME FIRES THEY DO!

- **Be creative**
  - Eventually people will be proficient and skilled as you desire. You need to switch things up occasionally to make it more enjoyable. Switch locations, don't always use the same building (your fire station), go out in the community, use drill school property, get into your buildings, find vacant buildings.

- **Make it realistic**
  - To make it realistic, set some parameters for speed and performance. Practice at "game" speed.
  - Reduce visibility by putting on hood backwards.
  - Move and flow fire lines through areas like you are attacking a fire.
  - Perform skills in a variety of situations and locations (especially in your running area).

- **Practice like you expect to play - full PPE / real speed**
  - This is similar to making it realistic. Its OK to do skills in uniform to practice skills, but from time to time you have to practice full speed (similar to football practice or a scrimmage in other sports).

- **Throw a "curveball" every now and then**
  - Curveballs can be a variety of things to keep everyone on their toes. We all know the foreground isn't scripted and things do happen from time to time that require us to adapt and overcome.
  - Examples:
    - Clogged nozzle (fill it with some rubber EMS gloves prior to starting the drill when no one can see)
    - Short stretch & extend - do a drill where they won't be able to make it and then have them regroup and extend the line
    - Engine or Truck FAO has a "simulated" trauma or medical emergency and cannot operate the apparatus - have a firefighter do it without warning as part of a scenario
    - Lose water and deal with a loss of water

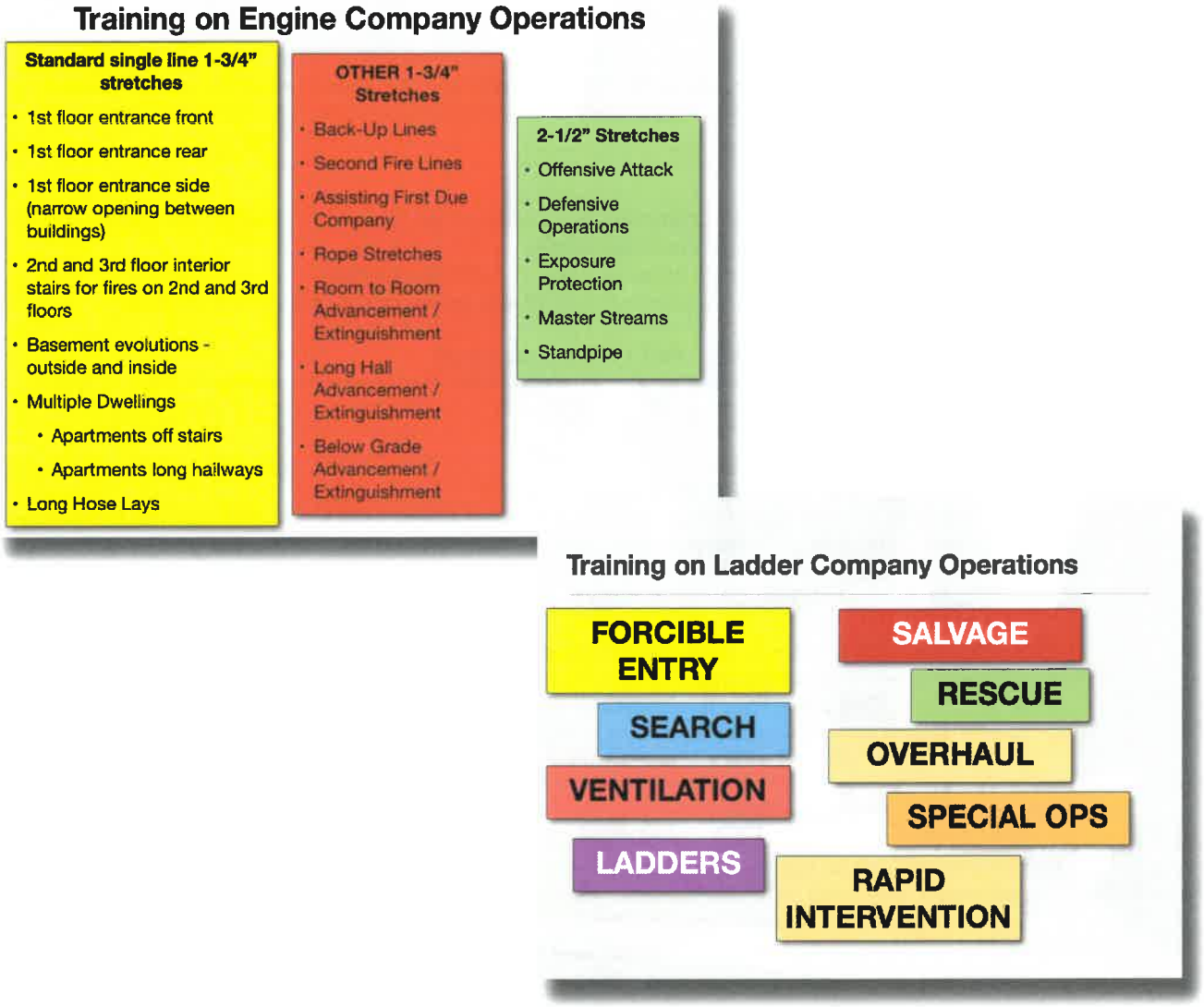
- **Short drills are often the best**
  - Most of the time at the company level a crew can do some evolutions without an extreme time commitment. When you focus on "trying" to make it stretch an hour 'vs' just doing a drill and practicing a skill - you will have more success on the latter.
  - As an example - the Engine Company Quick Water evolution should take around 1-minute to execute and then 10-15 minutes to reload and if you want to re-do the evolution, you can figure a maximum time of 30-minutes for the entire drill.

How Do I Make A Drill Plan?

When trying to decide what and how to drill on your company, you must first develop a "Drill Plan". This plan should be based on the following:

- Your specific tasks on the foreground (Engine 'vs' Truck)
- Working on weaknesses
- Practicing after an incident to improve operations
- Skills needed for your running area (mostly private dwellings 'vs' industrial)

Below is an example of a typical "drill outline" for Engine Company Operations to be completed at the company level. Start with the first evolution "1st Floor Front Entrance" and when that is dialed in and proficient, move to the "1st Floor Rear Entrance" and so on. Once you make your way through these drills - start over to maintain proficiency over time.



Other Drills

Often the most complicated part of our job as officers is making decisions on the incident scene. Of course you want to make the right decisions and ensure your decisions have the correct outcome. The best way to accomplish this is through "SIMULATION TRAINING". This can be done with pre-made scenarios distributed by Fire Training, information on the internet and/or pictures / videos of fires.

Decision Making

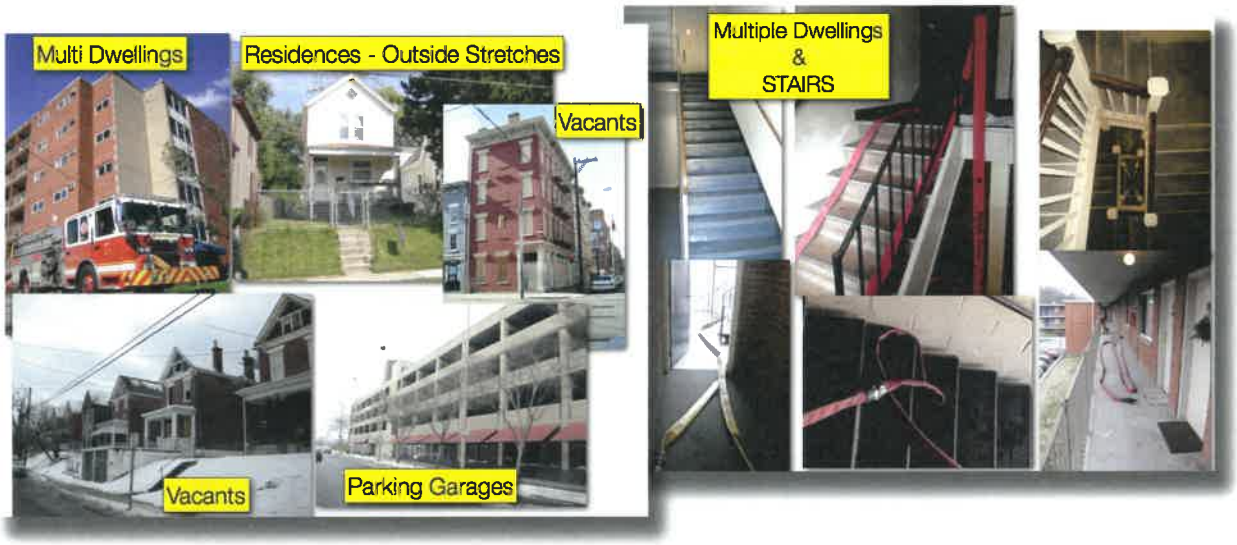
- **Preparing to Make Decisions**
  - **Simulation Training**
    - Builds experience when high-activity assignments aren't option
    - Builds experience quickly
    - Experience under controlled settings
    - Time pressures are a must for realism
  - **Continuously Expand Knowledge Base**
    - Building Construction, Fire Behavior, District Familiarity

A Simple Internet Search

Where Can You Train?

You can train in a multitude of locations - your fire station, out in your district, a drill school / training site. The key is to go back to what makes drill time successful and attempt to make it realistic and worthwhile. If you assess your running areas and look for areas to stretch hose, look at building characteristics, raise ladders you will find a multitude of areas that are useful.

"BUT I CAN'T STRETCH HOSE IN A BUILDING" - is an excuse often made by those who don't want to stretch. Simply asking the building management permission or explaining if questioned that you are trying to be proficient if there is a fire at their address will go a very long way for the people we are protecting. A very high percentage of the time the responsible party will have no problem with you laying out hose in the stairwells and/or hallways of their occupancies. You do have to be smart - no forcing doors, breaking glass or damaging the property. You shouldn't charge and flow fire lines in an occupied multi-dwelling - but you can stretch to the apartment door as practice!



Get into your Buildings!

Building & District Survey's

Start from Day #1

- Not something that is only in morning or 2-5pm
- All Day
- Everyday
- Busy Districts / Businesses
  - Adjust Times
  - Be Creative

Engine 12 Preplan

2971 Deckebach
Clifton House Apartments

Have A System

- Keep it simple
- Reports
- Accessible
- Post @ Fire House
- Premise Histories

Engine 12 Drill — February 2014

MILLVALE COURT
LONG HOSE STRETCH

OPTION #2 - Stop adjacent to walkway at 2090 Millvale
Officer takes 1-3/4" Hose Pack down walkway towards fire building
1st building (2092-2102) FF 1 & FF2 take 2-1/2" Wyed Load off E-12 150' accordion off pumper before FAO drives to hydrant (Crossfire)
2nd building (2014-2000) FF1 takes as much of accordion as possible, reaches back and drags with free hand rest of accordian and FF 2 takes 2 additional sections of 2-1/2" off (total of 5) before FAO drives to hydrant (Crossfire)

MILLVALE COURT
LONG HOSE STRETCH

1. Buildings to Left and Right of Lot and 2056-2066, 2068-2078 and 1984-1998 can be reached with drivers side rear 1-3/4" bed. It will take 2-3 guys to make it quickly to the furthest address.
2. Buildings 2092-2102 and 2000-2014 use Option 1 or 2. You will need to use the wyed 2-1/2" bed and bundle for these addresses regardless of option used.
3. 50' of hose at the front or rear entrance door should cover most of the apartment.
4. There are fences, terrain difference and steps on stretch from front suction on parking lot to make stretch more difficult. You must work together!

OPTION #1
Front Suction can be used for all addresses off parking lot:
1972-1982, 1984-1998, 2000-2014, 2016-2026, 2056-2066, 2068-2078 and 2092 to 2102
Officer takes 1-3/4" bundle to address
FF 1 - takes 1/2 of 2-1/2" accordion and FF 2 takes other 1/2 of accordion towards address.
FAO assists with last 100 feet of hose if going to rear buildings.
2000-2014 and 2092-2102 can also use OPTION #2

To Be Successful At A Fire You Should Practice This Ahead of Time

Engine 12 Drill — January 2014

1990 Westwood Northern
Reids Valley View Apts.

"In The Hole" - Apt. 10-20 can access from crossday and use hydrant in front of Apt. 21&22. If you hug curb, use rolled 50" 3" you can leave access for truck

For Apt. 21-38 our long bed (drivers side rear) will reach all apartments from front suction @ Hydrant at Apt. 21&22. You can stop and crossfire, pull back or even use the 2-1/2" wyed long bed with hose pack

1. 50' of hose will cover apartment.
2. We found its useful to drape 50' coupling over railing and it stays.
3. Doors are easily forced light-weight metal doors with dead hold locks

1990 Westwood Northern - Reids Valley View

1. For Apts. 1-9 enter first drive and lay off from hydrant at front of complex around office to this parking lot. 2nd Engine takes hydrant on WWN.
2. Doors are easily forced with ADZ end of halligan. Simple lightweight metal doors with dead bolts.
3. 50' of hose will cover all apartments.
4. 2 bedrooms, living room, bathroom and kitchen in each unit. Bedrooms are towards front (entrance side) and kitchen is towards rear in each unit.
5. Units hold smoke very well - can have good working fire and little smoke visible.

It Doesn't Always Have to be Elaborate!

If you carry it on the apparatus - then it's OK to drill on it. You need to maintain proficiency on all aspects of your tools and equipment to be proficient in how to use them.

Sometimes:

- Stuff you carry in your pockets
- Chocking doors
- The Pump and How it Works
- EMS Equipment
- Special hose loads
- Standpipe Equipment
- Fans
- Electrical Equipment
- Power Tools
- Hand Tools
- Meters

101 Drills for the Company Officer

07/01/2009

BY STEVE PRZIBOROWSKI

Once a firefighter leaves the recruit academy, the company officer is responsible to be that member's personal training officer to ensure that that person's training needs are met and that he is continuously on top of his game.

For current and future company officers, I provide below 101 drills they can use to keep their training interesting and, most importantly, relevant to the needs of their personnel. Where did the number 101 come from? Well, besides being catchy, most company officers tend to work one-third of the time, based on a three-platoon system. Take away days off for vacation or for other department-approved reasons, the average company officer will work approximately 101 shifts per year. Thus, there is no excuse for not having a drill idea for every shift. Many of these drills can be repeated regularly, even monthly, depending on personnel's needs. Once the year ends, you can restart this cycle or you can modify each item to provide some variety for the next year.

The officer is the company's personal fire service trainer, similar to a personal fitness trainer at a gym. So it is critical that each company officer be very comfortable and, more importantly, very proficient at providing his crew with the necessary training, education, and mentoring. In addition to his training role, the company officer is also the critical link between the department's training division and his fire company.

Many company officers think that the department training officer is responsible for providing all of the necessary training and education for themselves and their personnel. Nothing could be further from the truth, except at the fire academy, where a department training division member (who may not be the training officer) usually instructs the recruits. The recruit academy provides the newly hired firefighter with the basic knowledge, skills, and abilities to be a safe beginner and to function as a basic fire company member.

However, on graduating from the recruit academy, typically, a newly hired firefighter is sent out to a fire company to complete his probation under the direct supervision of a company officer. That officer will evaluate how well the recruit retained the information learned in the academy and whether he will successfully pass probation. Additionally, once the firefighter gets through probation, it is up to the company officer to ensure that that member meets all the continuing education requirements for the remainder of his career.

ALTERNATE LOCATIONS

Before we review the 101 drills, let's consider possible drill locations and instructors. In many fire departments, drills occur only at the training tower, the training center, or the fire station. Always training at the same location is one of the biggest problems I have seen in my career. This tends to program our personnel to always do things the same way and always know what to expect, since the drill site does not change much over time.

Do your personnel a favor: Break the normal cycle; use a variety of training locations that best meet your needs and, more importantly, your company's needs. For example, the fire station, the apparatus bay, the kitchen table, the dayroom, the fire station property, and the entire station are good training sites.

Go out to your first-due area, where your crew can actually see and experience different target hazards such as shopping centers, elderly care facilities, apartment complexes, and hotels/motels to which your company will most likely respond.

Outside of your first-due area, but within your department's jurisdiction, your neighboring fire stations may also have some unique target hazards not mentioned above, such as amusement parks, high- rise buildings, and stadiums. Your company might be called to assist at incidents involving these sites as well.

Outside of the fire department jurisdiction, your neighboring fire departments may also have some unique target hazards or locations. Again, you might be called to respond on mutual aid to this site in the future.

If all else fails, try your department's training center.

INSTRUCTORS

You need not be the instructor: you may not be the best instructor for every subject or topic. Since I know I'm not an expert at everything, there are certain subject areas for which I would rather have someone with more expertise provide the instruction.

Take the time to encourage other department or station personnel to develop their instructional skills, which will also help develop their careers. More importantly, allow the best instructor to teach the subject matter. Consider personnel within your own fire station with a specific area of expertise, such as a paramedic/emergency medical technician (EMS), an engineer (apparatus), or a firefighter or an officer who is the resident expert in one area, such as tools and equipment or hydraulics. The battalion chief may offer some great career learning experiences; even a probationary firefighter could teach on virtually any topic he learned at the academy. Also, consider instructors from other fire stations, fire departments, or even outside of the fire service. For example, a local utility company technician could provide training on electrical or natural gas emergencies.

How could a probationary firefighter be an instructor? Although this member may not be a subject matter expert, given his limited time in the fire service, having a probationary firefighter give the crew a training class is a great way to test him on how much he knows about a certain subject. You wouldn't expect that firefighter to know everything, but you would expect him to have a basic working knowledge. You and your other crew members could evaluate that knowledge and offer input.

As you can see, the company officer has one of the most important positions in the fire department, since he is the direct supervisor for the fire company that will respond to the person calling 911. The 911 caller will form an opinion of the fire department, most likely based on how quickly members arrived, how nice they were, and how well they solved the caller's problem. Thus, it is easy to see how a company officer needs to ensure that his company is trained and ready for virtually any type of situation they may face.

Not all of the above drills may apply to your department, depending on the types of apparatus you may have or your jurisdiction's target hazards. If an item doesn't apply to your situation, find something that does. Even if an item does not seem to apply to your department, you could be called to assist another department with that situation through automatic or mutual aid.

The company officer is a critical component of training, educating, and mentoring fire service personnel. If this officer expects the department training officer to provide the necessary training for his crew, he is in for a huge surprise. Most fire departments lack sufficient training division personnel to provide all of the necessary initial and continuing education for fire station personnel.

Using the drills listed here, the current or future company officer can ensure that personnel's training needs are met and that the company is prepared when the bell goes off.

101 Drills for the Company Officer

1. Review ladder terminology and maintenance.

2. Determine the appropriate length of ladder to do a job. One way to do this is to drive around your response area and point out different building features (e.g., roofs, ledges, windows, balconies)

and ask your crew to quickly determine what length of ladder would be best for a specific situation.

3. Deploy the attic/folding ladder.

4. Deploy each size ground ladder (straight and extension) that the department carries.

5. Practice aerial device operation and placement.

6. Review hose terminology and maintenance, including hose streams, nozzles, and foam usage.

7. Deploy small handlines (1-3/4 inch) in a variety of situations.

8. Deploy large handlines (2-1/2 inch, three inch) in a variety of situations.

9. Deploy a portable deck gun/master stream device in a variety of situations.

10. Determine the appropriate hose length for a variety of situations (e.g., fires on the second or third floor, down a long alleyway, or inside an apartment complex or shopping center that may require a longer than normal hoselay).

11. Use hose and couplings to find the way out of a building. Inside a building, make the hose into spaghetti and then order personnel out of the building to see if they can determine the correct direction of the couplings and safely get out of the building.

12. Review SCBA terminology and maintenance.

13. Don the SCBA.

14. Pass through a narrow opening while wearing an SCBA; this requires taking off the SCBA and putting it on again.

15. Determine how long it takes to drain one SCBA bottle.

16. Review emergency procedures while using an SCBA.

17. Refill and change SCBA cylinders.

18. Inspect and maintain a specific tool or category of tools (e.g., hand, power, or forcible entry tools).

19. Inspect, maintain, and operate each type of fire extinguisher.

20. Review fire behavior terms, and discuss strategy and tactics to use to mitigate each other

21. Watch Dave Dodson's The Art of Reading Smoke DVD.

22. Review the basic types of construction (Type I, Type II, Type III, Type IV, and Type V), especially as they relate to the buildings and types of construction commonly found within your jurisdiction.

23. Walk through a building under construction, identify the type of construction, and discuss appropriate strategy and tactics should you find yourself fighting a fire there.

24. Identify unique hazards relating to buildings within your jurisdiction (window/burglar bars, driveway gates, protective animals).

25. Review the strategic modes of firefighting (e.g., offensive, defensive), and discuss appropriate uses for each.

26. Review the three primary incident priorities: life safety/customer service (firefighters and civilians); incident stabilization/hazard mitigation; and property conservation.

27. Review the basic components of size-up, including what to look for during the 360° walk around the building.

28. Practice making radio reports for different types of buildings and in different types of situation

29. Review basic hydraulics/pump pressure calculations for a variety of situations.

30. Review basic and advanced pumping operations and troubleshooting techniques.

31. Practice basic and defensive driving techniques.

32. Practice spotting apparatus for a variety of situations (e.g., residential, commercial, wildland, and high-rise fires; freeway responses, vehicle accidents).

33. Identify the contents of each apparatus compartment. For each item, can your crew name what and where it is, its quantity, and its usage with the compartment door closed?

34. Pick a seldom-used tool (one per shift), and tell everything you know about it

35. Examine other types of apparatus inside and outside of your department; show and tell.

36. Practice using the different map books carried on your apparatus, including common symbols, how to locate streets, specific addresses, and so forth.

37. Place ALL the street names of your first-due area, as well as the major street names of your second-due areas (one name per piece of paper) in a coffee can to pass around to see if your crew knows where the street is, in which direction it goes, in which way the numbers increase/ decrease, the hydrant locations, the target hazards on it, and so forth.

38. Take the daily log book and review the responses from previous shifts; say the name of the street out loud and see which crew member can point in the correct direction first.

39. Review target hazards such as schools and businesses to which you may respond, including any challenges you may face and the locations and presence of items such as automatic sprinklers or standpipe systems.

40. Identify key address points within your first-due area. Start with the major streets and intersections, then move to the secondary streets and commonly traveled routes. Identify in which direction street address numbers increase and decrease.

41. Review the use of mobile and portable radios, including the capabilities and maintenance of each.

42. Provide a class on basic department paperwork, including tactical worksheets and commonly used maintenance or requisition forms.

43. Review proper radio terminology and etiquette.

44. Review one department rule, policy, or standard operating procedure (SOP) each shift. By the end of the year, you'll have covered each binder.

45. Review the current labor/management agreement and discuss the importance and usage of the items within.

46. Challenge your personnel with a scavenger hunt to locate commonly used department policies (e.g., sick leave, trading of shifts).

47. Review inspecting and maintaining ropes.

48. Review knot tying, especially those knots you will likely use in your operations.

49. Use a rope to tie a tool or hoseline for hoisting to an upper floor.

50. Review mechanical advantage system principles.

51. Review commonly used water supply systems in your jurisdiction (e.g., hydrants, tanks, sprinkler components).

52. Spot the apparatus for a hydrant connection from various angles.

53. Practice performing forward, reverse, and split hoselays.

54. Practice relay pumping.

55. Pick a different emergency medical service diagnosis to discuss each day (cardiac problems, respiratory problems, altered levels of consciousness, etc.).

56. Pick a different medical or trauma treatment protocol to review each day.

57. Review basic triage procedures.

58. Practice a different National Registry of Emergency Medical Technicians (NREMT) skill (e.g., patient assessment, splinting, vital signs) each day.

59. Review mass-casualty incident procedures.

60. Review ventilation principles and procedures.

61. Using actual buildings, discuss where and how to ventilate them.

62. Demonstrate inspecting, maintaining, and using each ventilation tool.

63. Review using, inspecting, and maintaining power and hand tools for vehicle extrication.

64. Review information on new vehicles and what challenges they may present (e.g., alternate fuel/ power sources, occupant safety systems, construction materials).

65. Obtain a used vehicle from your local tow yard to practice extrication techniques.

66. Review basic hazardous materials awareness and operations level actions (e.g., providing for safety, isolating and denying entry, and making the appropriate notifications).

67. Review the latest Emergency Response Guide (the orange U.S. Department of Transportation book), and apply it to various simulated situations.

68. Practice setting up and using an emergency decontamination system.

69. Hold a show-and-tell session with your local hazmat unit.

70. Review key incident command system (ICS) positions for high-rise incidents.

71. Review high-rise operations, including ALS Base (first unit establishes fire Attack, second unit establishes Lobby control, third unit sets up Staging, and the fourth unit sets up Base).

72. Practice standpipe operations such as troubleshooting, pumping, and so forth.

73. Review maintaining and using various salvage tools and covers in a variety of situations.

74. Review vehicle firefighting safety operations.

75. Review firefighter fatality and near-miss reports, consulting Web sites such as www.fireengineering.com, www.firefighterclosecalls.com, www.firefighternearmiss.com, and www.respondersafety.com, and discuss the findings with your crew.

76. Practice donning personal protective equipment (PPE) to ensure your personnel can dress quickly prior to getting on the apparatus.

77. Review inspecting and maintaining your PPE.

78. Review electrical emergency operations, including how to recognize and manage the most commonly found electrical hazards on the emergency scene.

79. Review rapid intervention team (RIT) operations, including terminology, tool caches, member assignments, radio communications, deployment issues, and so forth.

80. Set up a Mayday scenario that involves the RIT operations components above.

81. Review common ICS components, including terminology, command staff assignments, general staff assignments, position titles, position duties, usage of ICS field guides, and so forth.

82. Review search and rescue techniques, terminology, and challenges, and then practice in different types of structures.

83. Review forcible entry tools, techniques, and challenges.

84. Review operations for unique situations such as basements, parking garages, subways, railroads, trench rescue, confined space rescue, and water rescue.

85. Accompany a fire inspector on a fire prevention inspection. Not only will you learn how to better perform a fire inspection, but you also can educate inspectors on what your job entails, since many fire inspectors are not firefighters.

86. Have a fire investigator review basic fire cause-and-origin and evidence-preservation techniques. Since many company officers will be required to do basic cause-and-origin investigations as the first- due company officer, this is especially important.

87. Find videos, DVDs, and YouTube videos that can provide unique perspectives on a variety of subjects such as fire behavior (backdrafts/flashovers), strategy and tactics, ventilation, and firefighter safety, just to name a few.

88. Using fire service journals such as Fire Engineering, discuss current articles and fire service trends; use photos to discuss operations (you could have an entire discussion on the magazine cover photo alone).

89. Provide training or review on department computer operations, including completing an incident or fire report, accessing certain system features, sending e-mails, and so forth.

90. Review fire service history and, most importantly, your department's history.

NOTE: We removed some of these from the list because they don't pertain to any CFD standard operations.

STEVE PRZIBOROWSKI is a 17-year veteran of the fire service and a battalion chief for the Santa Clara County (Los Gatos, CA) Fire Department, where he has worked since 1995. He was selected as the 2008 California Fire Service Instructor of the Year and has been an adjunct faculty member at Chabot College (Hayward, CA) since 1993, teaching a variety of fire- and EMS-related classes. Prziborowski has a master's degree in emergency services administration and is enrolled in the National Fire Academy's Executive Fire Officer Program. He is a state-certified chief officer and master instructor and has earned designation as a chief fire officer through the Commission on Professional Credentialing. He is the author of numerous articles featured in leading fire service publications and is a regular speaker and presenter at fire service events across the country.

Reports

Excerpt From CFD Report Manual:

When paid Fire Departments became a reality in 1853, reports and record keeping were relatively simple. Generally, the most complicated report required in those days was the entry in a small ledger of alarms responded to, or the amount of hey and grain purchased for the horses.

Today Departments are responsible for a vast number and variety of reports pertaining to personnel, fire alarms, payrolls, pensions, fire prevention, and arson. In addition, reports are required for the purchase, maintenance & repair of fire stations, apparatus, and several hundred articles of fire fighting equipment.

As much as we dislike report writing, we must make sure to write factual, defensible, and accurate reports that clearly describe our actions on the fireground and provide sufficient detail to stimulate our memory months or even years later.

Writing the Report

By Robert Howarth

Your engine arrives at what appears to be a single-family dwelling with smoke and fire evident from the second-floor window on side A. You and your crew advance a hoseline and the arriving truck company conducts a search of the building. As more units arrive, additional duties are assigned, and within 15 minutes the fire is declared under control. During overhaul, it is determined that this seemingly mundane single-family dwelling has been divided into four separate apartments. Once final extinguishment is completed, units take up and return to their quarters to ready tools and equipment for the next one. As the officer of the first unit, you must complete the report and write a narrative memorializing the actions of the company.

Fast forward six months, and you receive a call from the law office of your jurisdiction advising you that there has been a lawsuit filed regarding the illegal modification of the building and complaints from residents about the damage done to their living area and possessions. The law office has your report and sets up a meeting to discuss what happened during the incident. Does your report accurately reflect what happened during the incident, and is there sufficient detail in the report to allow you to recall the details of that day? For many, the answer would be no.

Gathering Information

Report writing is one of the dreaded duties that all firefighters and officers must deal with on a daily basis. As much as we dislike the duty, we must make sure to write factual, defensible, and accurate reports that clearly describe our actions and provide sufficient detail to stimulate our memory months or even years later. The F.I.R.E.S. method of writing will assist you in capturing the incident in a narrative form that meets all of these requirements.

F = First observation/Findings: From the time the alert is sounded, data begins to be gathered and evaluated. What information was given at dispatch? What were the weather conditions? Were you given any additional information, such as people trapped or multiple calls, en route to the scene? Once on scene, what was your brief initial report? Did you take or pass command? What other observations did you make about the initial views of the scene? This sets the foundation of the report and helps you recall some of the details that might have seemed insignificant at the time but later turn out to be valuable. For

example, all of us are ingrained to look for cars in the driveway indicating that there may be someone home; however, noting the number of vehicles in the driveway on your arrival may be an important fact when questions about the number of people home at the time of the fire are raised at a later date.

I = Investigation/Initial actions: Although not every incident is a working fire, such determination can only be made after the first-arriving company completes an investigation. Whether it is a 360-degree walk around of the building or looking in the windows during an automatic fire alarm response, a determination of what is happening must be conducted. I know of a recent incident where a door was forced in a commercial multiple occupancy retail establishment during a fire alarm sounding response. Significant damage was done to the door and a complaint was lodged with the local jurisdiction. By the time the investigation of the complaint made it down to the company level, several weeks had passed. The narrative of the report contained no information about the reasons used to make the decision to force entry into the store. The days of saying, "We forced entry because the alarm was sounding," are dwindling rapidly. Fire officers must be able to articulate their reasoning behind a decision or face enhanced scrutiny from their superiors.

This is also the area where initial actions are noted. What assignments were given to responding units? Did crews need to force entry to investigate or mitigate the emergency? On working incidents, what size attack line was used? What was the status of the need for rescue or any injuries to occupants that required immediate care? These questions begin to hit the details that we need to capture in our report. A quick Internet search reveals multiple fire departments that have been involved in litigation because a homeowner asserted that the first-arriving unit failed in some aspect to control the situation. Accurately detailing initial actions will go a long way toward defending your work when being questioned two years later about what size hose was initially used.

R = Response to Actions: This portion of the narrative becomes the meat and potatoes of exactly what you did throughout the incident. For every action there is an opposite and equal reaction, and such circumstances need to be documented. Did you make a rescue or lead occupants to safety? Was suppression of the fire achieved with the handline that you selected? What happened to the smoke conditions once ventilation was established? These are just a sampling of the questions that the narrative should answer.

If questions arise at a later time, the details of your actions may be the only trigger to get accurate information about the incident. Don't ever underestimate when this inquiry into the incident may happen. I handled an incident at the beginning of 2014 that required a review of reports from eight years earlier. When I approached the providers and asked them for details about the prior incidents, the most common answer was, "I don't remember." The reports written during these incidents consisted of single paragraphs with the units that responded and the number of personnel. To say they were lacking details would be an understatement.

E = Evaluation: An evaluation of the incident scene and the final outcome is your next step. Exposure building information should be included here. Exposures become equally important to the overall scene. A fire in a garden-style apartment easily results in two, five, or 10 additional exposures that drive the dollar loss substantially higher. We must capture the basic information for this damage. Simply including address, occupants, owner, and a brief description of the damage is sufficient.

External factors also have an impact on the final outcome. Did you encounter a hydrant that failed to function (severe weather or damage)? Were there parking or access issues, crowd control, hydrants across six lanes of busy traffic? The list goes on. Noting these external items that affected the mitigation of the incident not only describes the incident but creates a historical reference for issues encountered that require code or legislative changes. When your legislative body is being told by a construction lobbyist, "It was an anomaly," your response of, "I remember it happening more than once," carries substantially greater weight with written documentation.

S = Special Statements: Last but certainly not least is the section on special statements. At some point, the incident will end. What did we do prior to leaving? Who did we turn the scene over to? Was it the police, the homeowner, or fire investigation? Someone accepted the responsibility, and here is where we make note of it. This is also a good place to list any issues, good or bad, that didn't directly have an

outcome on mitigation at the scene but still played into the overall incident. Keep in mind that the perception of the public may be slightly different from the actual actions that the responders have taken. A simple statement that services of the American Red Cross were offered to all displaced residents validates your actions when the media runs the story from a local citizen claiming the fire department "abandoned" them after the fire. It happens, and when it does happen, written documentation assists in keeping the positive public image intact.

In the Detail

The use of the F.I.R.E.S. system of report writing undoubtedly adds work to the fire officer's duties. This system is meant to put the necessary documentation in place for an inquiry about the incident at a later date. This report is not designed to be written as a post-incident analysis but rather a factual statement of what occurred on the incident scene. This is not the place to write about your opinions of what could have been done better. This system is for documenting the facts of the incident.

This report format can be in a paragraph form or written with a bulleted list of statements that cover the areas. Whichever method is employed, proper grammar, spelling, and punctuation should be used. Don't be ashamed or embarrassed to ask someone to proofread your writing.

Submitting a complete, correct, and accurate report shows professionalism and transparency while providing historical documentation of an incident. Many of us have heard the saying "Keep fire in your life" when it comes to being prepared for battle; keeping F.I.R.E.S. in your reports will keep you prepared after the battle has been won

3 Fundamentals of Incident Report Writing

By Robert Simmons

One of the most important tasks a fire officer, or typically the company officer, must complete after an incident is to submit a complete and accurate incident report. There are a number of reasons why it is important for company officers to be diligent in the completion of incident reports. In the post, I will discuss why their importance and how we can write an effective incident report.
So, what makes incident report writing a crucial aspect of our job?

- **An incident report is a legal document**
    - In the event of an incident leading to some form of litigation, the incident report may certainly be subpoenaed. Gordon Graham, a popular public safety consultant, explains that avoiding civil liability requires two things: "First, you must do your job right. Second, after getting it done right, you must be able to prove it." The only way to prove it is by properly documenting the incident.
- **It helps chiefs and administrators justify budgets and staffing.**
    - Information is power, especially in the budgeting arena. The better we are at documenting our strengths and weaknesses on emergency responses, the better the information will be when the chief looks at the future of the organization.

- **Proper incident reporting helps us understand the fire problem in the United States.**
    - The National Fire Incident Reporting System (NFIRS) is a data collection initiative managed by the Federal Emergency Management Agency (FEMA). All 50 state fire management agencies report emergency responses through NFIRS, and most require fire departments in their state to use NFIRS. Additionally, reporting to NFIRS is required if your department has received a grant under the Assistance to Firefighters Grant (AFG) program.
- **Complete incident reports can help us individually.**
    - Most incident reporting programs allow you to run queries on archived information.1 If we accurately record our actions in a report, we can use that information to build our resumes for promotions. Providing accurate and complete information in an incident report allows us to quantify our experience for promotions. Which do you think looks better on a resume?
        1. *I served as an operations officer at numerous structure fires.*
        2. *Over the last year, I responded to 100 structure fires and served as an operations officer for 300 hours during those incidents.*

As you can see, the company officer's job does not end when the apparatus is in quarters. Rather, that is when the documentation part of their job begins. So, let's look at three fundamentals of incident report writing.

Fundamentals of Incident Report Writing

A vital, yet often overlooked, skill for fire officers is incident report writing. How can we write a proper and effective report? Here are three basic rules to follow.

#1 – Spelling and Grammar

It is commonly taught in report writing classes that a misspelled procedure or finding in an EMS report is akin to not having done the procedure at all. I can recall sitting through a class as a young EMT where a lawyer was questioning us using actual patient care reports. Every one of us got hammered by the lawyer for doing things like "spliting" a fracture rather than splinting it.

Correct spelling and grammar in an incident report is essential in relaying information properly. The purpose of an incident report is to paint a picture of the incident for those with a need to read the report. If it is full of spelling and grammatical errors, it will be difficult to read and could land us in hot water if the report is used in a court case. Most incident reporting applications include a spell-check feature you can use to avoid spelling errors. However, this does not spot errors all of the time. Some tips to writing good incident reports are:

- Have someone else read the report prior to completing and submitting it, especially for major incidents.
- Write in a clear and simple language that can be understood by the general public.
- Exclude technical jargon and abbreviations that a layperson cannot understand.

#2 – Accuracy of Information

Incident reports should contain accurate information. One of the most common areas to put inaccurate information is timestamps. Often, we forget to report to dispatch when we have reached a benchmark, such as fire control or patient contact. This leads to not having accurate times in our incident reports. It is important to relay benchmark events to the people keeping track of our times. This could be the dispatch center or the incident commander. Regardless of how times are tracked, they must be accurately recorded in the report.

Another area where accuracy is key is in the use of NFIRS codes. The NFIRS system uses a series of number codes for items such as incident types (fires, medical emergencies, false alarms, etc), ignition sources, and various other pieces of data. These codes assist us in analyzing response data both locally and nationally. It is important that we use the correct codes when completing our reports. FEMA has produced a Coding Questions Manual to assist us in selecting the appropriate codes.

#3 – Completeness of the Report

An incomplete report is of no use to the fire officer, the organization, or the court system. Additionally, since incident reports are legal documents, not providing all available information in the report can have legal or administrative ramifications.

An NFIRS report has certain required fields. Often, we only fill in these required fields because that is all we need to do to submit the report. However, there is so much more we can do by providing all of the information we have available to us. By doing so, it keeps us in a safe, legal territory, provides more data for budget justifications, and allows us to better understand the fire problem in the United States.

I would encourage every firefighter reading this article to consider the importance of proper report writing and apply these three fundamentals to every incident report. On top of submitting an error-free report, we must take the time to ensure our reports are accurate and complete.

Communications

COMMUNICATIONS

Effective communication is the basis of good incident management, and faulty communication is the cause of many incident problems.

The purpose of communication is to establish a common or mutual understanding of meaning. Words are arbitrary symbols and have multiple meanings based on prior experience and knowledge of the individual. Communication can only take place if common understanding is established.

The communication process is a chain whose elements include the formation of ideas into messages by the sender and the sending of the message by the sender through a medium, where a second person receives it. The message is then interpreted and translated into action by the receiver (hopefully in the way intended by the sender). It is important that feedback be given the sender to be sure that the receiver understands the message.

Breakdowns in the communication process are the result of poorly organized thoughts, poor speech, noise and other distractions, bad hearing, unfamiliar words and experiences, interruptions, or time pressures.

Listening

Listening is the active, conscious process of receiving, interpreting, and understanding the spoken message. In order to strengthen listening skills, the CO must see listening as desirable and have a readiness to listen and an eagerness to understand.

Suggestions for improving listening skills include:

- Try to find the purpose of every listening situation.
- Physically and mentally concentrate on listening effectively.
- Be patient--one can listen faster than one can speak.
- Stop talking.
- Minimize distractions.

Interpersonal Communications

Through training and using standard procedures at each emergency, the IC needs to sharpen and develop interpersonal communication skills. As the leader, the IC can instill confidence in the decisions that are made and in subordinates who must carry them out by using effective interpersonal communications. "Command presence" is a term that conjures up an image of a person in control of the situation. Through stance, voice inflection, tone, volume, octave level, and setting the example in all procedures, the IC can have a reassuring impact on all those involved in the emergency. Both success and failure are contagious and the IC can be the source of either. The cumulative effect of poor communication skills will be a lack of leadership. In the absence of leadership, chaos can fill the void quickly.

Self-Confidence

To realistically expect subordinates to have confidence in decisions, the IC must first respect and have confidence in the decisions they make. The action plan they develop may, in retrospect, not be perfect but if subordinates believe the plan will work, their aggressive actions will usually overcome any minor shortcomings the plan may have. Short, precise statements given the IC, containing the essential information, contribute to better understanding and reduce the chance for confusion or misunderstanding. Brevity in radio transmissions does not indicate a lack of leadership, but rather can convey decisiveness.

Radio Discipline

A major tool in communication is the radio. It is imperative that the CO establish and promote appropriate procedures in the use of the radio at all times, particularly on the incidents. Many of the methods and procedures also apply in the use of the telephone.

At most emergencies, the adrenalin level of the responders can lead to communication problems that seriously affect the effectiveness of the operations. Everyone with a radio thinks what he/she has to say is more important than what anyone else has to say. This all too often results in a breakdown of radio discipline. Everyone is trying to talk at once. Messages do not get acknowledged, transmissions are cut off, all messages have equal priority, lines of communication become crossed, and control of the scene is lost.

UNDERSTANDING INCIDENT COMMUNICATIONS

Feedback

Communication is only effective when it is two-way. During the initial stages of an emergency, a large amount of radio traffic usually needs to take place. The bulk of the orders are given, information concerning the situation is being gathered and passed along to the responders, and the excitement level is at its peak. Unless proper discipline is maintained, messages get lost in the crush of radio traffic. Critical to any transmission is an acknowledgment the message has been received. Just because the IC transmits to Engine 1 to take a hand line to Side "B" of the building for exposure protection, this does not mean Engine 1 heard the order and will carry it out. Feedback needs to come back to the IC that Engine 1 has received and understood the message. That feedback could be assured if the following radio traffic took place:

IC:	"Command to Engine 1"
Engine 1:	"Engine 1 Go Ahead"
IC:	"Protect Exposure C with a hand line."
Engine 1:	"Copy Protect Exposure C with a hand line"

In less than 10 seconds, the IC has confirmation that Engine 1 has received and acknowledges what the IC was trying to say. Without that two-way communication taking place, the IC might well be confining the fire in Side "B" of the building and arguing later with the officer on Engine 1 why the exposure line was never placed in service on Exposure C.

OPTION

IC:	"Engine 1 Protect the "C" Exposure with a hand line"
Engine 1:	"Engine 1 Clear - Protecting "C" Exposure with a hand line"

Ongoing Feedback

The feedback needs to be ongoing throughout the incident. Using this same example, Engine 1 needs to advise the IC when the order has been carried out:

Engine 1:	"Engine 1 to Command - Hand line is in place on Exposure C"
IC:	"Command Clear"

This lets the IC know the order has been complied with. Engine 1 should tell the IC if they are unable to meet their objective and need additional lines.

The helpless feeling many incident commanders experience is the frustration of not getting information back as to how the crews are progressing. The IC needs as accurate a picture as possible of the extent of the emergency, what is involved, and how the forces at hand are able to deal with it. To gain this information, the IC must rely heavily on the feedback provided by personnel. They need to keep the IC updated on whether or not they are meeting their objectives and of additional information they obtain during the course of the incident.

The above communication procedures form a "model" that will provide for effective communications.

Need for Training

Don't expect radio communications to flow without problems during the high stress atmosphere of an emergency if no training program has been provided to teach personnel proper procedures and use of equipment. Departments need to spend time developing radio procedures that address their needs and establish how communication is to be handled among the agencies with which they function. Time needs to be spent in the controlled surroundings of a training session working on proper use of procedures, improving radio discipline, and proper use of the equipment.

Strange things can happen to people when a microphone is placed in front of them. A lawyer driving a Mercedes Benz may start talking like a long-haul trucker on his CB. Some fire officers are struck mute when required to talk over a radio. Skills need to be developed through training so that they come naturally during the stress of an emergency. Proper procedures and skills should be practiced on all emergency scenes and be the standard rule of the department.

THE NEED FOR EFFECTIVE INCIDENT COMMUNICATIONS

Effective Use of Resources

For an IC to manage an incident capably, the action plan needs to be conveyed in a manner that is clearly understandable to subordinates, with an emphasis on brevity. The IC's ability to communicate orders succinctly and clearly eliminates confusion and gives subordinates defined boundaries in which to operate. This drastically reduces the chance or need for firefighters to function independently or to freelance. A well-communicated action plan keeps emergency personnel functioning as part of the team, and maximizes the capabilities of the tactical resources with which the IC has to work.

The emergency scene is dynamic in nature, not static. It is constantly changing. If the IC is to have an accurate picture of what is going on, the information needs to flow back from subordinates. Procedures need to be established outlining when and how this information is to be transmitted back to the IC. Without periodic updates on how crews are progressing, the IC can be left in the dark, unable to react properly to the changing conditions. Once again, this information should be transmitted in a clear, concise manner.

In looking at problems with emergency communications and the need for procedures, skills, and discipline, one classic example of why poor practices lead to poor scene management can be found in compulsive talkers. They can be identified by the following characteristics:

Key microphone prior to knowing what they are going to say. (Dead air often filled with "uh---uh---."

Broadcast messages whose meanings are either vague, of little importance, repetitive, or rambling. Most likely, all of the above.

Ask numerous questions, the answers to which serve mostly to delay operations. This ties up the radio channel so that others are unable to get in any messages.

If you know a compulsive talker, you can probably add to the list of characteristics. It should be noted that good communications skills, procedures, and training can correct this.

Personnel Safety

Paramount on the list of the IC's responsibilities is the safety of personnel. Effective communication allows the IC to know where personnel are at all times. It allows for coordinated tactical operations so that no one crew is operating beyond the scope of the overall plan and the support of other crews. Personnel can be advised quickly of any safety hazards that may exist at the scene. Swift reaction and attention to any medical emergency can result from effective lines and methods of communication.

In the back of every IC's mind is the fear that one of the personnel will be killed or injured. By using proper communications throughout the emergency scene, the fear can be reduced and the safety of personnel protected.

THE NEED FOR A COMMUNICATIONS MODEL

Clear Text

Earlier, we mentioned the confusion caused by the use of codes. Many agencies and organizations have eliminated this problem by the use of "clear text." In lieu of codes, a standard set of words and phrases is used. This removes the chance for misunderstanding and misinterpretation of codes.

- "Affirmative."
- "Negative."
- "Engine 3 on scene" (at address).
- "Unreadable."
- "Report on conditions."

Resource Designators

In conjunction with the regional communications plan, a standard set of resource designators should be established. Terminology and equipment vary from department to department; it is important that a common understanding be developed of what calling for a particular resource will bring. One department may staff their engines with an officer and three firefighters while another will put an engine in service with only a driver, relying on volunteers to fill the crew at the scene. It needs to be predetermined among the agencies just what is meant by each resource designation.

As with the communications plan, the resource designators should be confirmed through cooperation and compromise on the part of the agencies involved. The Incident Command System (ICS) has a published list of standard resource designators which may serve as a basis for a region developing their designations. It could serve as a solution to such problems as to whether the truck with lots of water is a tanker, water wagon, or water tender.

Once developed, shortened versions are then used for radio call signs which allow for easy identification of resources.

WE SHOULD NEVER CHANGE DESIGNATIONS FROM COMPANY ASSIGNMENTS.

***EXAMPLE**: "ENGINE 1" YOU ARE NOW FIRE ATTACK!*
ENGINE 1 HAS BEEN ENGINE 1 FOR 100 YEARS AND WHEN WE MAKE THEM SWITCH RADIO DESIGNATIONS AT AN INCIDENT WE ARE ASKING FOR MORE CONFUSION.

Face-to-Face

When possible, use face-to-face communication. Face-to-face communication is the most effective form that can take place. It is much easier to convey the message when the person on the receiving end can see the facial expression, hand gestures, and other nonverbal messages the speaker is sending out. The speaker is better able to tell if the message is being received. A blank stare on the part of the person hearing what is being said is not nearly so reassuring as when his/her head is nodding in acknowledgment. The blank stare will indicate to the sender that he or she may need to clarify or expand on what was said. Failure on the part of an IC to recognize the need and effectiveness of face-to-face communication will eliminate the most productive line of information exchange at his/her disposal.

Another advantage of face-to-face communication is the ability to ask questions and seek clarification. For some reason, it is much easier to ask questions face-to-face than over a radio. It may be the fear of possibly asking a "dumb question" which is heard by the entire network or, rather than tie up additional air time, guessing at the meaning. Whatever the reason, face-to-face communication flows more naturally and is easier to understand.

Incident commanders should realize the importance of face-to-face communication, not only because it is the most effective way to pass information, but for the opportunity to have personal contact with key individuals. The IC can use the encounter to build confidence in those who must carry out the directions. It can also boost the spirits of the IC by knowing that worthwhile communication has taken place and has been clearly understood.

Use of Aides

What frequently happens at an emergency is that the IC becomes the head radio operator and spends much of the time on the radio responding to a multitude of transmissions. If extra personnel are available, an aide can be used to screen radio traffic, log information as to the status of companies, handle traffic from the communications center, and relieve the IC of all but the transmissions necessary to carry out the action plan.

Use of Runners

When there are problems with communication due to lack of radios, noise levels, or physical barriers, runners can be used to relay messages. Not only can runners relay messages, but they also can advise the IC of what they saw. This lends another set of eyes and perceptions. Messages carried by the runner can be either verbal or written. If the IC wants to minimize the risk of error, the commander may wish to write brief messages. While delivering messages, the runner should use a notebook to jot notes concerning the communications the IC wants delivered.

THE COMMUNICATIONS MODEL

The model is a six-step process.

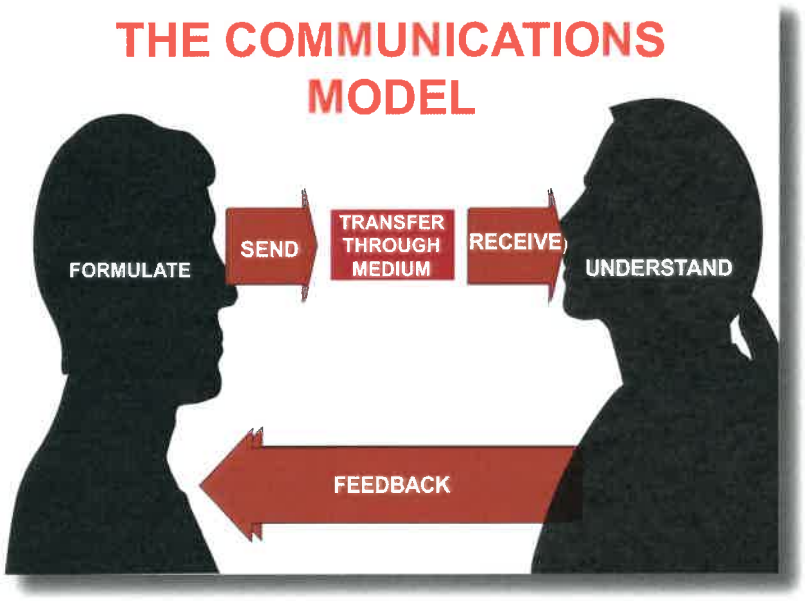
Training in the use of the model makes communication a matter of habit and it also develops confidence in your ability to communicate effectively.

Step one: The sender formulates an idea that he/she wants to convey to another person.

Before attempting to send the message, the sender must have clearly in mind what message is to be conveyed. It is very difficult to make a message clear to others until it is clear in your own mind.

Messages must be concise. Eliminate information that is not essential to the message you are trying to impart. The more information that is included, the greater the chance that important parts will be lost. If it is necessary to send a long message, send it in manageable parts. If the demands of the incident are interfering with your ability to formulate your messages, you must delegate to get back within the span of control. Formulation of ideas takes place in the brain.

Step two: Sender sends message.



The first part of sending the message is getting the attention of the intended receiver. The second part of sending the message is actually conveying the message.

Differences in word meaning are a major source of communication failure. An example is the word "charge." You charge someone a fee for doing a service, you charge a purchase when you want to pay later, you charge a battery when you want it to provide electricity, you charge a horse into battle against the enemy, you get a charge out of something funny, you put a powder charge in a cannon, and you charge a criminal with crimes

Discourage use of ten codes and pet names for apparatus, equipment, or buildings Use clear text and standard resource designators. Clear text is a standard set of words and phrases used as part of your ICS. Standard resource designators consist of standardized terminology used to identify apparatus and equipment.

In the case of written communication, sending occurs when words are written.

In oral communication, it is spoken words that are sent.

Step three: Transfer the message through the medium.

Types of media include verbal (face-to-face), and radio. If written, can the other person read it? Written media are often used at major incidents covering a long period of time.

Visual media include hand signals, signs or symbols (nonverbal), body language, and expressions and gestures.

Training should include proper use of equipment. Outside interference in the form of noise or confusion should be minimized. Equipment maintenance and purchase must have a high budget priority because of the importance of communications to safety and effectiveness. Examples of media by which written communication is transferred include memos, letters, and fax. Oral communication can be transferred by direct conversation, radio, telephone, etc.

Step four: The receiver receives the message.

The first part of receiving the message involves letting the sender know you are ready to receive the message. The second part of receiving the message is actually receiving the intended information. Training and positive reinforcement of good skills should be provided. The receiver should try to minimize background interference. Written communication is received by the eyes and oral communication by the ears.

Step five: The receiver interprets the message.

Training must be provided if the level of understanding of the receiver is not adequate to grasp the sender's meaning. Clear text and standard resource designators provide common terminology. It is

possible that the sender may have sent the message incorrectly or the receiver might have heard it incorrectly. Interpretation takes place in the brain.

Step six: The receiver confirms that the message has been received and understood by providing feedback.

If the message is important enough to send, it is even more important to know that it was received and understood. If there is any confusion or misunderstanding, the sender has the opportunity to correct it. Sender should ask for feedback if it is not provided. Radio traffic is reduced because communications model confirms receipt and understanding immediately through feedback.

Example of Communications Model in action:

Formulation of idea:

Sender: "I want Engine 1 to take 1-3/4" line to second floor." (Thought)

Sender: "Engine 1, Command." (Getting attention of receiver)

Transfer through medium: (Radio transfers message from sender to receiver)

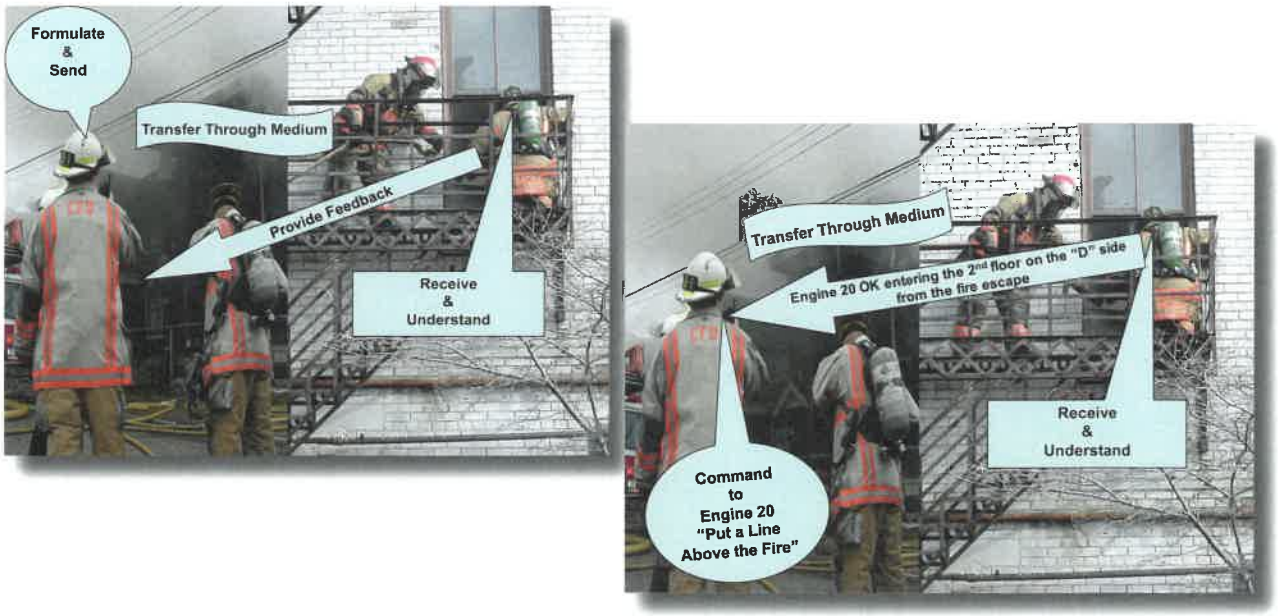
Receiver: "Command, Engine 1." (I'm paying attention)

Sender: "Take 1-3/4" line to second floor." (Conveying information)

Receiver: "I'm going to have my crew take 1-3/4" line to second floor." (Thought)

Receiver: "Taking 1-3/4" line to second floor." (Feedback that Engine 1 understands assignment)

Sender: "Affirmative, Engine 1."



Common Communications Problems

There are a number of roadblocks to effective communications. These should be understood and avoided as much as possible. Some roadblocks can only be resolved on a long-term basis, others may be out of the control of the CO. It remains the responsibility of the CO to identify each communication roadblock he/she is unable to resolve and to bring these problems to the attention of his/her superiors through the appropriate channels of authority.

When firefighters get together to tell war stories and talk about the problems they face, one of the major stumbling blocks to their operating at maximum effectiveness will inevitably be the lack of good communications. Communication is acknowledged by ICs to be their number one problem. When we look at the causes and try to determine what needs to be done to improve our emergency scene communications, there are some basic concerns that need to be examined.

Benefits of Using the Communications Model

The fire service across the country enjoys the reputation of dedicated public servants. One way to improve and enlarge that reputation is by projecting a professional image in the way communications are handled. Other emergency service and governmental agencies will use communications as one of the measures by which to judge your department. When a representative from another emergency agency views your department as being highly capable, cooperation is easier to receive. In addition, you have recruited a supporter who enjoys public credibility.

It is important to any department's growth to have the support of the community. With so many scanners now in use in cars, homes, and carried as portables, few, if any, radio transmissions go unnoticed. What the public hears may likely be the only contact you have with the majority of them, and communications will be the sole criterion upon which they evaluate your department.

Tactical Communications Responsibilities

When communication breaks down on the incident so do coordination, control, and the ability to provide for firefighter safety. All personnel have the responsibility to communicate effectively. This starts with a good brief initial report by the first-in officer, and continues throughout the incident.

There are different types of tactical communications including: initial conditions reports, implementation orders of the action plan, progress reports from officers who are responsible for meeting the action plan, reports of safety hazards or evacuation orders, and tactical benchmarks.

It is important to communicate the completion of tactical operations addressing specific incident priorities.

These are: life safety, incident stabilization, and property conservation.

- Completion of primary search (life safety priority) allows a shift of emphasis in tactical operations to incident stabilization. "All Clear."
- Resources confining the fire to permit search operations can now be applied to extinguishment.
- Stopping the forward progress of the fire allows the IC to shift resources to property conservation. "Under Control."
- Some resources assigned to fire attack and ventilation may be reassigned to overhaul and property conservation.
- When further property loss is stopped, the IC can begin the process of demobilization. "Loss Stopped."
- Resources can be made available and returned to service.

Fire Fighting Benchmarks Operations 203.01D

On Scene

- Announce "On Scene" on FG channel

Water on the Fire

- Announced by 1st Engine to put water on the fire. *"E12 1st Floor, Water on the Fire"*

Primary Search - All Clear

- Announced when its complete - only announce areas completed *"Truck 21, 2nd Floor Primary Search Complete"*. Also announced by Command

Fire Under Control

- Announced by Engine Co. Officer - *"E23, Fire Under Control"* and by Command when determined from Command Post

Secondary Search - All Clear

- Announced when completed and also by Command.

Fire Out

- Announced by Command

PAR

- Requested when fire is reported under control or as outlined in 202.07

All Clear - Remove SCBA

- Announced by Command after SO-2 has monitored air quality.

Make Sure You Use Location Identifiers On All Transmissions: "Engine 5, 3rd Floor to Command, Water on the Fire"

Progress reports from COs. "Report on Conditions."

The tactical operations to which they were assigned are having a positive impact. (Good news.) Assigned tactical operations are not having a positive impact and why. (Bad news.)

Let your immediate supervisor know the nature of the problem. Try to offer a solution to the problem, along with the bad news, since you are usually in the best position to make that determination.

Additional resources that may be needed include: additional crews to assist with the tactical operation, and any additional or specialized equipment.

Advance warning to the supervisor is needed when relief crews will be required and if and when resources might be available for release or reassignment, and periodic reports on the status of the incident and assigned resources.

Progress Reports from COs
"Report on Conditions"

- Advanced warning to the supervisor as to when relief crews will be needed.
- If and when resources might be available for release or reassignment.
- Periodic reports on the status.
- **CAN** Reports
- **C** – Conditions
- **A** – Actions
- **N** - Needs

Reports of safety hazards or evacuation orders. "Emergency Traffic."

All personnel have the responsibility to communicate when safety hazards are identified that may adversely affect firefighter safety or the tactical operation.

A method to quickly convey emergency information should be established through standard operating procedures. Written procedures should include a method to quickly convey this information to everyone on the incident. These should be included as an important part of your department's communications training. Written procedures should also include methods, in addition to radio communications, to notify personnel of imminent danger and of the need to evacuate to safety. These can include: blasts on the air horns, sirens, PA systems, and anything loud and easily understood by all personnel.

Reports of safety hazards or evacuation orders
"Emergency Traffic"

- All personnel have the responsibility
- A method to quickly convey emergency information should be established
- Accounts for all personnel when the structure has been evacuated
- Examples:
  - Water Loss
  - Collapse Concerns
  - Hazards to Fire Fighters

Departmental procedures should include a method which accounts for all personnel when the structure has been evacuated: designated reporting locations, radio checkoff system, and confirmation by supervisors that all personnel are accounted for.

CFD Radio Procedures

701.03 Transmitting Radio Messages

A. Think before you transmit. Radio messages should only be used to:
   1. Give an assignment.
   2. Report the status of an assigned task.
   3. Request resources.
   4. Report a safety issue.

B. All radio transmissions are "Clear Text" and use no codes or CB language.

C. Always follow the manufacturer's recommendations as to the proper method to transmit on any radio.

D. Because some talkgroups will be shared by companies on multiple incidents, radio discipline is essential.
   Use the following guidelines:

   1. Face to face communication is best. Communicate in person whenever practical.
   2. When using the radio clearly identify your company, and the company you are calling, before beginning your message.
      Example: *"Engine 3 to Ladder 3"*
   3. Combine messages if possible. When calling command, do not wait for permission to proceed. Make your request with the initial transmission.
      Example: *"Engine 7 to command, we need an additional line to the second floor"*

E. Use PMDC for all status changes, thus eliminating unnecessary radio transmissions.

F. To avoid asking messages to be repeated, use dispatch printouts, or write down dispatch information if out of quarters. The Fire Alarm Dispatcher will repeat all alarm locations.

G. Members shall avoid transmitting messages when other radio traffic is taking place allowing a few seconds after the last transmission before beginning radio message.

H. Answer all calls promptly; do not assume the Fire Alarm Dispatcher has received your transmission or request unless acknowledged. Field Units do not have to be recognized before transmitting messages relating to fires or fire alarms.

Example: Field Unit: *"Engine 28, investigating at 121 Fifth St"*
Dispatcher: *"OK Engine 28, investigating at 121 Fifth St"*

I. After dispatch of companies, Dispatcher shall broadcast any additional information that will aid field units in carrying out their mission.
Example: *"Attention all units responding to 3028 Woodburn Avenue. We received a report of smoke coming from washing machine in basement"*
NO ACKNOWLEDGMENT BY FIELD UNITS IS REQUIRED.
Dispatcher will require acknowledgment of any message involving lives, person trapped, etc.

EMERGENCY TRAFFIC

701.05 Emergency Traffic

A. The use of emergency transmissions shall be held to a minimum, use only when there is a need to clear all other radio traffic.
B. All requests for additional alarm(s) will be treated as emergency traffic.
C. To establish emergency traffic, the field unit will transmit their unit designation followed by the word "Emergency".
   Example: Field unit: *"Engine 23 Emergency, transmit the second alarm for 3028 Woodburn"*
   Dispatcher: *"OK Engine 23. Second alarm 3028 Woodburn"*

D. All other units will hold radio traffic until the emergency has been cleared.
E. The Fire Alarm dispatcher will announce "*Emergency Traffic Clear*" to signify the return to normal radio traffic.
F. In the event of an extra alarm fire, companies out of quarters on non-emergency tasks are to return to quarters.

"Emergency" - To be used when an emergency is imminent, or has already happened, such as:

1.) A building collapse
2.) A wall collapse
3.) A roof collapse
4.) Rapidly changing fire conditions
5.) Water supply interruption which puts firefighters in a precarious position
6.) Any circumstance that can seriously injure a firefighter
7.) A collapse potential that needs to be investigated
8.) Immediate evacuation of the building necessary for any of the above or for any circumstance the incident commander deems necessary.

D. Emergency Alert Procedure

This procedure shall be used to alert firefighters on the fireground of an emergency condition.

1. To clear all radio traffic on the fireground frequency, the firefighter requesting the emergency shall repeat the word "Emergency" three times. At this time no other radio traffic shall be transmitted until the

MAYDAY TRAFFIC

"MAYDAY" - To be used when a firefighter is in danger.
A firefighter must declare a MAYDAY when confronted by, but not limited to the following situations:

1.) Injured and in need of immediate assistance or unable to reach a safe location under their own power.
2.) Lost / Disoriented
3.) Trapped / Entangled and unable to exit structure before expending air supply.
4.) Low on Air / Low air alarm sounding in conjunction with any other item listed
5.) "MAYDAY" will also be declared by other members and/or RAT Team that locate a member(s) in any of the above situations.

C. Mayday Procedure

The following procedure will be used to alert firefighters on the emergency scene of a Mayday.

1. To clear all radio traffic on the fireground frequency, the firefighter requesting the Mayday shall:
    a. The firefighter shall repeat the word "MAYDAY" three times followed by the **nature of the Mayday, location, identification and Company number of the firefighter(s) involved if possible and what,if any plans they have to remove themselves from the situation.** (Example - "Mayday, Mayday, Mayday, - Firefighter Down - Second Floor - Firefighter Doe from Engine 22) Any Fire Company finding a firefighter down shall declare a Mayday and the mayday information shall be repeated including the manner of removal from the structure. (Example - "Mayday - Mayday - Mayday - Firefighter Down - Lieutenant from Engine 22 - We will be coming out the rear door")
    b. The firefighter shall then manually activate their PASS device.
2. At this time the **Incident Commander** will:
    a. Notify all Companies on the scene of the "Mayday" situation.
    b. Notify Dispatch of the "Mayday" situation.
    c. Order all Companies to switch their radios to the Mayday channel (channel 16 in their current Fire Ground Talk Group) for routine fire ground messages. The original fire ground channel will only be used for the firefighter(s) involved in the MAYDAY, RAT Chief, Rapid Assistance Teams and RAT Assist Teams.
3. **Dispatch** will:
    a. Transmit an additional alarm.
    b. Dispatch an additional District Chief to replace the second on-scene District Chief who has become the RAT Chief.
    c. Dispatch an additional RAT Company.
    d. Page the 40-hr staff (All Call).

ON SCENE REPORTING

701.07 On Scene Radio Transmissions

A. All transmissions are to be "clear text" which by definition is the use of plain English. No codes of any type should be used in communications. In other words, just say what you mean and ask for what you need in as few words as possible.
B. All units shall continue unless the situation is downgraded by naming which units will handle.
C. The first arriving unit and the first arriving District Chief require a brief report for fire runs. This report should include the unit ID and the condition found.
D. It is not necessary to state the obvious; if you are "investigating" it is assumed there is nothing showing.
E. In those instances where the call for an additional company is for manpower only, it should be followed by the word *"Manpower"*. Thus, the officer in charge of the responding unit will know that a source of water is not needed and to report to the Incident Commander or staging area as appropriate.

701.09 On Scene, Size-Up and Status Reporting Terminology

A. SIZE-UP REPORT

1. The first unit arriving at the scene of a fire or 1-Alarm will give a brief size-up report describing the situation.
2. For structure fires, the report should include:
    a. Apparent Conditions
        i. Nothing showing or investigating - (indicates checking)
        ii. Smoke showing - (amount (light, medium or heavy) and location – floor number, basement, attic and side (A,B,C or D – see following diagrams)
        iii. Fire Showing - (amount (light, medium or heavy) and location –floor number, basement, attic and side (A,B,C or D – see following diagrams)
        iv. Fully involved
    b. Structure Type
        i. Occupancy (dwelling, commercial, public, etc)
        ii. Size (large, medium, small)
        iii. Height (assumed 1 story unless reported)
        iv. Construction (frame, brick, or metal)
        v. Occupant Status (occupied, vacant*, unoccupied**, or undetermined)

        *Vacant building is one having no tenants at any time of day.

        **Unoccupied building is one in which tenants or workers usually occupy, but due to time of day, or day of week, no one is in the building.

    c. Action taken
        vi. Investigating
        vii. Fast Attack
        viii. Command
    d. Attack Strategy
        ix. Offensive
        x. Defensive

Quick Assessment

- Height or Area
- Construction
- Occupancy
- **UPON ARRIVAL** Then Apply Rest
  - Life Hazard
  - Location & Extent of Fire
  - Exposures
- KNOWN
  - Apparatus & Staffing
  - Terrain
  - Water Supply
  - Auxiliary Appliances
  - Street Conditions
  - Weather
  - Time
- Other
  - HazMat
  - Special Conditions

Location & Extent

- **Location**
  - Floor & Side or space
- **Extent**
  - Nothing Showing
  - Light Smoke
  - Heavy Smoke = Working Fire
  - Fire or Heavy Fire
  - Full Involvement

Apply It

- **Height**
  - 2-Story
- **Construction**
  - Wood Frame
- **Occupancy**
  - Residence

WHAT ELSE???

Apply It

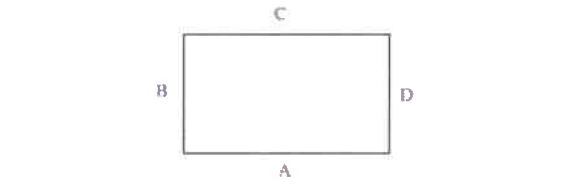
RADIO REPORT
Engine 1 On Scene
2 Story Wood Frame Occupied Residence
Fire on 1st Floor Bravo Side with Exposure On "B" side
Offensive Fire

- **Height**
  - 2-Story
- **Construction**
  - Wood Frame
- **Occupancy**
  - Residence
- **Life Hazard**
  - Occupied
- **Location & Extent**
  - Fire 1st Floor Bravo Side
- **Exposure**
  - Exposure on B side
- ***Report Strategy***

LOCATION DESIGNATIONS

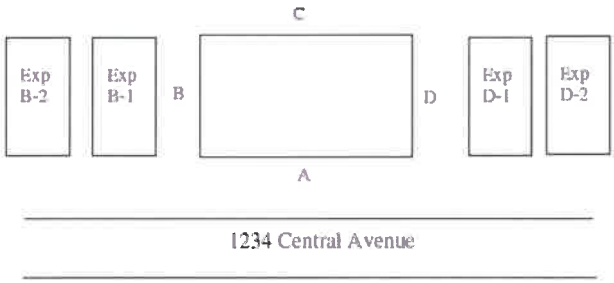
B. Building Side Division Designations

1. Label ABCD
2. Begin with A on the Address Side of the Building
3. Label Clockwise



C. Building Side Division Designations

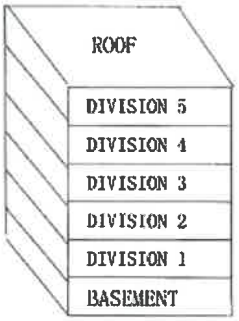
1. Use lettered side of original fire building as described above
2. Add a numeric designation as you move away from the building



D. Building Floor Division Designations

1. Each Division Described by floor number
2. Especially useful in high rise buildings

EACH FLOOR IS A DIVISION



(OR LOBBY)

Button Layout

Volume Control
Clockwise = On/Volume Up
Counter Clockwise = Off/Volume Down

Zone Toggle
Toggles between Zone A, Zone B, and Zone C

Zone Up
Toggles up through the zones.

Push – To – Talk
Press to Transmit

Channel Selector
Toggles between selector 1 - 16

Indicator
LED Red - Transmitting (blinking = low battery) Yellow - Channel busy (blinking = encrypted) Green - Powering Up

Emergency Button
Push to enable, hold down to disable Emergency

Zone Down
Toggles down through the zones.

Keypad Lock
Locks out all front buttons, and side buttons other than PTT

	CFD EMS A	CFD FIRE B-J	CFD SPEC OPS	CFD EVENT	CFD TRAINING	CINTI POLICE	CMA	8 TAC-NWD
	CFA	CFB-J	OPS	EVT	CFT	CPD	CMA	NWD
1	31 MAIN DISP	MAIN DISP	MAIN DSP	MAIN DSP	MAIN DSP	MAIN DSP	CMA 1	MAIN DSP
2	31 EMS	COMMAND B	SOC 1	EVENT F1	TRAINING 2	PF GRND	CMA 2	HOSPITAL
3	31 MVC	STAGING B	SOC 2	EVENT F2	TRAINING 3	CPD DIST 1	CMA 3	UC HOSPITAL 1
4	31 DIST 1 OPS	B TAC 1	ODOT 8	EVENT F3	TRAINING 4	CPD C2C 1	CMA 4	UC HOSPITAL 2
5	31 DIST 2 OPS	B TAC 2	ODOT 8 OPS	EVENT F4	TRAINING 5	CPD DIST 2	CMA 5	CHILD HOSP 1
6	31 DIST 3 OPS	B TAC 3	DISASTER NET	EVENT F5	TRAINING 6	CPD C2C 2	CMA 6	CHILD HOSP 2
7	31 DIST 4 OPS	B TAC 4	USAR 1	PD EVENT 1	TRAINING 7	CPD DIST 3	CMA 7	
8	31 TRIAGE A	TRIAGE B	GC HAZMAT	PD EVENT 2	TRAINING 8	CPD C2C 3	CMA 8	INCI E
9	31 TREATMENT A	TREATMENT B	DIVE TEAM	PD EVENT 3	TRAINING 9	CPD DIST 4	CMA 9	ARSON E
10	31 TRANSPORT A	TRANSPORT B	COAST GUARD	PD EVENT 4	TRAINING 10	CPD C2C 4	CMA 10	INTRNL E
11	31 PF GRND	ALL CALL B	LUNKEN	PD EVENT 5	TRAINING 11	CPD DIST 5	CMA 11	
12	31 HOSPITAL	REPEATER 1	CVG POLICE	PD EVENT 6	TRAINING 12	CPD C2C 5	CMA 12	8 TAC 94
13	31 RIVER	REPEATER 2	31 C400	PD EVENT 7	TRAINING 13	UC POLICE	CMA 13	8 TAC 93
14	31 SIMPLEX A	SIMPLEX B	RIVER RUN	PD EVENT 8	TRAINING 14	XU POLICE	CMA 14	8 TAC 92
15	31 MAJ MED	SIMPLEX 2	NOD DSP	HCMA 5	ALL CALL M	CIN STATE PD	CMA 15	8 TAC 91
16	31 MAYDAY EMS	MAYDAY B	TROD DSP	HCMA 6	MAYDAY M	CVG POLICE	CMA 16	8 CALL90

SCREEN SYMBOL DEFINITIONS

- Blinks when the battery is low
- The more stripes, the stronger the signal strength for the current site (trunking only)
- Direct radio to radio communication or connected through a repeater
  On = Direct
  Off = Repeater
- L = Radio is set at Low power
  H = Radio is set at High power
- Scanning a scan list
- Blinking dot = Detects activity on the Priority-One Channel during scan
- Steady dot = Detects activity on the Priority-Two Channel during scan
- On = Secure operation
  Off = Clear operation

Mic Layout

EMERGENCY BUTTON
Volume
Light
Push-To-Talk
Channel Announcement

SIMPLE SIZE-UP

Trying to remember all 13 or 15 factors (WALLACE WAS HOT or COAL TWAS WEALTHS) when the flames are turning water to steam can make your head hurt. They are better used for training purposes and for keying in on those factors which are present at the incident.

REMEMBER: BELOW

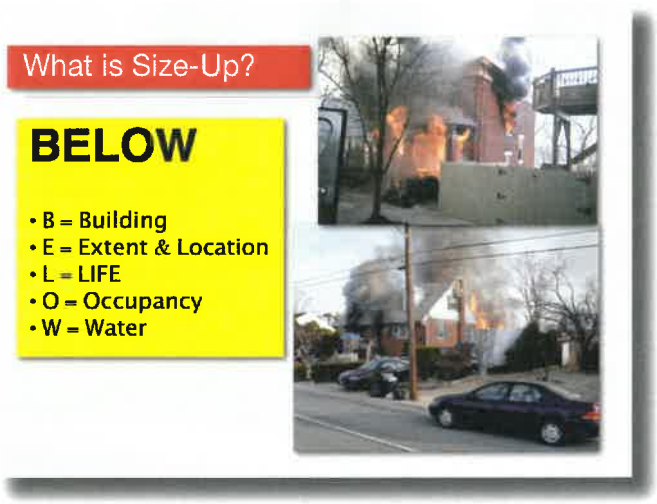
B - Building

E - Extent and Location of Fire

L - Life

O - Occupancy

W - Water



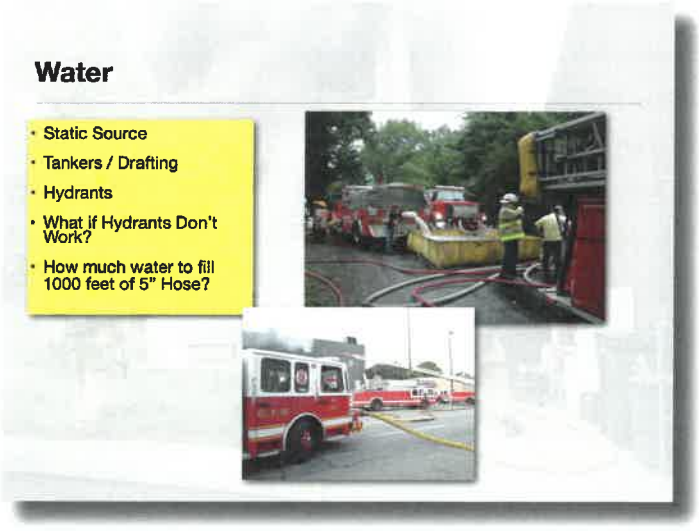
The **BUILDING** is what the building is and how its made, this is different than occupancy. Refer back to the Building Construction section to review key characteristics of Building Construction and Identification. For this segment we will focus on wood frame private and multiple-dwellings.

Determining the **Extent and Location** of the fire upon arrival during our size-up helps you determine quite a few things. Based on the smoke conditions and/or fire conditions you can hopefully determine where the fire is. With this information you can hopefully determine its location in relationship to occupants presenting at openings or where they are suspected based on search parameters. Determining how big the fire is is also important at this point. The large commercial building in the lower right of the above image is charged with smoke to the floor, this means that entire container is charged, which likely means a decent fire within that space. Based on the above factors - you next decide where the fire is going - this is important in relationship to occupants and internal / external exposures. In the upper right image - you can see the fire is rapidly heading upstairs as its venting from the open, unprotected stairway window on the "D" side. The fire on the lower left has potential to spread to multiple places through auto exposure, voids and pipe chases.

Life generally only relates to "Occupants" of the building. When there are no occupants, then the life hazard turns to us as Firefighters. We are going to search all occupancies for people at some point. The difference is we are searching for potential rescue or recover based on the fire conditions and building conditions. Life hazards may be mitigated in unison with fire attack. When someone reports people are trapped in a building it generally "changes" peoples minds and sometimes leads to improper choices on rescue 'vs' fire control. For example, a fire remote in a multi-dwelling where the stairs are not usable by occupants has forced them to their balconies, where they aren't in immediate danger. Focus of first due companies to persons not in danger on balconies takes precious initial resources away from fire attack and searches in areas closer to the fire where people are likely to be in greater danger.

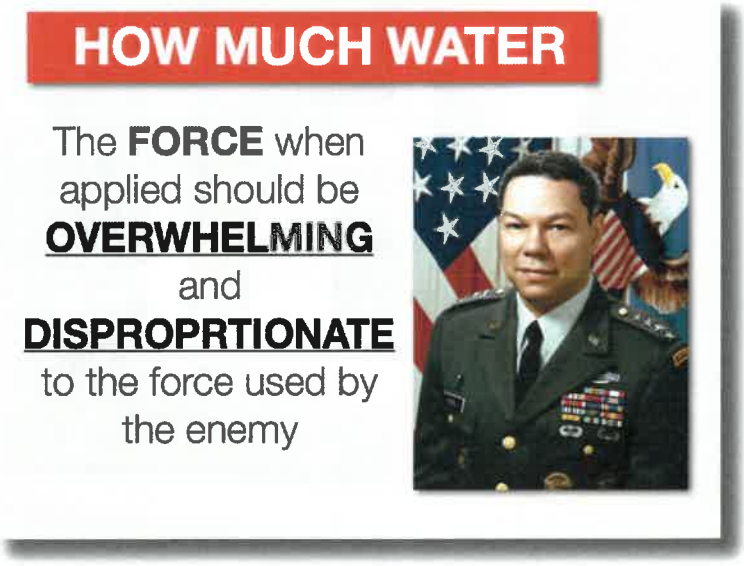
The term **occupancy** has nothing to do with people inside the building - it relates to what the building is used for. Occupancy and life are related and should be considered in the size-up process. You should always expect a Single Family or Multi-Family "Occupancy" to be occupied at anytime of the day. A fast food restaurant in the middle of the night that is closed is likely not occupied. Most commercial, industrial, office, churches, etc. are also not going to be occupied or have high occupancy numbers upon arrival as most people in these spaces are awake and alert - making self-egress possible.
On the flip-side, a hospital or nursing home "Occupancy" is highly likely to be occupied upon arrival.

Water is generally an easy assessment for Cincinnati Firefighters. What happens from time to time is a breakdown in our water system - either due to human error or mechanical error upon arrival at the scene. Human error issues can come from not checking hydrants for water and freezing occurs or a firefighter who charges the 5' supply prematurely causing an inability to secure a water supply.



Additionally, a hydrant may have been struck prior to the fire and went unnoticed by fire companies or bystanders and it is rendered inoperable upon arrival. Hydrants may be inaccessible due to obstructions (cars, shrubbery, etc). In some areas, persons can take brass threads from the hydrants to recycle them - thus rendering the hydrant totally inoperable. Leaking at a loose base or stripping of the stem are also common issues encountered on the fireground. Lastly, water mains can expel debris through the hose and cause a decrease in water coming into the pump as objects get jammed against the intake strainer.

HOW MUCH WATER - the amount of water you deliver will have the greatest impact on the outcome of the incident. We've all heard "The Fire Goes - As the First Line Goes". This is so true; generally you have one opportunity to win and WATER WINS! The amount of water you deliver should overcome the BTU's being produced by the burning objects. Former General Colin Powell military doctrine in the Gulf War was to overpower the enemy by applying a force that is overwhelming and disproportionate to the force used by the enemy. In our world - the enemy is the fire and the force we are applying is water and manpower.



WATER SUPPLY ISSUES

A variety of issues can occur on the fireground and must be prepared for ahead of time. As we will discuss in the next section, its extremely important to know how long your on-board water supply will last on standard hose layouts with standard hose sizes used. This is also equally important to determine from on-board master stream devices. In addition to knowing how long your on-board tank water will last its imperative to know how to troubleshoot and deal with common issues.

Some of the water supply issues encountered are:

Apparatus Operator Mishap or Problem

- This is a problem that really can only be fixed through continual practice and training. If that doesn't work – maybe that person shouldn't be driving.

Apparatus Mechanical Malfunctions

- The apparatus is a big series of moving parts and is bound to break occasionally. Hopefully through continual maintenance, these occurrences can be avoided at a fire. Don't forget with a positive water source, you can still move some water until another option is available.

Frozen Fire Hydrants

- This can occur in areas subject to freezing. With constant maintenance and checking of hydrants for water, this can be minimized greatly. Fire companies should not rely on others to check their hydrants for functionality. This needs immediate communication on the fireground to everyone and possibly additional resources for longer supply hose lays.

Broken or Inoperable Fire Hydrants

- These are also full of moving parts. Often with maintenance and care – hydrants will function when needed. If it breaks immediate communication and further actions are needed just as listed for the frozen fire hydrant.

Blocked or Obstructed Fire Hydrant

- This can or can't be an issue. You sometimes see fire hoses in pictures running through car windows and are all kinked and poorly laid due to the position of the car. If the hydrant has other discharges (side), then with appropriate adapters a supply connection can be made without major kinks. If you are going to use front or side intake directly at the hydrant – you can also move the car with your bumper.

HOW MUCH WATER AND HOW LONG WILL IT LAST

It is extremely important to know how long the water will last in your booster tank while flowing standard fire lines from your engine. Flowing of your pre-connected fire lines, standard 2-1/2" fire lines and various master stream configurations will allow the entire engine crew to know exactly how long constant water flow will last. During evaluation, you should flow water while timing the evolution and make notes of how long it takes to get to ½ tank, ¼ tank and then completely empty (no more water). From previous experience, the empty lights will go out or begin to flash well before you are totally out of water.

What does this do for the engine crew? This evolution is extremely eye opening, especially on standard fire lines (1-3/4") that are most commonly used on the fireground. Imagine knowing by exact visual recognition that your 200 foot pre-connected fire line will flow continuous water for 2, 3 or 4 minutes at continuous flow (obviously different for everyone depending on hose and nozzle configurations, booster tank sizes and amount of GPM you deliver in your department).

Having this valuable information can add a person to help facilitate the hose stretch in a short-staffed engine company by allowing the engine operator to know that they have time to help deploy and flake hose prior to worrying about finalizing a water supply hook-up. It also allows the engine to gain confidence in rapidly using a 2-1/2", portable master stream or apparatus mounted master stream for large fires, exposure control or quick knockdown of large fires.

INITIAL ARRIVAL CONSIDERATIONS

Upon arrival at the scene, you must determine where to position the apparatus. There are many variables to consider, such as: other responding companies, location and extent of the fire, apparatus layout and hosebed configuration and street layouts. Generally it depends on two simple points the building and fire conditions. For Offensive Operations the engine should position to best utilize the hose loads on the apparatus to achieve quick deployment and fire attack. In most situations, the engine should leave access for a ladder company if responding by stopping short or pulling past the building. By pulling past the building, it enables the officer and crew to get a 3-sided view prior to ever exiting the apparatus (which is extremely beneficial). Be mindful of blocking the street of other apparatus when laying supply lines on narrow or congested residential streets. In these situations you may have to consider:

- Reverse lay - stopping at fire building, laying out hose and having apparatus drive forward to hydrant ahead of the fire.
- Not charging supply lines until other apparatus (Ladders) arrive on scene.
- Having the lay-off person move hose to the side of the street

For Defensive Operations the engine should position to best utilize the master stream devices on the apparatus while taking into consideration collapse zones on well-involved building fires. The apparatus may become the most expensive and dangerous exposure if placed incorrectly. When heavy fire conditions are impacting other structures or immediate defensive operations are needed upon arrival to control a fire or protect and exposure, rapid deployment of large fire lines and use of apparatus mounted master stream devices is the only tactic that is beneficial for rapid fire control. In these circumstances, the engine should own the front of the building and crews should be proficient in rapidly operating master stream devices upon arrival.

Key Considerations:

- Position the apparatus to take advantage the hose loads and layouts you have. If you always stretch off crosslays, it doesn't matter if you stop short or go past. If you always stretch off the rear, it will be more difficult to stop short and stretch versus going past.
- You can always stretch more hose, but you can't stretch ladders on ladder companies.
- On wide streets, it might be best to keep the engine close to the building and allow the ladder to be further away and operate over the engine to access the building.
- Consider reverse lays on narrow streets or dead end to limit congestion and keep the street open for other apparatus.
- Non-essential apparatus for function on the fireground (ambulances, rescues, support vehicles, etc.) should position away from the scene to allow access to engine and ladder companies.

The following procedure outlines the fire ground strategy to be employed at structure fires - FROM CFD Operations Manual 203.01, 7/2014.

1. Fire ground operations will fall in one of two strategies, OFFENSIVE OR DEFENSIVE. The two strategies are based on a standard Risk Management Plan that is to be employed at ALL structure fires. This is the basis for this procedure.

    a. Activities that present a significant risk to the safety of members shall be limited to situations where there is a potential to save endangered lives.

    b. Activities that are routinely employed to protect property shall be recognized as inherent risks to the safety of members, and actions shall be taken to reduce or avoid these risks.

    c. No risk to the safety of members shall be acceptable when there is no possibility to save lives or property.

    d. In situations where the risk to fire department members is excessive, activities shall be limited to defensive operations

2. Considering the level of risk, the Incident Commander will choose the proper strategy to be used at the fire scene. The strategy can change with conditions or because certain benchmarks (i.e. ALL CLEAR) are obtained. The strategic mode will be based on:

    a. The building (type of construction, condition, age, etc)
    b. Structural integrity of the building (contents vs. structural involvement)
    c. The fire load (what type of fuel is burning and what's left to burn)
    d. The fire and/or smoke conditions (extent, location, etc.)
    e. The rescue profile (savable occupants/survivability profile)
    f. Treat all buildings as if made from light-weight construction until proven otherwise.

3. The Incident Commander is responsible for determining the appropriate fire ground strategy. Once the appropriate strategy is initiated, it becomes the Incident Commander's job to ensure that all personnel are operating within the strategy. By controlling the fire ground strategy, the Incident Commander is providing overall incident scene safety. The proper strategy will be determined based on the following:

    a. Avoiding simultaneous ***OFFENSIVE*** and ***DEFENSIVE*** strategies in the same fire area. This typically happens by first committing personnel to interior positions, then operating master streams from exterior positions. This places interior crews in danger of injury or death. Darkening down a fire from the exterior while companies are in a protected area away from the fire area is acceptable.

    b. Matching the appropriate strategy to the fire conditions of the structure, and minimizing risk to fire fighters.

4. Managing fire ground strategy should start with the arrival of the first unit and be constantly monitored and evaluated throughout the entire incident. The initial Incident Commander (usually a Company Officer) will include the fire ground strategy in the on-scene report. As Command is transferred to later arriving officers, these officers assuming Command should evaluate the fire ground strategy based on the Risk Management Plan.

5. Fire ground strategy provides a starting point for fire ground operations. Once the strategy is announced, all fire fighters know whether to operate on the interior or exterior of the building.

The fire ground strategy cannot be a mystery to anyone, everyone operating on the fire ground should be operating in the same strategic mode; Offensive or Defensive.

6. OFFENSIVE STRATEGY

Within the framework of the Risk Management Plan, the structure should first be determined to be safe to enter. Once determined safe, an Offensive Fire Attack is centered around RESCUE. When safe to do so, the Cincinnati Fire Department will initiate offensive operations at the scene of structure fires. The following are guidelines for offensive fire attacks:

a. Ensure a RAT team is on the scene or one is responding
b. Initial attack efforts should be directed toward supporting a primary search -- the first attack line should go between the victims and the fire to protect avenues of rescue and escape.
c. Determine fire conditions and extent before starting fire operations (as far as possible).
d. Attack the fire from the interior of the building, however an aggressive interior attack can begin with a stream operating from the exterior of the building prior to attack lines entering. This is called "Quick Water" or Transitional Attack.
e. Command should consider the most critical direction and avenues of fire extension, plus its speed, particularly as they affect:

   - Rescue activities
   - Level of risk to fire fighters
   - Confinement efforts
   - Exposure protection

   Confining the fire is the number one priority; everything else gets better when "water is put on the fire".
f. Command should allocate personnel and resources based upon this fire-spread evaluation.

g. Command should consider the 7 sides of the fire: front, rear, both sides, top, bottom, and interior. Fires cannot be considered under control until all 7 sides are addressed. Failure to do so frequently results in fire extension.

h. Where the fire involves concealed spaces (attics, ceiling areas, construction voids, etc.), it becomes paramount that companies open up and operate fire streams into such areas. Early identification and response to concealed space fires will save the building. Officers who hesitate to open up because they don't want to beat up the building may lose the entire structure.

i. Ventilation is a major support item that should be carefully addressed during fire attack. Ventilation should be well coordinated with the fire attack line. Communication should occur between the ventilation crew and the fire attack line to ensure water is ready to be flowed on the fire prior to the ventilation occurring. This is called "Controlling the Flow Path of the Fire". Ventilation openings should be made in the fire area. Ventilation that is not coordinated and occurs too early, will cause increase in fire intensity and fire spread. This also decreases the time prior to flashover. Controlling the doors is also a method of controlling the fire flow path.

j. *WRITE-OFF PROPERTY THAT IS ALREADY LOST* and go on to protect exposed property based on the most dangerous direction of fire spread. Do not continue to operate in positions that are essentially lost.

k. Command should balance and integrate attack size and position with fire conditions, risk and resources. Many times offensive/defensive conditions are clear cut and Command can quickly determine the appropriate strategy. In other cases, the situation is MARGINAL and Command should initiate an offensive interior attack, while setting up defensive positions on the exterior. THE ONLY REASON TO OPERATE IN MARGINAL SITUATIONS IS RESCUE.

l. The effect of the interior attack should be constantly evaluated, and the attack abandoned if necessary. Strategy changes can develop almost instantly or can take considerable time. Command should match the strategy with the conditions. The Incident Commander controls overall incident scene safety by determining the proper strategy to be used.

m. The Incident Commander should continuously evaluate the structural stability of the fire building so as to change strategy before the building becomes structurally unsafe.

n. Command should abandon marginal attacks when:

- A primary search all clear is obtained and the situation is still marginal.
- The roof is unsafe or untenable. Especially working fires in large unsupported, or lightweight truss attic spaces.
- Interior forces encounter heavy heat and cannot locate the fire or cannot make any progress on the fire.
- Heavy smoke is being forced from the building under pressure and is increasing.
- Command needs to constantly evaluate conditions while operating in marginal situations. This requires frequent and detailed reports from Division/Group Supervisors.

o. It is imperative that Command assign a Roof Division as early as possible during marginal situations for rapid evaluation of roof conditions. In certain situations Command should strongly consider not committing crews to the interior of a structure unless he/she receives a report from Roof Division that the roof of the structure is safe to operate on and under. It is better to go from an offensive to a defensive strategy too soon rather than too late.

7. DEFENSIVE STRATEGY

a. The decision to operate in a defensive strategy indicates that the offensive attack strategy, or the potential for one, has been discontinued for reasons of personnel safety, and the involved structure has been conceded as lost (the Incident Commander made a conscious decision to write the structure off).

b. The announcement of a change to a defensive strategy will be made as Emergency Traffic and all personnel will withdraw from the structure AND MAINTAIN A SAFE DISTANCE FROM THE BUILDING outside the collapse zone which is at least 1 1/2 times the distance of the highest point of the building. Officers will account for their crews and advise their Division/ Group Supervisor on the status of their crew. Division/Group Supervisors will notify Command of the status of the crews assigned to their Division/Group. A PAR (Personnel Accountability Report) shall be obtained after any switch from offensive to defensive strategy.

c. Interior lines will be withdrawn and repositioned when changing to a defensive strategy. Crews should retreat with their hose lines if safe to do so. If retreat is being delayed because of hose lines, and it's unsafe to stay in the building, hose lines should be abandoned.

d. All exposures, both immediate and anticipated, should be identified and protected. The first priority in defensive operations is personnel safety; the second is exposure protection.

e. The next priority may be to knock down the main body of fire. This may assist in protection of exposures but does not replace it as a higher priority.

f. Master streams are generally the most effective tactic to be employed in defensive operations. For tactical purposes, a standard master stream flow of greater than 750 GPM should be the guideline. Adjustments may be made upward or downward from this figure but it is very significant in the initial deployment of master streams.

g. When the exposure is severe and water is limited, the most effective tactic is to put water on the exposure and, if need be, from the interior of the exposure.

h. Once exposure protection is established, attention may be directed to knocking down the main body of fire and thermal-column cooling. The same principles of large volume procedures should be employed.

i. Fire under control means the forward progress of the fire has been stopped and the remaining fire can be extinguished with the on-scene resources; it does not mean the fire is completely out. When the fire is brought under control, Command will notify dispatch utilizing the standard radio report of "FIRE UNDER CONTROL." Dispatch will record the time of this report. Command should initiate a PAR report from all on scene resources.

j. If defensive operations are conducted from the onset of the incident, Command will notify dispatch that there will not be a primary search completed for the affected structure(s).

E. PRE-PLANNING

Will identify major problems and prescribe what is needed to meet them, without going too deeply into step by step actions. Pre-plans may also include apparatus placement for first alarm companies. Pre-plans may modify this topic, but should not otherwise address procedures. Pre-plans are required for buildings equipped with Fire Suppression systems, industrial complexes, or any high hazard building. Pre-plans shall include important information in outline form, and appropriate drawings. Also, see 202.02 Pre-planning.

F. WATER SUPPLY

1. A source of water supply shall be secured by the first-in Engine Company unless the pre-plan preempts this requirement.
2. The water supply should preferably be a 5" supply line, or soft suction. The more pumped water, the higher the overall attack capability.
3. When laying a supply line, do not lay a line or position the Engine company to block access by the ladder company. Preferably lay hose to one side of the street or access road.
    a. On narrow or dead-end streets where access will be limited, Engine Companies should consider utilizing a reverse lay (Crossfire) to a hydrant past the address to allow unimpeded access for the first arriving ladder company.
4. It is the responsibility of each Engine company to provide its own uninterrupted, adequate supply of water. "Provide" in this case does not mean they should necessarily lay the line or that they should pump it. If there is any doubt, lay your own supply line.
    a. If the first Engine is unexpectedly without a supply line, ensure second arriving companies are aware of the situation prior to arrival and can provide a water supply.

5. For each supply hose lay over 1000 feet an Engine company shall be placed to boost pressure and relay water to the initial attack Engine company. An Engine company should be placed every 1000 feet for supply line stretches over 1000 feet.
6. For Defensive or Large GPM operations, FAO's should attempt to connect the 5" supply directly into the side intake to provide maximum GPM flow into the fire pump and avoid any friction loss from the front intake piping.

Fire Behavior

Fire Behavior terminology

In order to be a good officer you must understand basic fire behavior terminology. We will start with "FIRE". Fire is a rapid, chemical reaction that releases heat and light. Before learning the methods and tactics for extinguishing fires, it is important to understand what goes on physically and chemically to make a fire occur. It is also important to understand how a fire behaves in different situations. A fire is a complex chemical process that converts one combination of substances and, at the same time, releases energy in the forms of heat and light. The understanding of fire behavior is the basis for all fire fighting principles and actions.

In order to understand fire behavior, we will begin by identifying the conditions that are necessary for fire (also known as combustion) to occur. Three basic ingredients are required to create a fire: fuel, oxygen and heat. These three essential components are referred to as the fire triangle. First, a combustible fuel must be present. The fuel is the material that burns. Second, oxygen must be available in sufficient quantities. Third, a source of heat must be present. The heat is essential to initiate and sustain the reaction between the fuel and the oxygen.

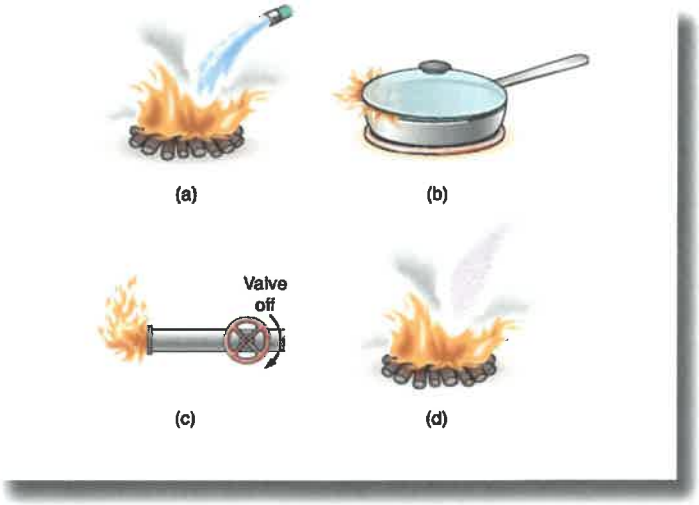
Heat is required to raise the temperature of the fuel and the oxygen to a point at which they will react together. After the fire is ignited, the process of combustion releases heat energy, which is usually sufficient to keep the reaction going. If nothing interferes with the combustion process, the fuel and the oxygen will continue to burn until the supply of one or the other is exhausted.

A fourth factor is often mentioned and is necessary to maintain a self-sustaining fire. A self-sustaining series of chemical chain reactions has to occur in order to keep the fire burning. When this factor is included, the process is represented by a four sided geometric shape called the fire tetrahedron. Each side depicts one of the four factors that must be present for a fire to take place. A fire cannot occur without all four components.

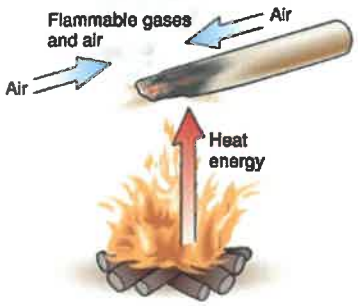
Our objectives as fire fighters and fire officers are to extinguish fires. Although there are many different methods that can be used to extinguish fires, they can be summarized by four main methods: The four main methods are:

- Cool the burning material (figure "A")
- Exclude oxygen from the fire (figure "B")
- Remove fuel from the fire (figure "C")
- Break the chemical chain reaction (figure "D")

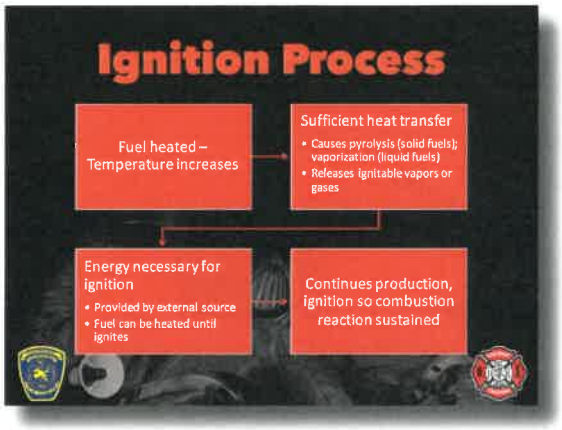
- Water is the universal cooling agent. It expands 1700 to 1 times in a fire compartment, often purging the oxygen and thereby cooling and smothering the fire.
- Carbon dioxide and separates the oxygen from the burning product.
- Dry chemical interrupts the chemical chain reaction of the fire.



Fuel is the actual material being consumed by a fire, allowing it to occur. Any material or matter that will burn is classified as a fuel. The ability of a material to burn is regulated by its composition an physical state (solid, liquid, or gas). Additional factors, such as surface to mass ratio, have a strong influence on the ease of ignition and the rate of combustion for a particular fuel. Most of the combustion process occurs when a material changes from its solid or liquid state to a gaseous state. All matter burns in a gaseous physical state. Because gases are already in that physical state, they become the most dangerous fuel if they are flammable. Also, some liquids, such as gasoline, emit sufficient vapors at ambient temperature to produce flammable gases. Therefore, even though they appear to be a liquid, their flammability and hazard dangers are the same as those of gases. Finally, solids usually require heat from some external force sufficient enough to decompose the solid material into liquid and gases.

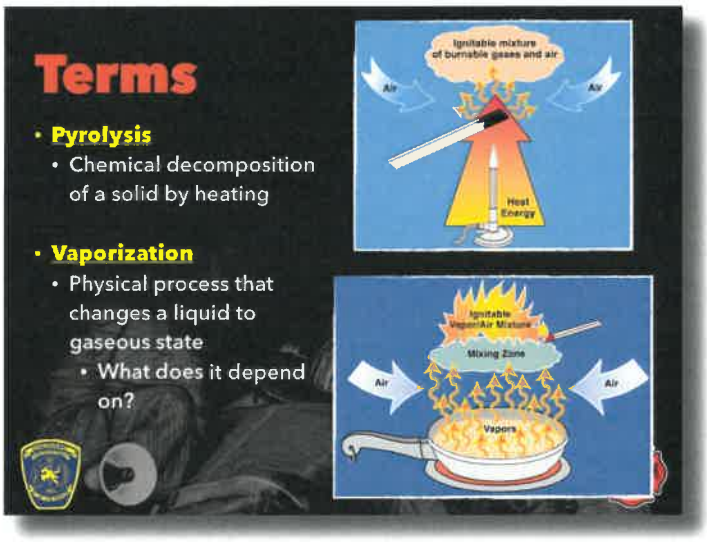


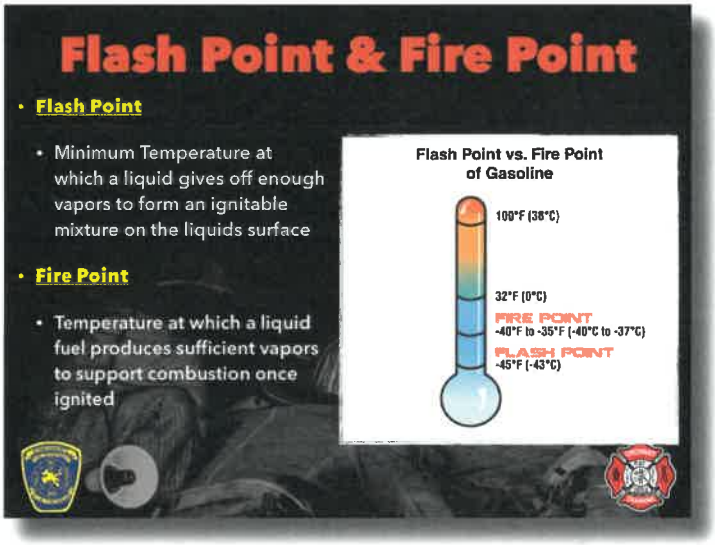
This decomposition process is know as pyrolysis as depicted in the figure to the left. The flammable gases given off by the decomposing solid becomes the fuel, not the solid itself.



Ignition temperature is the minimum temperature required to initiate or cause self-sustained combustion of a material independent of the heat source

Ignition sources must be at least as hot as the ignition temperature of the material in order cause combustion.

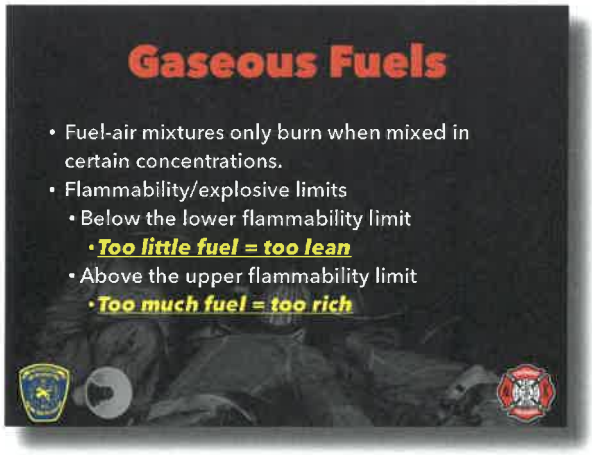




Flash point is the temperature at which a flammable liquid produces enough vapors to be ignited. This is the most important property of a flammable liquid. Flash point is not interrelated to ignition temperature, in fact, flash points are considerably less than ignition temperatures.

Flammable range is the term used to describe the mixtures of flammable gases and air that will burn when they are mixed at certain concentrations. These are often described in terms of flammable or explosive limits. If there is too little fuel (vapor) present in the mixture, there will not be enough fuel to support the combustion process. This mixture is known as being too lean. If too much fuel vapor is present in the mixture, there will not be enough oxygen present to support the combustion. The mixture is known as being too rich. Lower Explosive Limit or (LEL) is used to describe the lower end of the flammable range and Upper Explosive Limit or (UEL) is used to describe the upper end of the flammable range. The material will ignite readily if it is between its LEL and UEL ranges and is considered too lean below the LEL and too rich above the UEL.

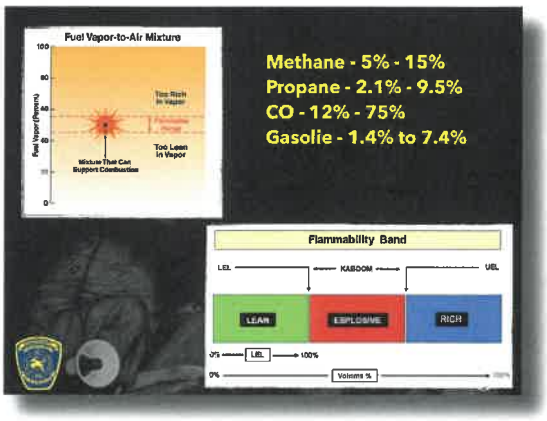
Flammability of Fire Gases - Fire gases are capable of burning in both diffusion and pre-mixed states. The smoke given off in a fire is flammable. Particulate smoke is a product of incomplete combustion and



may lead to the formation of a flammable atmosphere which, if ignited, may lead to an explosion.

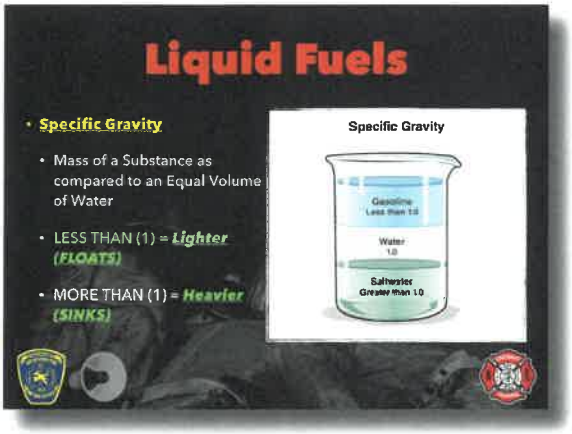
Flammable limits apply generally to vapors and gases and are defined as the concentration range in which a flammable substance can produce a fire or explosion when an ignition source (such as a spark or open flame) is present. The concentration is generally expressed as percent fuel by volume.

Above the **upper flammable limit (UFL)** the mixture of substance and air is too rich in fuel (deficient in oxygen) to burn. This is sometimes called the upper explosive limit (UEL).

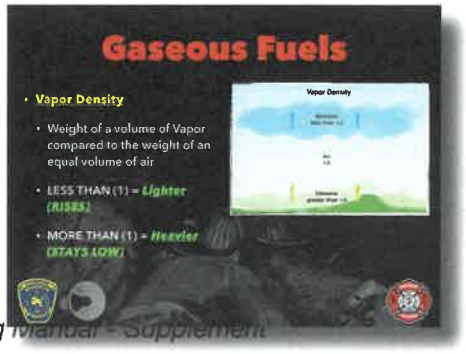


Below the **lower flammable limit (LFL)** the mixture of substance and air lacks sufficient fuel (substance) to burn. This is sometimes called the lower explosive limit (LEL).

Specific gravity is the weight of a solid or liquid substance as compared to the weight of an equal volume of water. Liquids with a specific gravity greater than one will sink in water and liquids with a specific gravity less than one will float on water.

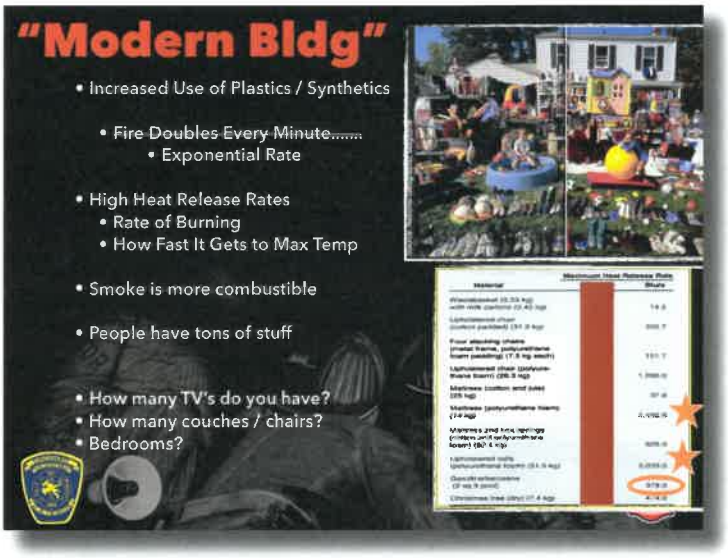


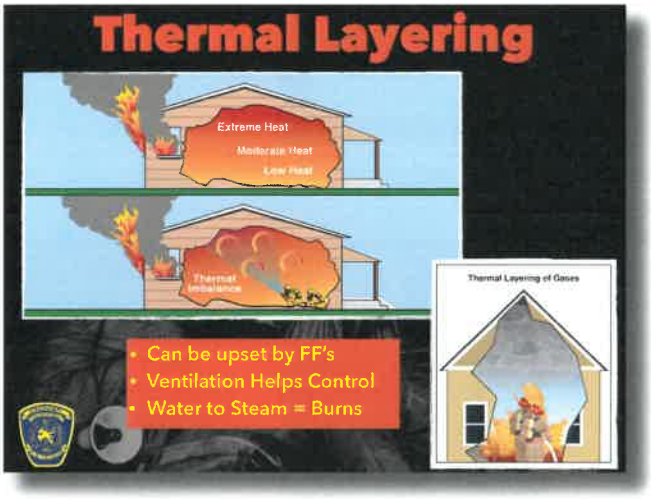
Vapor density of a vapor or gas is its relative density as compared to air. Any vapor with a vapor density of less than one will rise in air and eventually dissipate. Any vapor with a vapor density of greater than one will sink in the air and stay close to the ground.



Spontaneous Ignition occurs when a substance a molecule is oxidized by ambient air on a substance. The combination of the substance and the molecule releases energy. If the substance and the molecules are compacted tightly enough together and there is sufficient air present, the insulating effect of the substance retards dissipation of heat being generated by the chemical reaction and the substance is heated to its ignition temperature and ignites.

Heat Release Rate - The amount of energy (fire intensity) released by burning materials is recorded in Kw or Mw/sq.m. In a compartment fire a minimum level of HRR is normally required before 'flashover' can occur - this can be increased by - (1) an increase in the area of the ventilation opening; (2) an increase in the compartment size; (3) an increase in hk which depends on the thermal conductivity of the compartment boundary.





Thermal Balance - The degree of thermal balance existing in a closed room during a fire's development is dependent upon fuel supply and air availability as well as other factors. The hot area over the fire (often termed the fire plume or thermal column) causes the circulation that feeds air to the fire. However, when the ceiling and upper parts of the wall linings become super-heated, circulation slows down until the entire room develops a kind of thermal balance with temperatures distributed uniformly horizontally throughout the compartment. In vertical terms the temperatures continuously increase from bottom to top with the greatest concentration of heat at the highest level.

Under-Ventilated Fire - Unlike the ventilation controlled fire an under-ventilated fire is not recognized as a burning regime but rather a situation where fuel-rich conditions have accumulated within a compartment. The situation may not involve a fully developed fire and may only be in a state of smoldering. The conditions may or may not present warning signs related to backdraft.

Ventilation Controlled Fire - Sometimes referred to as an 'under-ventilated fire' although this may be incorrect (see 'under-ventilated' fire) - most fully developed fires that occur under confinement or within a compartment are ventilation controlled and burn under fuel-rich conditions. In these situations the highest temperatures are normally noted at the ventilation openings. The rate of air supply is insufficient to burn all the fuel vapors within the compartment, possibly leading to much external flaming.

Fire development stages

A fire officer must understand the stages or phases of fire growth. When fuel, heat, and the necessary chain reactions are all present under adequate circumstances, a fire will occur. As a typical fire progresses, it will pass through four distinct phases, unless the growth process is interrupted. The phases of fire are as follows:

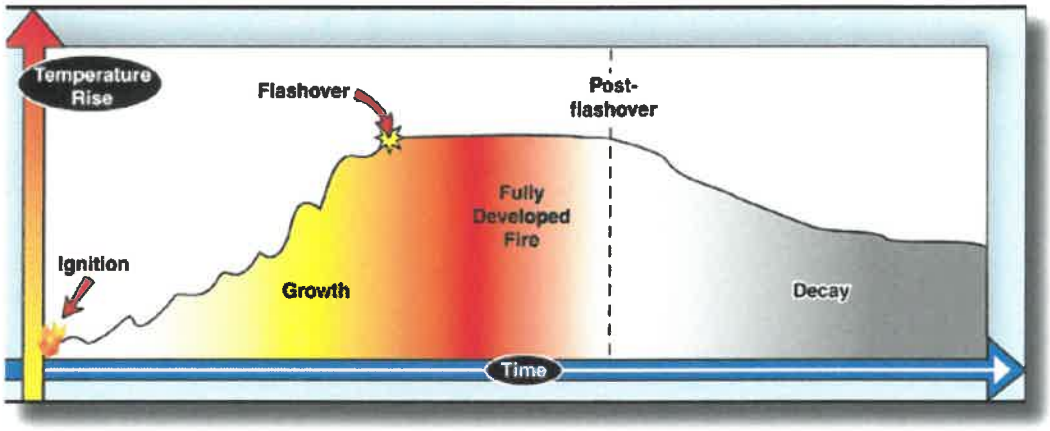
Ignition

Growth

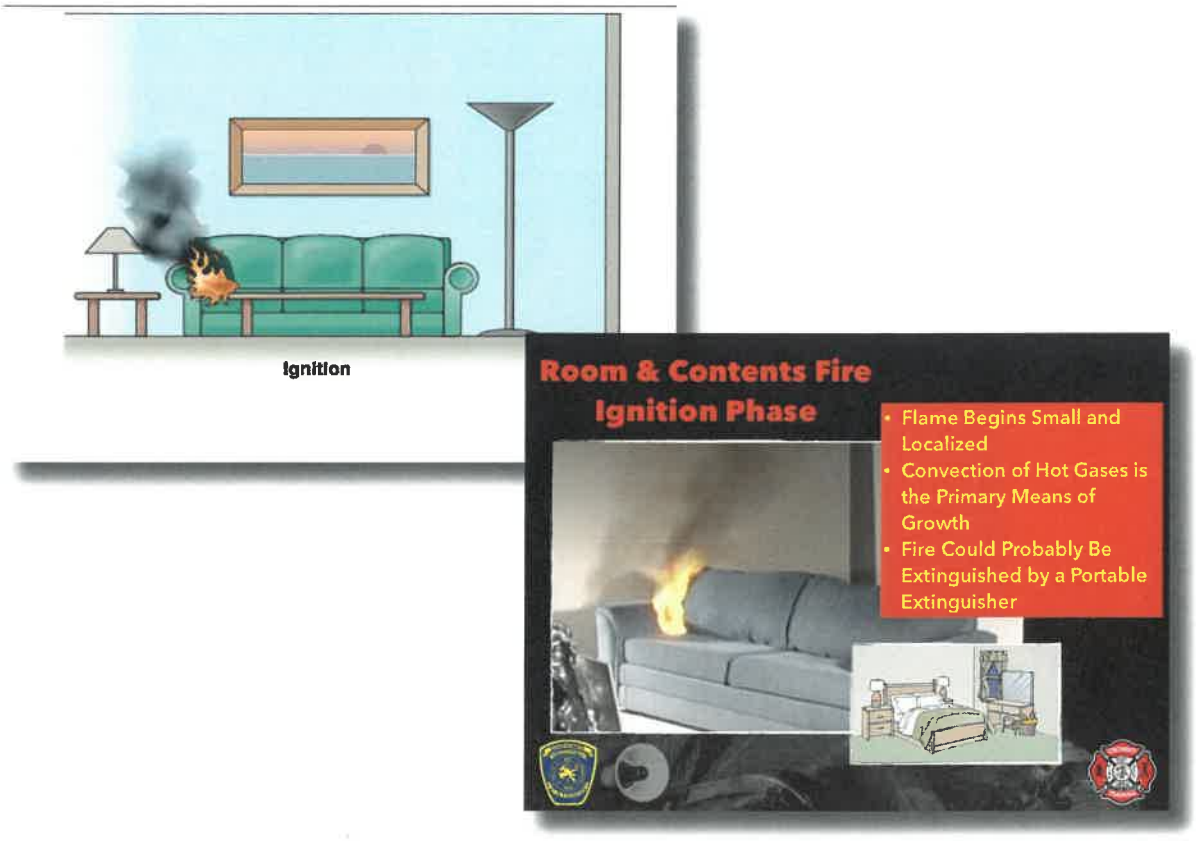
Flashover

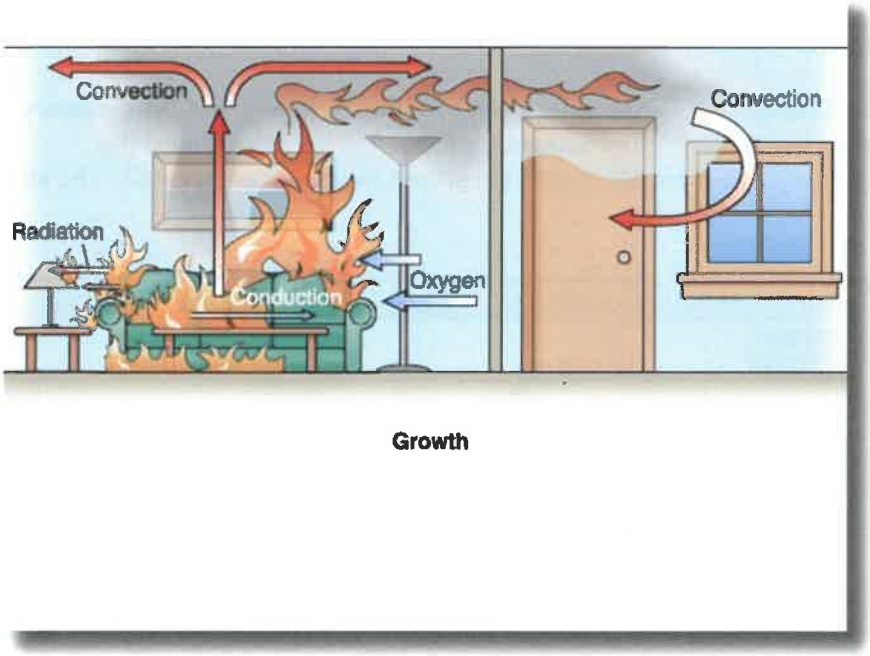
Fully Developed

Decay



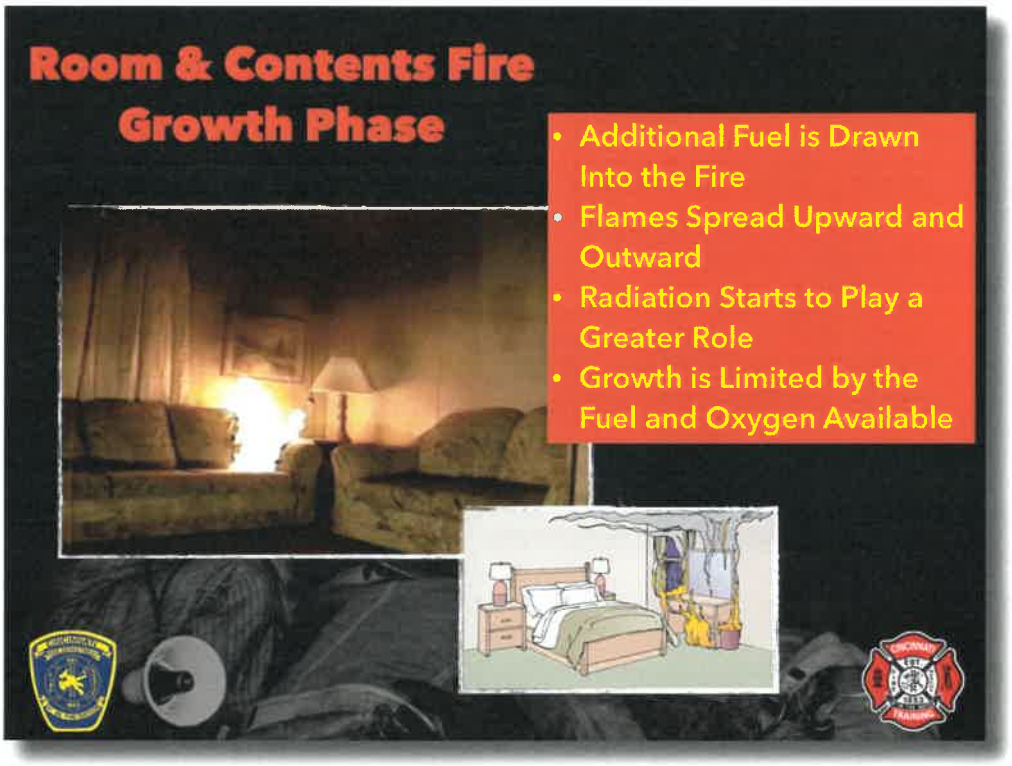
The **ignition phase** is the starting point of the fire. When all four parts of the fire tetrahedron are present and the fuel is heated to its ignition temperature, ignition occurs.

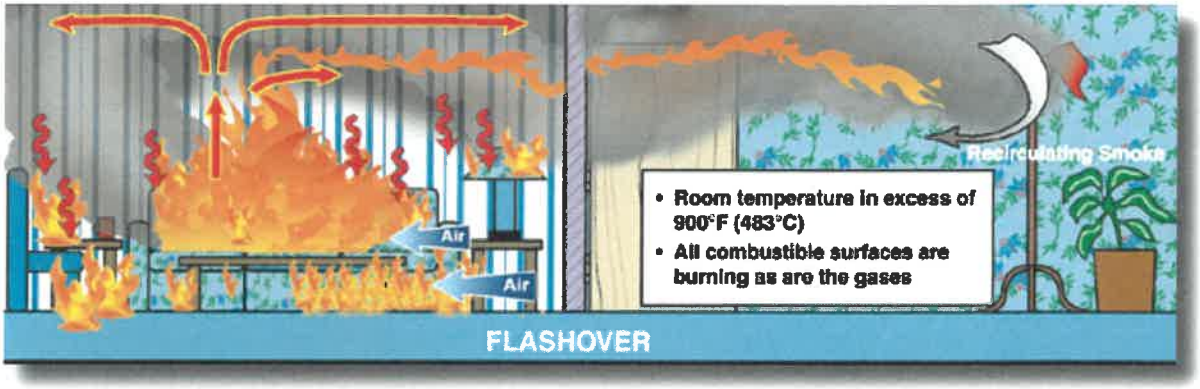




Growth

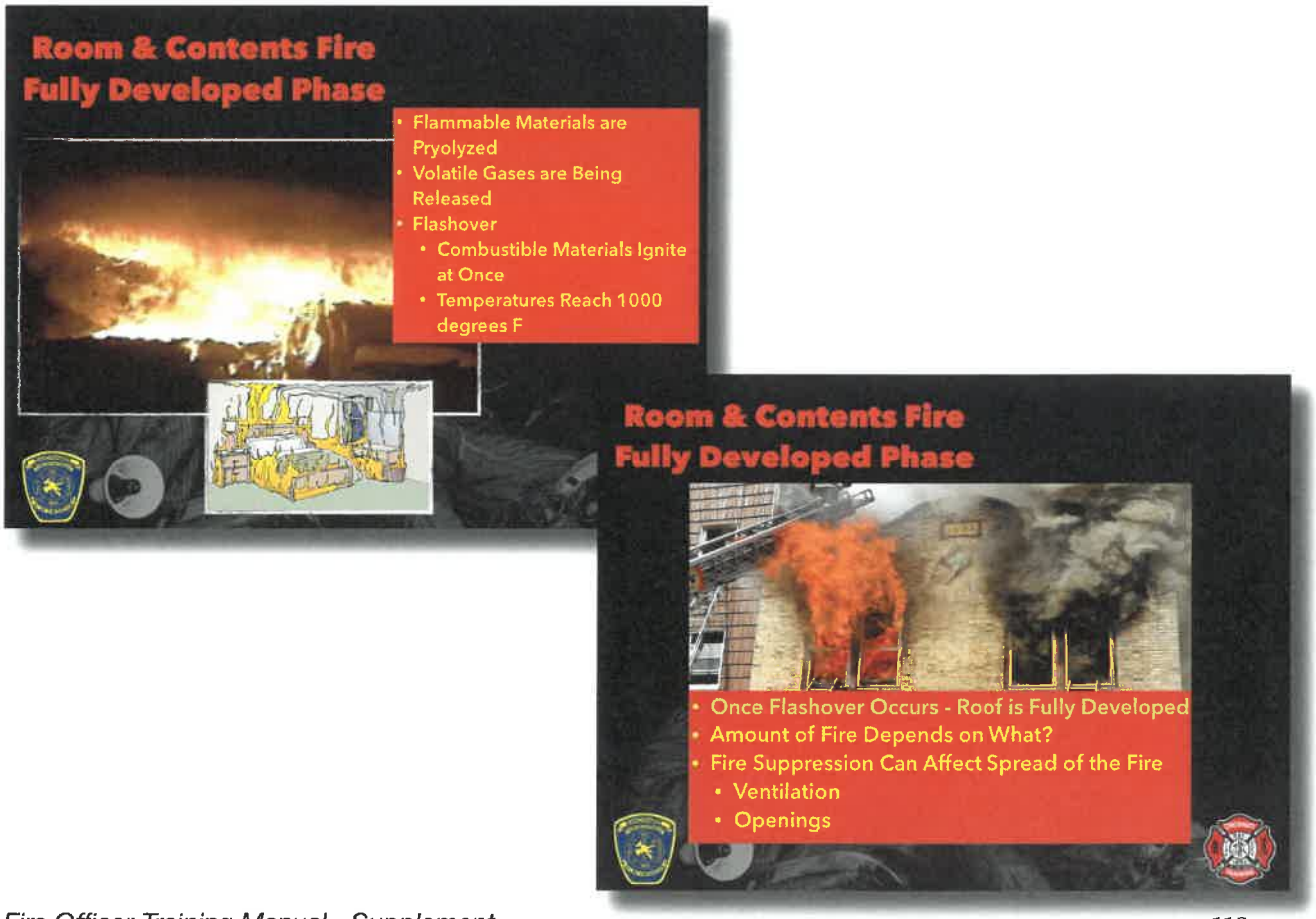
During the **growth phase** of a fire, additional fuel becomes involved in the fire. A combination of convection and radiation ignites more surfaces of the objects closest to the original fire. As more fuel is ignited, the size of the fire increases and the visible plume of smoke and fire gases reach the ceiling. The convection flow begins to draw additional air into the fire. With additional air more fuel becomes involved. Hot gases from the plume flow across the ceiling and begin to bank down in the smoke at the walls. This is where thermal layering begins and the creation of the thermal balance is starting within the fire compartment. The fire will continue to grow as long as there is sufficient oxygen present and the fuel source is maintained.





Flashover is the point between the growth phase and the fully developed phase where all the combustible materials in a room become ignited. Most fires begin small. As a fire grows in size, the combined forces of radiation, convection, and conduction cause the surface temperatures of all other combustible materials in a room, space, or fire compartment to approach their ignition temperatures. The surface temperatures reach a point where individual items begin to ignite in rapid succession. As each additional item ignites, it adds more heat energy to the room. At the flashover point, all of the remaining items reach their ignition temperatures at virtually the same time. Suddenly everything in the room or fire compartment begins to burn, releasing energy at a much faster rate. Temperatures reach 1000 to 2000 degrees in a matter of seconds.

When a fire has progressed past flashover it goes to the fully developed phase. During this phase all materials have ignited and are producing heat at their maximum rates. During this phase oxygen is consumed rapidly.



The final phase is the **decay phase**. At this point the fire is running out of fuel. The atmosphere is still hot and heat energy is still being released; however, the rate of combustion is slowing down. The fire decrease to a smoldering state, consuming all of the fuel and oxygen that is available. Eventually, all fuel will be consumed and the fire will go out.

FIRE BEHAVIOR FACTORS AND PREDICTION OF WHAT IS HAPPENING

An important part of your job will be the ability to make an accurate fire behavior prediction. Understanding fire behavior factors will assist you greatly in determining what is happening and what is likely to happen. They will have an impact on safety, strategy, and the use of resources. Those factors are:

- Heat release
- Thermal stratification
- Rollover
- Flashover
- Backdraft
- Heat Release

Heat Release

Heat is described in several ways, all of which bear a definite relationship to each other. In order to better understand the concept of heat, the following definitions are necessary:

British thermal unit (Btu):

One Btu is the amount of heat required to raise the temperature of 1 pound of water 1 degree Fahrenheit (F), (when the measurement is performed at 60 degrees F).

Knowledge of the types of materials present in a given fire situation and their heat values is important, and can assist you in determining the amount of water to apply, as well as the behavior of other materials within the environment.

Heat of combustion: The amount of heat that will be released by a substance when it is completely consumed by fire.

There are a number of variables which influence the output of heat from burning materials. Some of these factors are:

- The amount of area of solid combustibles exposed to heat and oxygen (the state of subdivision).
- The area of free surface of the liquid (in case of flammable substances to give off vapor pressure).
- The conductivity of solids (wood, etc.) which can influence the amount of heat given off when materials burn.

Even though the heat values (in Btus) of various materials are not precise, they provide us with necessary information for developing the concepts of "fireloading" and the heat absorption qualities of water. Some examples of the heat of combustion values of various materials are shown in the following table.

Materials	Btu/lb.
Asphalt	17,150
Cotton batting	7,000
Gasoline	19,250
Paper	7,900
Polystyrene	18,000
Polyvinyl chloride	7,500 to 9,500
Wood	7,500 to 9,050

Thermal Stratification

Thermal stratification is the layering of heat in a given enclosed area. The ceiling or upper area will be a higher temperature. Floor covering materials are potentially less hazardous than ceiling or wall surfaces.

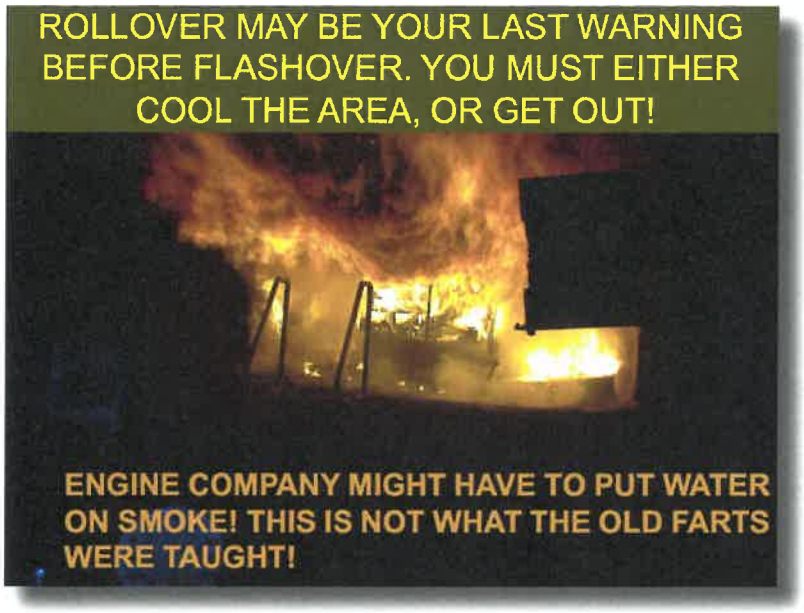
In the pre-fire inspection, you should not ignore the degree of combustibility of materials used throughout the occupancy. In the MGM Grand Hotel fire, the use of plastic materials in ceiling areas impacted dramatically on the fire behavior.

The introduction of water through a nozzle will rapidly change the thermal stratification of the enclosed area. In most cases, a thermal balance will occur following the introduction of water. The temperature in the room will equalize.

If the thermal balance is disturbed, temperatures can be raised beyond the point where any victims trapped inside would have a chance of surviving. Wide fogs applied into a room can turn the water into superheated steam, endangering both potential victims and firefighters. Full protective clothing and SCBA are a must for firefighters.

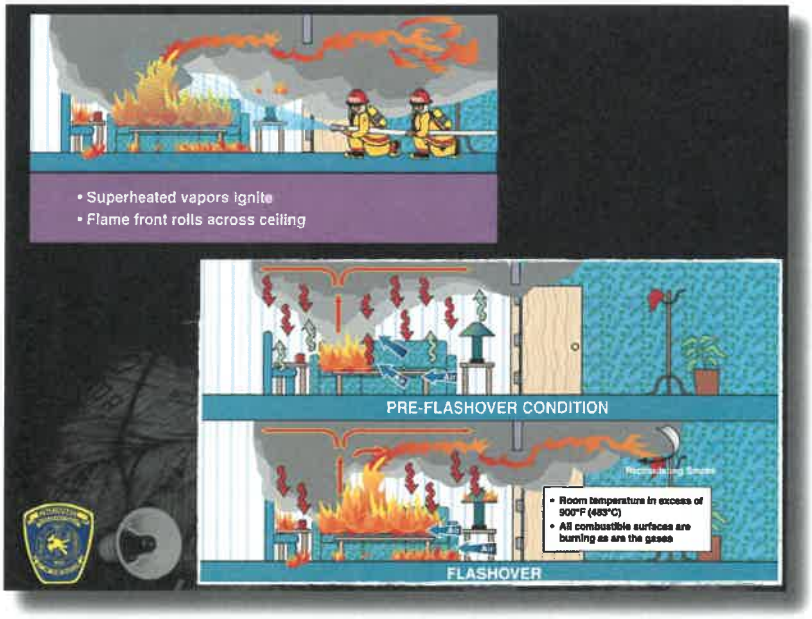
Rollover

The term rollover is used to describe the fire or flame front that is often observed rolling along in front of the materials that are actually burning. As a combustible gas is produced and liberated from combustible materials it must mix with air (oxygen) in order to burn. Since the material that is burning consumes tremendous amounts of air (oxygen) there may be a limited amount of air (oxygen) in the upper levels of the room to support combustion of all the fuel being produced. This fuel rich atmosphere will be pushed in front of the fire by the thermal column of heat from the fire and may not come within its flammable limits for several feet away from the main body of the fire. This is especially true in confined areas such as hallways. Often fire seems to be rolling along at ceiling level at a distance up to 10' to 20' ahead of the main fire. What is actually being witnessed is a fuel rich mixture being pushed well ahead of the fire; when it comes into its flammable limits (mixture of air and fuel gas) it burns. This is often described as the fire rolling over.



Flashover

A very basic definition of flashover is the ignition of combustibles in an area heated by convection and radiation, or a combination of the two. The combustible substances in a room are heated to their ignition point and almost simultaneous combustion of the material occurs. In other words, the entire area is preheated to its ignition temperature and can become fully involved in fire in a matter of seconds. The transition from the growth to the fully developed stage, called flashover is the most dangerous time during a fire.

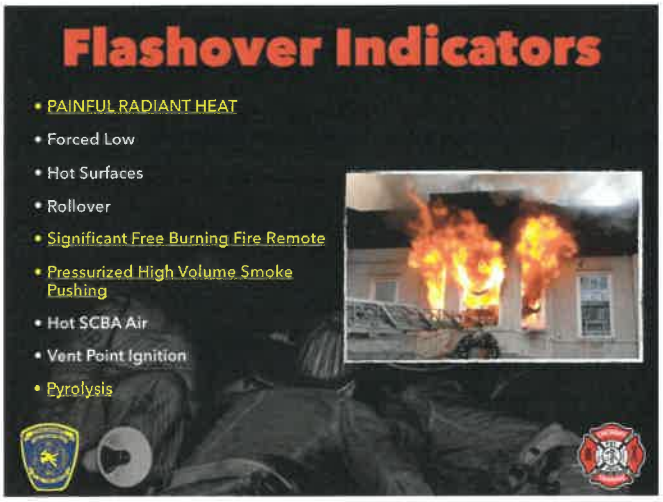


Some of the warning signs of imminent flashover are: intense heat; free-burning fire; unburned articles starting to smoke; and fog streams turning to steam a short distance from the nozzle.

To reduce the chance of flashover, temperatures need to be lowered quickly by ventilation and water application.

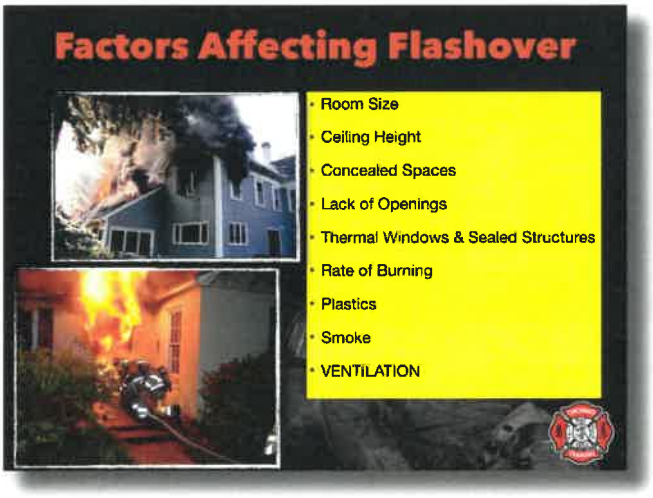
Flashover is often the most deadly condition for fire fighters and victims because it occurs almost instantaneously often without many warning signs except intense heat, pressurized smoke and possibly rollover. Flashover signals the end of an effective search and rescue operation in the involved fire compartment. Flashover usually signals the change from a contents fire to a structural fire.

A fire fighter in full protective gear (PPE) cannot survive flashover for more than about 2 seconds. The sudden increase in temperature overwhelms the protective capabilities of the PPE and allows heat to be transferred to your skin. It only takes an increase from normal body temperature to about 130 degrees to start the burning process to your skin. The common warning signs of flashover are:



- Dense black smoke pushing out of a doorway or window opening under pressure. The smoke moves several feet from the opening as it is being pushed by the high heat in the fire compartment. The dense black smoke is often referred to as black fire.
- Intense heat felt through the fire fighters PPE.
- Pyrolysis of surrounding solid materials.
- Rollover or fire above your head during interior operations

The only thing that fire fighters can do to prevent flashover is to be aware of their surroundings and cool the fire environment prior to it reaching flashover. Advancing without a charged hose line or committing too far on an interior search without the protection of a hose line in conditions that are imminent for flashover is extremely dangerous. To prevent flashover you must apply water into the smoke carefully to cool the superheated gases and atmosphere within the compartment. You can also prevent injury by exiting the atmosphere or by providing ventilation. Early ventilation prior to hose line placement may intensify the fire and allow for quicker spread and transition from the growth stage, through flashover and into a fully developed fire. Ventilation will initially release heat, but then allow for more rapid fire spread.

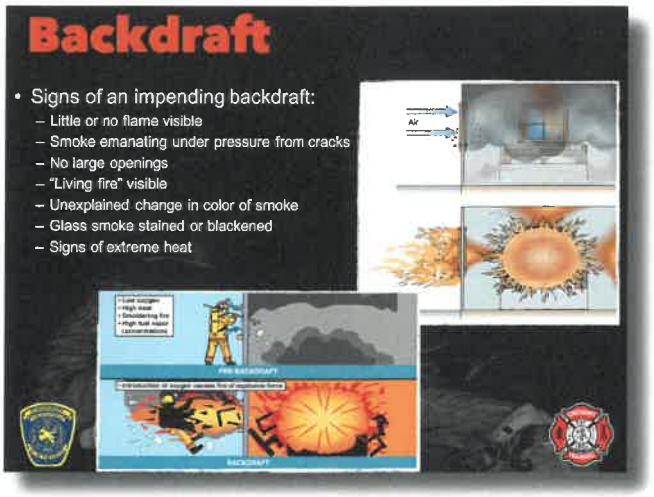


Whenever flashover conditions exist, defensive search procedures must be utilized. When entering a room through the doorway, you should check behind the door for a victim and quickly scan the fire compartment visually and with a TIC and also call out for victims. If no response, close the door if possible and await the engine company. If you are entering rooms via the fire escape or portable ladder look for signs of rollover in the smoke exiting the window. If rollover is

present, do not enter the window. Instead, crouch below the heat and sweep the interior area and windowsill with a tool to attempt to rapidly locate any victim that may have collapsed near the exit.

Backdraft

As a fire develops, the combustion process creates an atmosphere that is deficient in oxygen and can lead to the possibility of backdraft occurring. This is also referred to as a smoke explosion. The difference between flashover and backdraft is the amount of oxygen present. In flashover there is adequate oxygen available for combustion, and the fire is free-burning prior to flashover. In backdraft, there is insufficient oxygen for active burning, and the fire is smoldering. It is an oxygen-deficient atmosphere.



Normally, sufficient oxygen is present during most fires so that the conditions leading to backdraft are minimized. However, when oxygen is depleted and the fire begins to smolder, an oxygen-deficient atmosphere is created in the fire area. When conditions like this develop, gases such as carbon monoxide and carbonaceous-particle smoke or suspensions are produced. These are capable of reacting with oxygen.

This poses an explosion threat if oxygen is improperly allowed to enter the structure. The accumulated gases will ignite readily, spreading fire or causing a violent explosion. Due to temperatures in the room, the fuel is evolving into ignitable vapors at or above their ignition temperature. All that is needed is oxygen to complete the fire triangle.

When backdraft conditions are present and oxygen is introduced before the inside pressure is relieved, the resultant explosion can blow firefighters and their hoses to that great fire station in the sky. The potential for backdraft exists in buildings, rooms, attics, or any other confined space. An indication of backdraft is when a fire has depleted the oxygen content in an area, yet has preheated that space above the ignition temperatures of the combustibles in it. Another indicator is hot, heavy smoke issuing from the building (smoke is sometimes described as lazy, or sick-looking). This may be accompanied by dark carbonization on the window glass. In this situation, the building may seem to be breathing (drawing smoke back in the opening followed by expelling smoke from the opening). Backdrafts may occur during the incipient phase as well as the smoldering phase.

Ventilation is the first priority and must precede fire attack under backdraft conditions.

Fire Travel Predictions

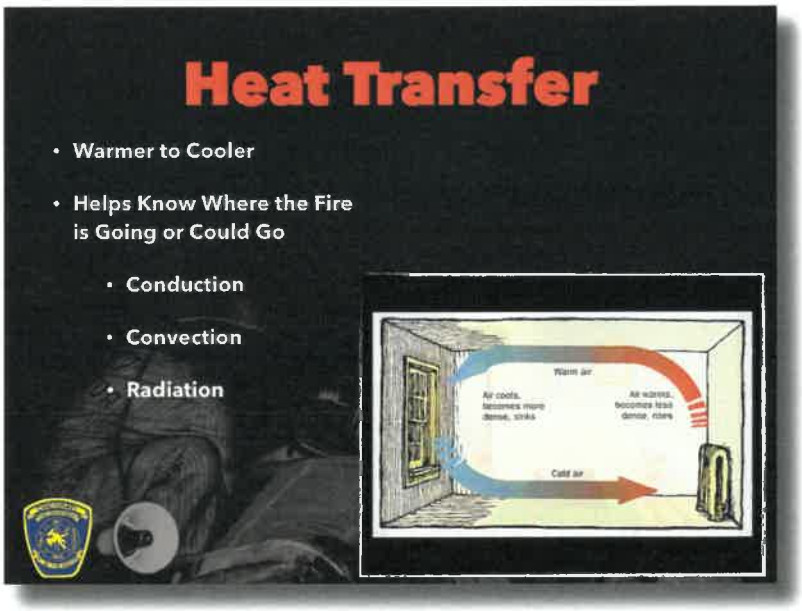
Heat and Smoke Travel

Checking fire extension requires knowledge of how fire spreads, along with knowledge of building construction features and the effects of concealed vertical and horizontal spaces. Whenever and wherever openings are made, hose lines should be ready. While every effort should be made to minimize damage to the building and its contents, openings have to be large enough for inspection, hose manipulation, and ventilation.

Until determined otherwise, it is a safe assumption that when a working fire exists inside a building, fire has entered concealed vertical channels.

Personnel should be looking for indicators such as blisters and discolorations on walls, smoke patterns at molding, walls hot to the touch, or smoke (or fire) showing around roof features, such as vent pipes, etc. If these are present, checking vertical extension is a must.

The tendency for most fire to travel vertically does not preclude horizontal travel. Fire will follow any path available: void spaces between ceilings and floors, over false or hanging ceilings, around utility conduits, etc. Extension occurs not only within the structure, but also from building to building. Here again, hose lines must be in place prior to opening up these areas. Most of the time, the indicators of fire in these areas are difficult to read, but look for some of the indicators present in vertical spread. These areas should not be overlooked and have been responsible for fatalities, as well as for fires getting out of control.



Tactical operations in large and complex occupancies will have to be carefully coordinated in order to accomplish a reduction or change in heat and smoke travel. Ventilation is a key tactical operation that will affect how, when, and where heat and smoke spread through a structure.

In your pre-fire inspections and plans, always look at all the possibilities of heat and smoke travel in a specific occupancy. The time of the fire is not the time to study heat and smoke probabilities.

Based on the fire behavior factors and resource capabilities, you must make a fire behavior prediction which answers the following questions:

- Where is the fire at this time?
- In what direction is it likely to spread?
- Is there a probability that flashover is imminent?
- Is there a probability that backdraft is imminent?
- Is collapse likely to occur within the time required for offensive operations?

Once you have the answers to these questions, you have identified the problems and can have a much clearer idea of what the resource needs are.

The travel of fire in structures can be predicted based upon a good understanding of building construction and fire behavior factors. Fire, smoke, and heat travel are dependent upon many factors such as void areas within the structure, the effect of the wind, and the positioning of hose lines.

The building layout and design can be an advantage or a disadvantage to your fire confinement and suppression efforts. Fires in large open areas will generally be more difficult to confine than fires in a compartmented area. Items such as fire load and built-in fire protection features will affect your efforts. Items such as firewalls, fire doors, and automatic sprinkler systems can play a major role in the amount of resources you will need and efforts it will take.

Fires generally spread from room to room via open doorways or through doors that are lightweight and do not last more than a few minutes under fire conditions. Fires generally spread from floor to floor via open stairways or via open shafts and voids.

Fire travel predictions can be made by asking a few basic questions:

- Where is the fire now?
- Where is the smoke showing?
- What is in place to stop the spread of the fire and smoke to other areas of the structure, such as firewalls or other fire resistant materials?
- What signs do I see such as discoloration of paint, bubbling tar, or other building reactions that will provide me with clues as to the fire travel?

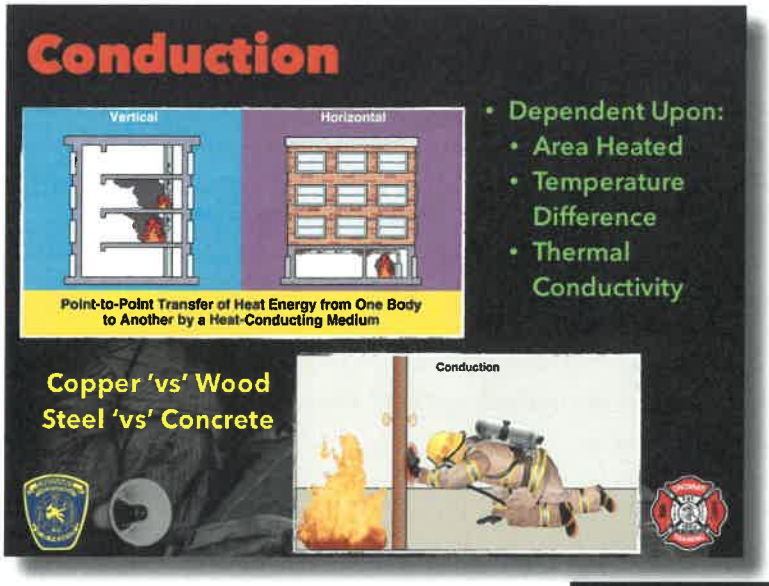
The ability to predict fire travel will provide an officer accurate predictions that can lead to successful operations, realistic and proactive decisions, and adjustments as needed.

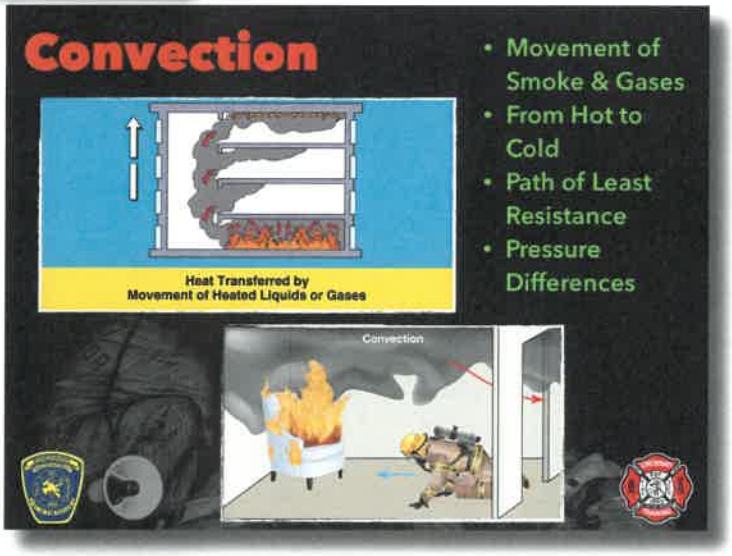
A good fire officer is an informed officer. An informed officer will be a well trained officer. A well trained officer will be a safe officer. Be careful out there!

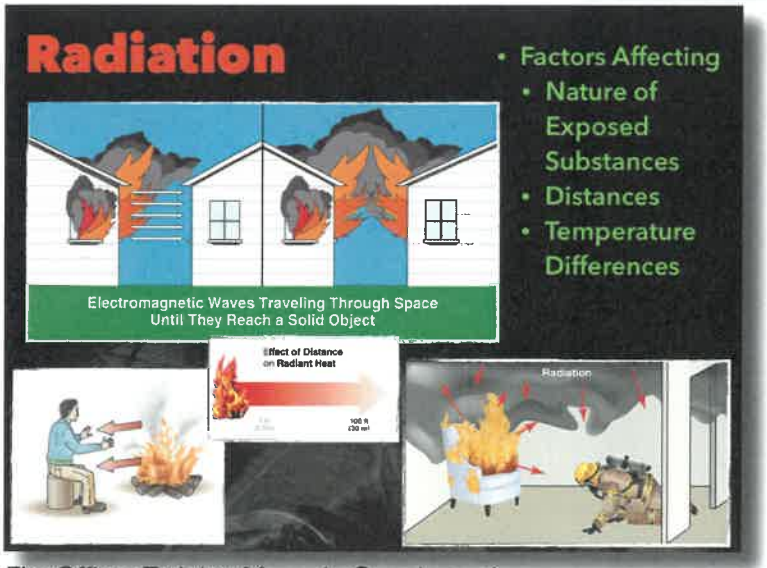
When fire is contained to the compartment of origin, extinguishment is a relatively simple matter. However, a great many problems come from the extension of the fire to locations outside the compartment of origin. Fire can extend in the following ways

- Through protected openings
- Through multi-layered ceilings
- Laterally in cock-loft spaces
- Upward through openings in walls
- Rising upward in a high rise situation and auto-exposure from window to window
- Thermal layering
- Radiated to other buildings
- Via stairways and stairwells

METHODS OF HEAT TRANSFER







HAZARDS OF COMBUSTION

Fire Gases vary greatly with the type of material burning. However, carbon monoxide, the most prevalent fire gas, is developed in almost every fire. Hydrogen cyanide, hydrogen sulfide, and hydrogen chloride are other gases that result from the burning of fuels containing those specific chemicals in their molecular structure. Regardless of the gas produced, fire gases can be separated into three classes; asphyxiants, irritants, or toxics.

Asphyxiants are gasses that occlude oxygen from getting into the body's cells. Carbon monoxide and natural gas are both asphyxiants.

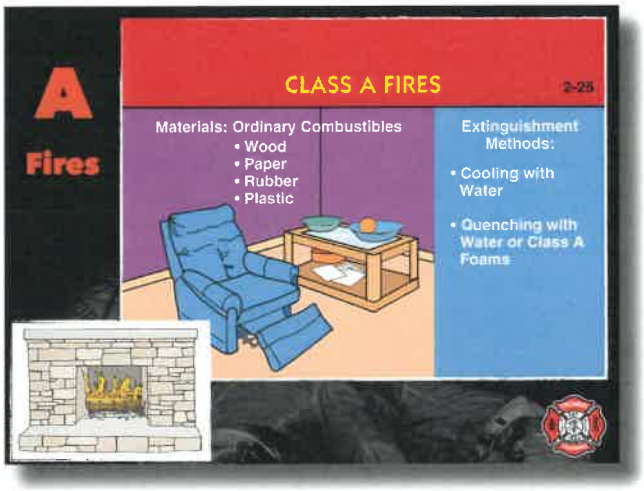
Irritants are gases that cause irritation to the respiratory tract causing difficulty in the exchange of oxygen in the lungs. Hydrogen chloride is an example of an irritant.

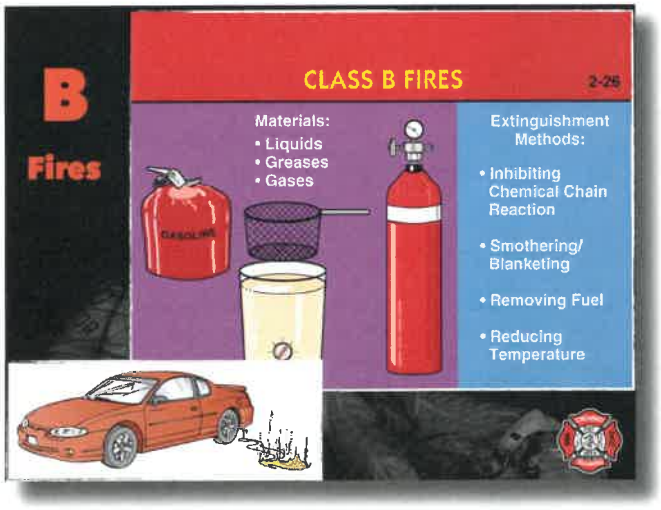
Toxics are gases that actually attack internal organs or the nervous system. These are carcinogens, pesticides, and can also be produced by burning plastics.

Classes of fires

Fires are classified in one of 4 methods. Class "A", "B", "C" or Class "D".

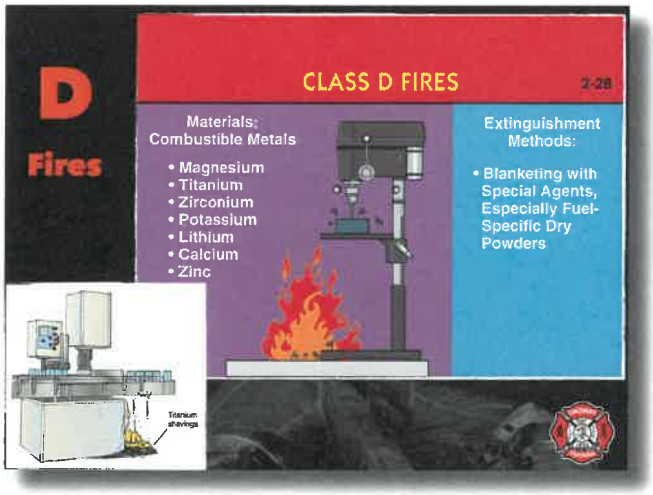
Class "A" fires involve ordinary combustibles such as wood, paper, cloth, rubber, household rubbish and natural vegetation. Water is the most common extinguishing agent for Class "A" fuels.



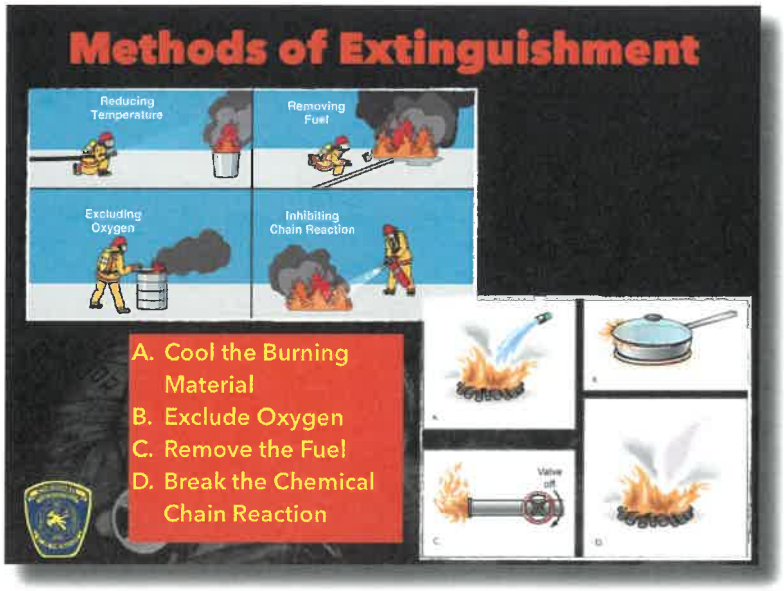


Class "B" fires involve flammable or combustible liquids such as gasoline, oil, grease, tar, lacquer, etc. Several agents are approved for class "B" fires. They include water, water and foam mixtures, CO_2, and Dry Chemicals. Small fires can also be smothered.

Class "C" fires involve energized electrical equipment. This may involve building wiring, appliances, tools, fuse boxes, circuit, transformers, generators or electric motors. Agents that don't conduct electricity such as CO2 or Carbon Monoxide must be used on Class "C" fires

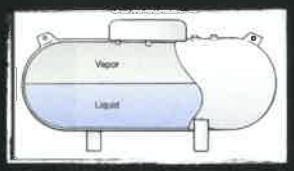


Class "D" fires involve combustible metals such as magnesium, titanium, zirconium, sodium and potassium. Special techniques and agents are required to extinguish a metal fire. Because of chemical reactions that occur during a Class "D" fire, it is important to select the proper extinguishing agent and application technique.

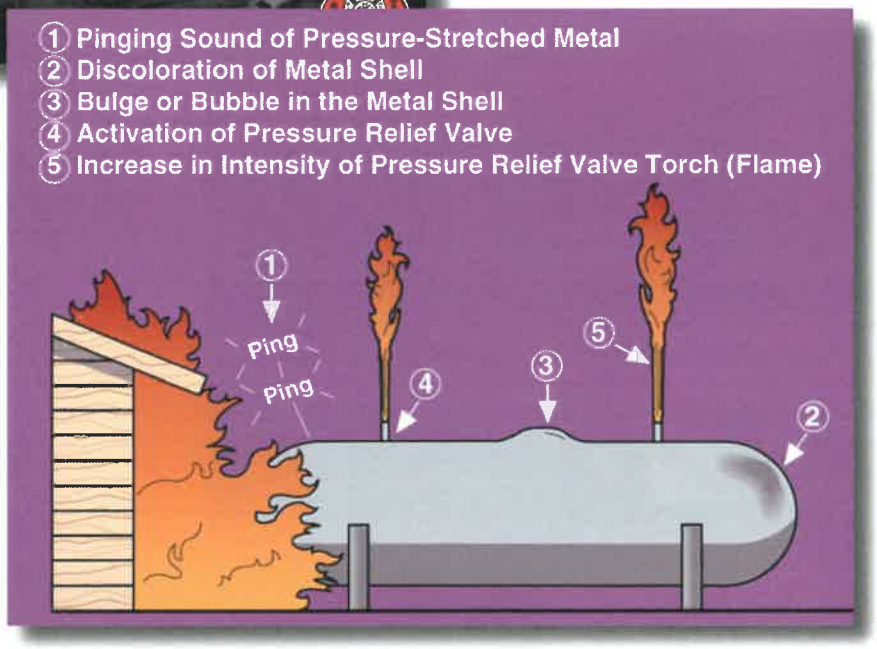


BLEVE

- Boiling liquid, expanding vapor explosion
- Occurs when a tank storing liquid fuel under pressure is heated excessively



- Sequence:
  - Tank is heated
  - Internal pressure rises beyond ability to vent
  - Tank fails catastrophically
  - Liquid fuel at or above boiling point is released
  - Liquid immediately turns into a rapidly expanding cloud of vapor
  - Vapor ignites into a huge fireball



Predict the Event

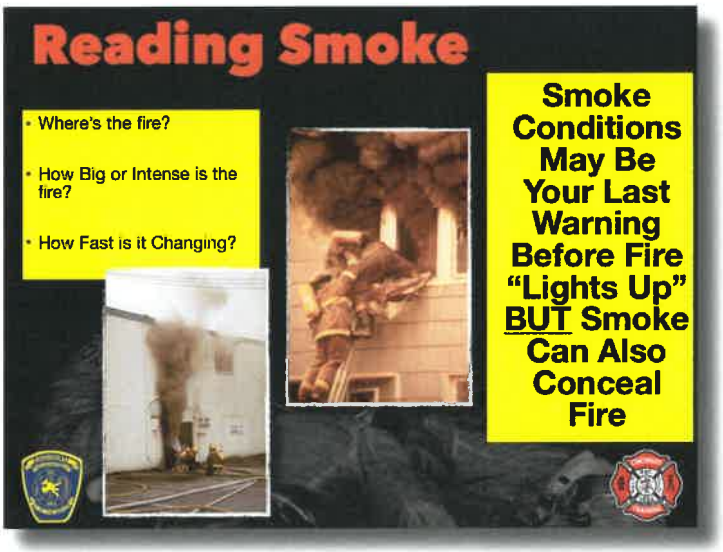
Predict the Event

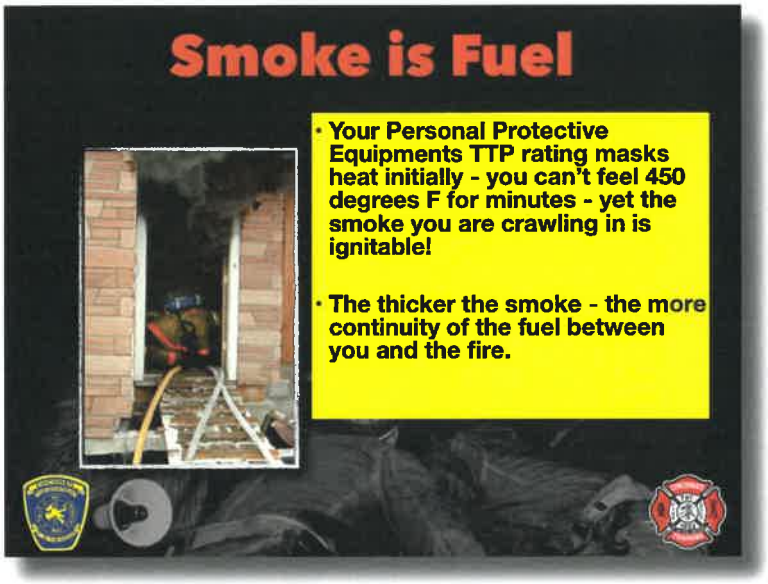
Predict the Event

Predict the Event

Always Monitor areas above, below and around any inside Teams!

Predict the Event


Reading Smoke
• Where's the fire?
• How Big or Intense is the fire?
• How Fast is it Changing?
Smoke Conditions May Be Your Last Warning Before Fire "Lights Up" BUT Smoke Can Also Conceal Fire


Smoke is Fuel
• Your Personal Protective Equipments TTP rating masks heat initially - you can't feel 450 degrees F for minutes - yet the smoke you are crawling in is ignitable!
• The thicker the smoke - the more continuity of the fuel between you and the fire.


Smoke
Smoke
Carbon Monoxide
Carbon Dioxide
Carbon Particles
Sulfur Dioxide
Water Vapor
Light
Flame
Flammable Vapors
Heat
Fuel
Oxygen
Oxygen
• Smoke is UNBURNED FUEL
• Most abundent gas in smoke is Carbon Monoxide
• CO Is FLAMMABLE
• Range of 12.5% to 74%
• Ignition Temperature 1128 deg. F

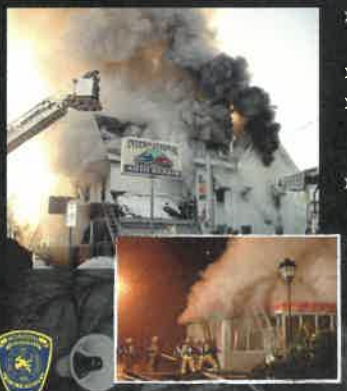
Reading Smoke

- Smoke is fuel
  - Volume
  - Velocity
  - Density
  - Color
- What is going on?
  - Where is the fire
  - How big is the fire
  - How much smoke
  - How fast is it changing
  - Turbulent or lazy
- May be last thing you see to indicate impending conditions / change

Volume

- Gives an impression
- Establishes relativity to the "box"
- Remember: a small volume of smoke from a very large box is significant
- Volume is a source of pressure (velocity)

Velocity



- How fast is the smoke leaving?
- Turbulent or Laminar?
- Is laminar smoke heat or volume pushed?
- Compare velocity from like-sized openings to find fire location

Density

- **Most Important Factor**
- Tells you the future
- Continuity of Fuel
- Likelihood of an Event
- "Degree" of the Event

Color

- Tells Stage of Heating
- Should compliment velocity to find location of fire
- "Brown" Smoke is usually unfinished wood being heated
- Remember, smoke color can be *filtered* over distance or through resistance

VELOCITY !!!

- Velocity trumps color
- *ANY* thick, fast moving smoke is ignitable
- Zero visibility makes you a slave to your environment

What is Happening?

Turbulent smoke is ready to flash – and indicates that floor temperatures are past human life thresholds (zero rescue profile!)

Manage it – but reduce your risk-taking!

Putting It All Together

- Black/Thick/Fast = heat and explosive
- Black/Thin/Fast = flame near
- White w/Speed = hot – but fire is distant
- Uniform speed/color (steady flow & light color)from many places = deep seated fire
- Brown = unfinished wood being heated
- Turbulent = Flashover

Black Fire

- **Black Fire** - term used to describe the High Volume, High Velocity, Extremely Dense, Black Smoke
  - Fire Above Your Head & You Can't See It
  - Sure Sign of Impending Flashover - VENT & COOL are only choices

Size Up At The Door

What Are You Looking For?

- Out at Top and In at Bottom
- Rises When Opened and Clears Out
- Fills the Door (may / may not) be Thin

Flashover Survival

- Flashover signals the end of:
  - Any chance of successful search and rescue in the involved area
- You have approximately 2 seconds to exit the fire compartment.....
  - 5 FEET OF TRAVEL
    - Thermal breakdown of your turnouts will reduce your ability to think correctly
    - Your skin will begin to burn
    - Your SCBA facepiece will begin to break down
    - The air in your bottle will become superheated

Flashover Survival

- **Point at which a fire fighter will not be able to escape safely**

A Fire Fighter Can Travel 2.5 Feet Per Second With No Hose

- **When FLASHOVER occurs a fire fighter has 2 seconds to exit and can escape if within 5 feet or less of exit**

Flashover Survival

- Stay Oriented
- Wear PPE (take care of it & clean)
- Be alert for signs of rapid fire growth and impending flashover
- Constantly monitor heat conditions
- Try to Know Its Happening Before It Happens
- Never remove your PPE
- Open nozzle above your head
- Exit the area immediately

Fire Training

Events Leading to LODD

- Total Fire Envelopment - everything goes orange (disoriented)
- Intense pain due to heat penetrating your PPE
- Separation from partner, team or hoseline
- Removal of SCBA - Including gloves or facepiece
- Loss of rational thought process
- Extreme actions

Fire Training

PPE

- Provides false sense of security
  - Nomex breaks down at 750 deg F
  - PBI breaks down at 1200 deg F
  - SCBA facepiece breaks down at 500 deg F
  - Helmet shield will melt at 300 deg
  - Skin burns at 124 deg F
- Average temperature at Flashover over 1000 deg F (700 to 2000 deg)

Fire Training

What Do You Do?

YOU HAVE GOT TO
HAVE WATER
AND
PUT WATER ON THE
FIRE