Emergency Scene Management I - FIRE-1112

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https://pixabay.com/photos/career-firefighter-relaxing-job-1501615/

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Chapter 1 - Rules and Regulations, Policies, and Standard Operating Procedures

Policy vs Procedure

Fire Officers must thoroughly know the department's regulations, policies and standard operating procedures. Officers, especially new ones, are expected to understand and enforce department rules. They must know the difference between rules & regulations, policies, and SOPs.

Rules and Regulations

Rules and regulations are developed by various government or government-authorized organizations to implement a law that has been passed. Rules may also be established by a local jurisdiction or within a fire department that set conditions of employment. For example, a fire department may have a rule that requires all members to wear their seat belts when riding in vehicles.

Rules and Regulations do not leave any room for latitude or discretion.

Policies

Policies are developed to provide definite guidelines and act as a building block for present and future actions. Policies outline what is generally expected in stated conditions. Policies often require personnel to make judgments and to determine the best course of action within the stated policy. For example, a policy could state that the fire officer shall ensure that the station sidewalks are maintained to provide safety from slips and falls during winter conditions. This is a directive policy because it gives the officer latitude in determining how to ensure the safety of pedestrians.

Standard Operating Procedures / Standard Operating Guidelines

Standard Operating Procedures (SOPs) are sometimes referred to as Standard Operating Guidelines (SOGs) and are written by a specific response organization to standardize a method or activity performed by members of the organization. They provide detailed information to perform an expected action, and allow for judgement calls, recognizing that situations can be different. SOP's affect only the organization that wrote them. They must conform to all applicable laws and regulations; for example, a response agency cannot have an SOP that directs members to operate in chemical protective clothing without any backup. SOPs should be in place to cover all areas of activity in which an organization's members take part. They are reviewed and amended periodically and are approved by the chief of the department.

Rules and Regulations	**Policies**	**Standard Operating Procedures**
implement a law that has been passed	provide definite guidelines	provide detailed information to perform an expected action
do not leave any room for latitude or discretion	outline what is generally expected in stated conditions	affect only the organization that wrote them
	leave any room for latitude or discretion	leave any room for latitude or discretion

Chapter 2 - Construction Classifications

Codes

Historically, a number of building codes were used throughout North America, but several of these codes have been combined. The most prominent codes used now are those published by the International Codes Council (ICC) ®, NFPA 5000®, Building Construction and Safety Code® published by the National Fire Protection Association, and the National Building Code of Canada published by National Research Council Canada. Canada's Constitution gives the ten provinces and three territories jurisdiction over construction. Some cities also have this authority through a special relationship with their provincial authority. In general, construction classifications are based on the types of materials used in the construction and on the fire-resistance ratings of major structural components.

It is important to remember that fire resistance ratings are a measure of how long structural assemblies will maintain their load-bearing ability under fire conditions, not of how easy or difficult it will be to fight a fire in that building. Most building codes have the same five construction classifications that are described in NFPA® 220, Standard on Types of Building Construction , but may use slightly different terms to name the classifications. The five types of building construction listed in NFPA® 220 include:

- Type I – Fire-Resistive
- Type II – Noncombustible
- Type III – Ordinary
- Type IV – Heavy Timber
- Type V – Wood Frame

Type I Construction – Fire-Resistive

Type I Building
John Foxx/Alamy Images

Known also as fire-resistive construction, Type I construction maintains its structural integrity during a fire. Fire-resistive construction consists mainly of reinforced concrete with structural members, including walls, columns, beams, floors and roofs that are protected either by blown-on insulation or automatic sprinklers. The fire-resistive compartmentation, provided by partitions and floors, tends to retard the spread of fire through the building. These features allow time for occupants to exit the building and firefighters to conduct interior firefighting.

Limited combustibility of the materials of construction, makes the primary fire hazards the contents of the structure and the interior finishes. This allows firefighters to launch an interior attack with greater confidence than in a building that is not fire-resistive. The ability of fire-resistive construction to confine the fire to a certain area can be compromised by openings made in partitions and by improperly designed and in-adequately dampered heating and air-conditioning systems.

Steel Fireproofing
JUAN RODRIGUEZ
https://www.thebalancesmb.com/fireproofing-method-structural-members-845033

Strengths:

- Resists direct flame impingement
- Confines fire well
- Little collapse potential from the effects of fire alone
- Impervious to water damage

Weaknesses:

- Difficult to breach for access or escape
- Difficult to ventilate during a fire
- Massive debris following collapse
- Floors, ceilings and walls retain heat

Type II Construction – Noncombustible

Type II Building
Dennis Tokarzewski/Shutterstock. Inc.

Type II construction, also known as noncombustible construction, is made of the same types of materials as fire-resistive construction except that the structural components lack the insulation or other protection of Type I construction. Type II construction has a fire-resistance rating on all parts of the structure including exterior and interior load-bearing walls and building materials. All-metal buildings also fall into this classification. Materials with no fire-resistance ratings, such as untreated wood, may be used only in limited quantities. Again, one of the primary fire protection concerns is the contents of the building. The heat buildup from a fire in the building can cause structural supports to fail. Another potential problem is the type of roof on the building.

Noncombustible or limited combustible construction buildings often have flat, built-up roofs. These roofs consist of a combustible or noncombustible roof deck covered by combustible felt, noncombustible insulation and roofing tar. Fire extension to the roof can eventually cause the entire roof to become involved and fail.

Non-Insulated Steel Beam
East Harding Construction
https://eastharding.com/pine-bluff-main-library-press-release/

Strengths:

- Almost as resistive to fire as Type I construction
- Confines fire well
- Almost as structurally sound as Type I construction
- Impervious to water damage

Weaknesses:

- Difficult to breach for access or escape
- Difficult to ventilate during a fire
- Massive debris following collapse
- Floors, ceilings and walls retain heat
- Steel components subject to weakening by fire
- Steel components subject to weakening by rust and corrosion

11 Sep 2001, Financial District, Manhattan, New York, New York, USA — New York City firefighters walk through the rubble at the World Trade Center, the skeletal remains of the Twin Towers behind them. On the morning of September 11, 2001, two hijacked planes were crashed into the Twin Towers in Manhattan, killing nearly 3,000 people, including hundreds of firefighters involved in rescue operations. — Image by © Neville Elder/CORBIS

Type III Construction – Ordinary

Type III Building
Ken Hammond/USDA

Strip Mall
Anthem Properties Group Ltd.
https://anthemproperties.com/properties/heritage-hill-retail/

Known also as ordinary construction, Type III construction requires that exterior walls and structural members be made of noncombustible or limited combustible materials such as concrete blocks or day tile blocks. Interior structural members including walls, columns, beams, floors and roofs are completely or partially made of wood. The wood used in these members is of smaller dimensions than that required for heavy-timber construction. See the Type IV-Heavy Timber construction that follows.

The primary fire concern specific to ordinary construction is the problem of fire and smoke spreading through concealed spaces. These spaces are between the walls, floors and ceiling. The heat from a fire may be conducted to these concealed spaces through finish materials, such as gypsum drywall or plaster, or the head can enter the concealed spaces through holes in the finish materials. From there, the heat, smoke and may spread to other parts of the structure. If enough heat is present, the fire may actually burn within the concealed space. These hazards can be reduced considerably by packing fire-stops inside these spaces to limit the spread of the combustion byproducts (heat, smoke, etc)

Strengths:

- Resists fire spread well from the outside
- Relatively easy to vertically ventilate

Weaknesses:

- Interior structural members vulnerable to fire involvement
- Fire spread potential through concealed spaces

- Susceptible to water damage
- Walls can retain heat

Type IV Construction – Heavy Timber

Type IV Building
Courtesy of APA – The Engineered Wood Association

Also known as heavy timber construction, Type IV construction requires that exterior and interior walls and their associated structural members be made of noncombustible or limited combustible materials. Other interior structural members, including beams, columns, arches, floors and roofs are made of solid or laminated wood with no concealed spaces. This wood must have dimensions large enough to be considered heavy timber. These dimensions vary depending on the particular code being used.

Heavy Timber construction was used extensively in old factories, mills and warehouses. Traditional Heavy Timber construction is rarely used today in new construction except for decorative reasons. The use of Heavy Timber construction with glue-lam beams is growing.

The primary fire hazard associated with Heavy Timber construction is the massive amount of combustible contents presented by the structural timbers in addition to the contents of the building. Although the Heavy Timbers remain stable for a long period under fire conditions, they give off tremendous amounts of heat and pose serious exposure protection problems for firefighters.

Strengths:

- Resists collapse due to flame impingement of heavy beam
- Structurally stable
- Relatively easy to vertically or horizontally ventilate
- Relatively easy to breach for access or escape
- Manageable debris following collapse

Weaknesses:

- Susceptible to fire spread from outside
- Potential for flame spread to other nearby structures
- Susceptible to rapid interior flame spread

- Susceptible to water damage
- Large open spaces

Type V Construction – Wood Frame

Type V Building
Jones and Bartlett Learning. Courtesy of MIEMSS

Also known as Wood Frame construction, Type V construction has exterior walls, bearing walls, floors, roofs and supports made completely or partially of wood or other approved materials of smaller dimensions than those used for Heavy Timber construction. Wood frame construction is the type commonly used to construct the typical single-family residence or apartment house of up to seven stories. This type of construction presents almost unlimited potential for fire extension within the building of origin and to nearby structures, particularly if the nearby structures are also wood-frame construction. Firefighters must be alert for fire coming from doors or windows extending to the exterior of the structure.

Strengths:

- Easily breached for access, ventilation or escape
- Resistant to collapse from earthquakes due to lightweight and flexibility
- Collapse debris is relatively easy to manage

Weaknesses:

- Susceptible to fire spread from outside
- Susceptible to rapid flame spread inside
- Susceptible to total collapse due to fire or explosion
- Susceptible to water damage

Non-standard Construction

(sometimes referred to as Hybrid Construction)

Standard Construction – Shaughnessy Tudor
Kettle River Timberworks Ltd.
http://www.kettlerivertimber.com/

Non-Standard Construction “Curve Appeal”
Kettle River Timberworks Ltd.
http://www.kettlerivertimber.com/

Log Cabin
Booking.com
https://www.booking.com/hotel/ca/riverside-resort-whistler.html

Pre-Fabricated Home
Ovlix
https://www.ovlix.com/property/
8Y5kB5-23-8508-Clerke-Road-Coldstream-BC-V1B1N2

In many parts of North America, local building codes allow non-standard buildings to be constructed under certain circumstances. These structures do not conform to any of the standard construction types listed in NFPA® 220. Some non-standard structures are allowed to be built on large properties that are in very remote areas. Others are simply new construction concepts that are not yet recognized by national building codes. Even these innovative structures must conform to local zoning and land-use standards. One example of non-standard construction are Manufactured Homes.

Other forms of non-standard construction are allowed in certain jurisdictions. To protect yourself and your fellow firefighters, you must be aware of what types of structures are being built in your area of responsibility. In other words, you must pay attention to what is going on in your response district and make frequent preincident planning surveys of construction sites.

Attic, Basement Void Space Considerations

There are aspects of the building construction that make it difficult for firefighters to get the line where it needs to be. Areas that present access issues like basements, attics and void spaces present issues that need to be addressed by the Incident Commander.

Basements are below-grade spaces. Basements are built in a variety of forms however the main consideration is there access and egress. It is easier to identify basements on the method of access: walk-out, look-out, walk-up. Walk-out basements have access points to the outside meant for access and egress from that level. Look-out basements have windows but don't allow for regular exterior access. Walk-up basements are below grade and access and egress are via stairs interior and exterior. It is imperative that Incident Commanders evaluate the ventilation profile of basement fires, both current and future.

The latest UL studies have found that water applied via the interior basement stairs had a limited effect on cooling the basement or extinguishing the fire. However, water applied through and exterior window or door, quickly darkened down the fire and reduced the temperatures throughout the building and no fire or hot gases were "pushed" up the interior stairs.

Attics and voids are usually not meant for normal human occupancy and have restricted or no access. They usually have unprotected structural elements. The lack of fire protection in these spaces allows for the fire to spread at a more rapid pace. Consideration should be given to the structural stability of the involved systems, and possible collapse concerns. Further, when opening up spaces it should be understood that each opening presents a new flow path for gasses to move and the possible effects on the energy production of the fire.

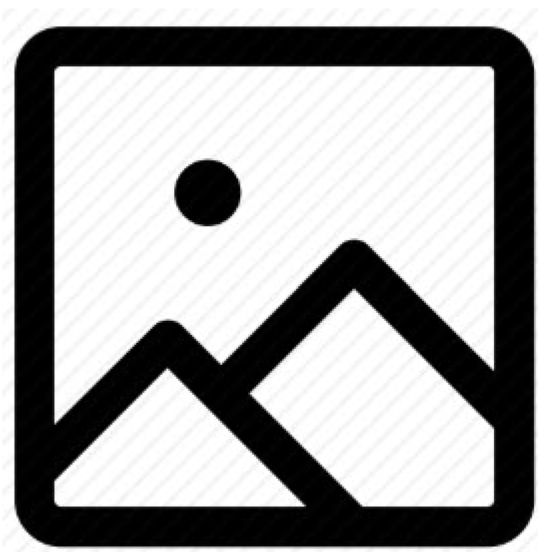
If the attic space eaves can be accessed with the hose stream from the exterior, that is where we should start flowing water….it has been proven to be the best method to apply water into the attic space and apply water on the actual materials that are burning.

Chapter 3 - Structure Fire Research

The time-temperature graph typically referenced in instructional manuals has changed to reflect the modern fire environment. Based on studies from ULFSRI and NIST it has been shown that the amount of energy produced by the fire is related to the available air. A fire in a box will produce energy in proportion to the amount of air in the box. As the air in the box is used and oxygen levels decrease so too will the energy production, and the fire will begin to decay. If an opening is created in the box, and air enters, the fire will begin to produce energy again. The amount of air is the governing factor for the amount of energy produced. If a second opening is made in the box the energy production would further increase, this will reflect in greater energy production and higher temperatures than the first two examples.

Consideration should also be given to the length of time between the decay stage and the introduction of fresh air. The introduction of fresh air can happen as a result of a failure in a window or through firefighting tactics. The speed at which the fire will resume producing energy is dependant on a number of circumstances, but we need to understand that if nothing is done and the fire is given air, the energy production will increase and things are going to get worse.

The energy production of a fire can be looked at in a **Fuel Limited vs. Vent Limited relationship**. In the early stages of fire development, energy production is predominantly governed by the amount of fuel, making it Fuel Limited. As the fire grows the energy production becomes predominantly dependent on the amount of oxygen available, making it Vent Limited. Identifying the difference between the two provides context for the fire officer to begin to evaluate other fire indicators.



Fuel Limited vs Vent Limited Image Placeholder

The energy production of the fire and its effects on the movement of gasses requires a deeper look into gas laws, pressure, flow paths. These core concepts will allow the officer to evaluate and identify ventilation openings and smoke characteristics to make educated decisions on the extent and location of the fire.

Gas Laws

The Gas Laws help us to interpret what the smoke is telling us, and are governed by physics.

- **Charles Law 1787** states that the volume of a gas at constant pressure is directly proportional to its temperature
    - Gasses expand when heated, and contract when cooled
    - Gasses become less dense and rise when heated
- **Guy-Lussac's Law 1802** found when the volume of gas remains the same and the temperature is increased, pressure increases in proportion to the temperature of the gas.
    - When gasses are confined and heated, pressure increases.
    - Increased pressure indicates higher temperatures.

These laws can be used to begin to evaluate the smoke exiting a structure. If it moves fast, the smoke has heat and the fire is creating a lot of energy. With the heat comes the creation of pressure, and with pressure comes higher temperatures. We can evaluate the smoke based on these characteristics and look at the Flow Path or Paths and smoke characteristics to gain further information on the location and extent of the fire.

Flow Path

The Flow Path is the movement of heat and smoke from the higher pressure fire area toward the lower pressure areas on the interior and exterior of the structure. The Flow Path or Paths can provide clues for evaluating the fire problem. Evaluating the opening and determining the location of the neutral plane, as well as the direction of flow, the officer will begin identifying the possible level and location of the fire problem.

The atmospheric balance between the higher temperature gasses and the fresh air. The neutral plan can be used to assess the opening and its role in the flow path. If the neutral plane is in the middle of the opening it is likely a main ventilation opening for the fire. If the neutral plane is at the top or bottom of the opening the flow is unidirectional and is an indication that there is another ventilation opening somewhere else in the structure.

- **Uni-Directional** – gas flow in one direction through a single opening. As an inlet or an outlet, the officer must come to a resolution that there is another opening completing the equation.
- **Bi-Directional** – gas flow both ways through an opening. Fire gasses exit the top part of the opening while fresh air enters the bottom. Often this indicates that this opening is the only inlet/exhaust to the fire area.

Examples

Fire Flow 4

Fire Flow 5

Ventilation opening classification and identification requires an understanding that higher temperature gasses will seek lower pressure areas. As pressure is created in the area of origin, smoke will move through the path of least resistance. These flows will be governed by gas laws with hot gasses going up and away to lower pressure areas.

With the assessment of flow paths, it also important to understand the principles of conservation of mass. We are unable to see fresh air moving, however, if we see smoke exiting, the Conservation of Mass Principle tells us that something is replacing it. So, when applied to bidirectional flow, we can see smoke exiting, but only on the top half of the window, and void space below. We know, based on this principle that it is fresh air that is replacing the smoke that is exiting. We also know that the fresh air will bring oxygen that will allow the fire to continue to create energy.

Evaluating Smoke

Evaluating smoke can further provide context for the officer to assist to create and effective Incident Action Plan. Evaluating smoke involves requires interpreting the Volume, Velocity, Density and Colour.

- **Volume** – how much. If there is a lot of smoke, it is likely that it is a large fire beyond the incipient stage.
- **Velocity** – how fast. If smoke is moving fast there is a greater temperature difference between where the smoke is being generated and connected spaces. Hot smoke will be turbulent and rise fast, whereas cool smoke will have a laminar flow. In comparing the

two, laminar flow smoke has travelled some distance from the seat of the fire versus turbulent smoke that rises quickly is indicative of smoke with a lot of temperature.

- **Density** – how thick. The thicker the smoke, the less complete the combustion. Smoke is fuel. If the fuel is too rich and unable to burn due to oxygen limitations, consideration has to be given to the flammability range of dense smoke and its capacity to further spread the fire.
- **Colour** – how it appears. It is not an exact science. It is more likely to be used as a tool to indicate the stage of heating and location of the fire within the building by comparing smoke in different locations. Light colour smoke can be considered early stage burning. Black or carbon-rich smoke can indicate incomplete combustion.

Chapter 4 - Firefighter Survivability and Structural Stability

Chapter 5 - Calculating Fire Flow

Chapter 6 - Personnel Requirements

Chapter 7 - Water Supply

Chapter 8 - Exposures

Chapter 9 - Communications, Accountability and Rapid Intervention Teams

Chapter 10 - Risk-Benefit Analysis

Chapter 11 - Incident Command System

Common Terms

AIR TRACK

This is the chosen ventilation path of air through a structure, from the entrance to the exit port. Continual air track monitoring is critical to a safe and efficient PPA Attack.

HI VOL

4 inch or 5 inch supply lines

RECREATION TIME

Safe time for an interior fire attack based on fire conditions and structural integrity.

auto extrication

the act of removing a patient from an auto

This is where you can add appendices or other back matter.