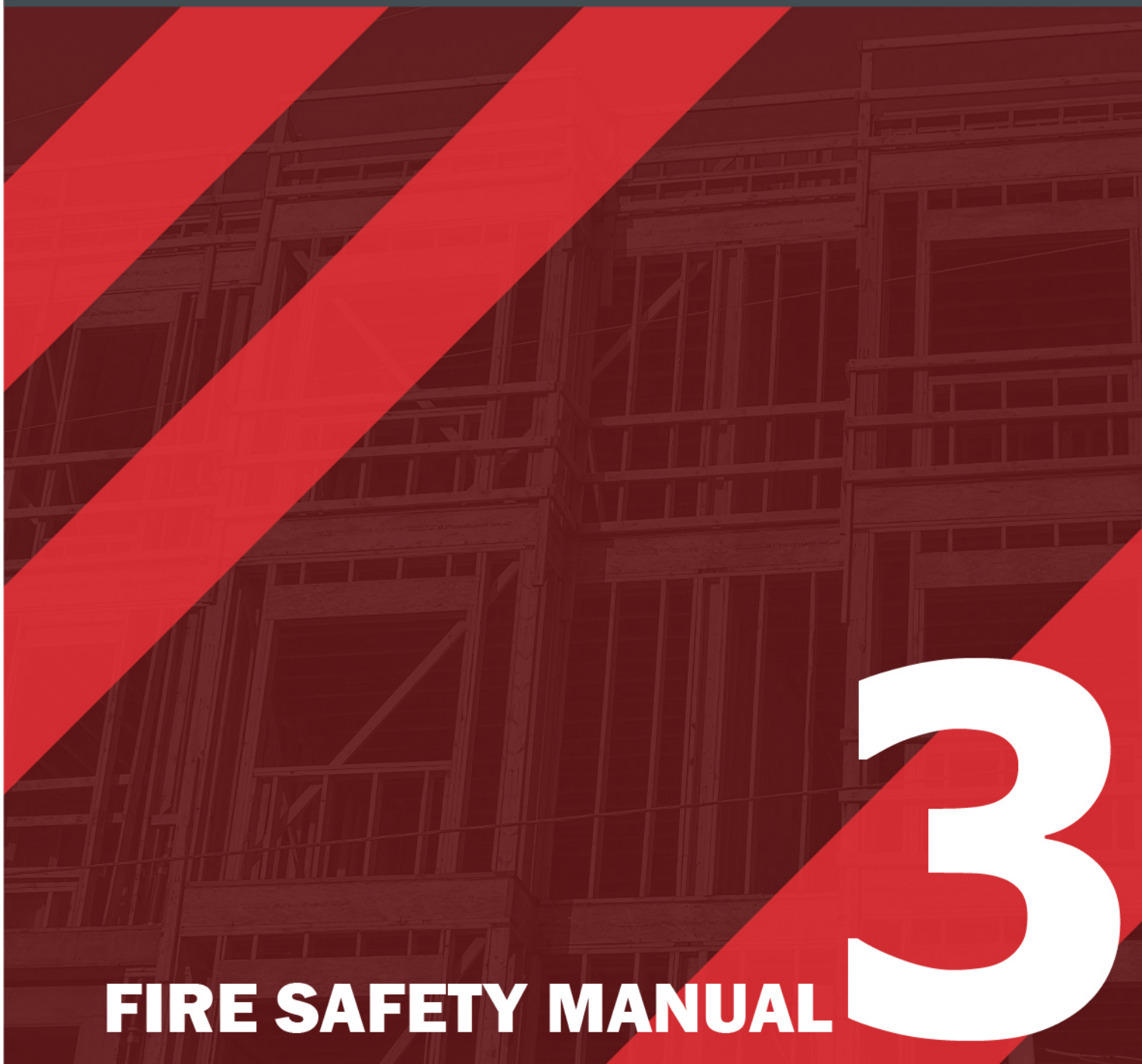
CONSTRUCTION FIRE SAFETY COALITION

Fire Department Tools for Prevention and Suppression of Fires During Construction of Large Buildings



FIRE SAFETY MANUAL 3

AMERICAN WOOD COUNCIL

The American Wood Council is an independent organization that provides independent, non-proprietary information about timber and wood products to professionals and companies involved in building design and construction.

The American Wood Council is resourced by:

Prepared by:
Ronny J Coleman
Jeff Shapiro
Hugh Council

This document produced in cooperation with
The Australian Wood Council

First published: June 2014

Stakeholders

The following individual organizations have participated in the process of developing the program sponsored by the American Wood Council.




NOTICE:

THOSE INDIVIDUALS UTILIZING THIS MATERIAL TO PROVIDE ORIENTATION AND/OR TRAINING AND EDUCATION OF PERSONNEL SHOULD ALSO VISIT THE FOLLOWING WEBSITES:

Woodaware.com

Modernfirefighting.com

Constructionfiresafetypractices.com

Contents

1. Scope of this Document

1.1 Background

The scope of this document is to provide background and information to fire departments that may experience the construction of large area buildings in their community. Many fire departments have limited experience in the planning and response to these complex buildings. This requires a thorough understanding of the fire and building code provisions as well as the proper use of NFPA 241, Standard for Fire Prevention in Buildings Under Construction and 1620, Standard for Pre-Incident Planning.

1.2 Fire Experience

Large loss building fires are not new to the fire service. Over time there have been many buildings destroyed by fire during construction. The difference today is that large area buildings that experience fire have increased. The term large building is subject to interpretation. In general, building height and area of different construction types is governed by the intended use of the building. The frequency and severity of fires during construction has been well documented. In 2011 the U.S. Fire Administration in Topical Fire Report Series: Vol 12/Issue 4, it was reported that from 2007 to 2009 there were 900 large loss building fires annually. A large loss building fire is defined as fires that resulted in a total dollar loss of 1 million or more. These fires caused an estimated 2.8 billion dollars in property damage and yet they made up than less than 1% of building fires.

The National Incident Fire Reporting System (NFIRS) provides ongoing information on fire statistics on a national basis. Therefore, it is possible to be able to measure the effectiveness of fire prevention if these statistics are evaluated on an ongoing basis. The risk of fires in these types of buildings can be improved by focusing on best management practices.

In addition, the fire services monitoring of various fire scenarios regarding line of duty deaths (LODD) and attempting to capture near misses. All of these databases should be monitored to determine improved performance by use of effective code enforcement and effective fire ground operations.

The National Fire Incident Reporting System (NFIRS) provides ongoing information regarding fire statistics on a national basis. The national fire experience will continue to be evaluated on an annual basis to determine whether the risks of these types of buildings is deteriorating or improving.

In addition, the fire service is monitoring various fire scenarios with a Line of Duty Death program (LODD) and attempting to capture near misses and lessons learned. Both of these databases should be monitored to determine effectiveness of adopted practices in preventing injuries and fatalities when combating fires of this nature.

1.3 Causes of Construction Site Fires

According to the US Fire Administration NFIRS has identified six causes of construction site fires. In order to understand the types of incidents that are likely to occur, the following causes should be considered:

- Hot Work
- Smoking
- Heating devices
- Electrical malfunctions
- Cooking fires
- Criminal activity and vandalism

1.4 Pre-Fire Planning and Codes

Given these potential causes of fires, the fire department has a need to conduct two different types of activities. The first is to conduct pre-fire planning on the site as soon as the building is contemplated; the second priority is a need to prepare for specific tactics and strategy if a fire actually occurs. Depending upon the timing and sequence of events on a site the presence or absence of built in fire protection, may aid or complicate a fire fighting operation.

When we consider that the fire and building codes are created to provide buildings with a high level of fire safety, the fire service needs to understand why these buildings are particularly vulnerable during construction. Chapter 33 of the IFC and IBC provide full chapters on this topic. A review of fire service features required by the fire code is the beginning of an effective pre-fire planning program. As firefighters, we have an obligation to know what stage of construction may be occurring in our response area and to be proactive to ensure the greatest level of safety in the event a fire occurs.

Working closely with the building official and the property developer, as well as visiting these sites regularly are solid steps in improving fire safety on site.

1.5 NFPA 241-1620

NFPA 241, Standard for Safeguarding Construction, Alteration, and Demolition Operations, was issued by the Standards Council on November 27, 2012. The document contains 11 chapters and 2 annexes that provide safeguards for buildings under construction. Its use, along with NFPA 1620, provides a solid framework for risk mitigation on most sites. Furthermore, there are numerous NFPA standards, such as NFPA 10, Standard for Fire Extinguishers and NFPA 51B, Standard for fire prevention during welding, cutting and Hot Work that are relevant to this discussion.

1.6 Actions to be Taken

If your community has a large area building under construction that is also multi-storied and will be under construction for a long period of time, the best strategy for the fire service is to work closely with the developer from the very outset of the project. This activity should include role clarification and focusing on the basic precautions for preventing fire. Whenever there is a fire in a building under construction there is going to be plenty of challenges for responding fire companies. The emphasis needs to be placed on prevention. The code requirements contained in model building and fire codes must be enforced, the planning processes and enforcement practices of NFPA 241 and 1620 need to be monitored.

Simultaneously fire departments need to prepare for an aggressive attack in case an event occurs. Constant monitoring of fire department access and water supply is required in order to be effective in preventing small fires from becoming big ones.

2. Federal Regulation

2.1 OSHA Partnership

The Occupational Safety and Health Administration (OSHA) have initiated partnerships with employers, employees, and employee representatives in a wide range of industries to encourage, assist, and recognize efforts to eliminate workplace hazards. Participants work together to identify a common goal, develop plans to achieve it, and implement those plans in a cooperative way. Partnerships can transform relationships between OSHA and an employer or entire industry when properly followed. Former adversaries recognize that working together to solve workplace safety and health problems is to everyone's advantage. This is especially true in working with the fire service.

This manual recognizes that there are two types of involvement with these buildings by the fire service. The first is fire prevention and its involvement with plan checking and ongoing inspection. The second is fire department response and suppression and its ability to perform during an emergency.

This manual addresses how to coordinate the building industry's fire prevention efforts with the fire department's interests in creating a safe community.

2.2 Federal Regulation

A good, effectively managed worker safety and health program can be a big factor in reducing work-related injuries and illnesses and their related costs. OSHA offers voluntary guidelines to help employers and employees in workplaces it covers developing effective safety and health programs. *Safety and Health Program Management Guidelines (Federal Register 54 (18): 3908-3916, January 26, 1989)* identifies four general elements critical to a successful safety and health management program. These are:

- Management leadership and employee involvement;
- An analysis of worksite hazards;
- Use of hazard prevention and control initiatives; and
- Safety and health training

The Occupational Safety and Health Act of 1970 encourage states to develop and operate their own job safety and health plans. States that do so must adopt standards and enforce requirements that are at least as effective as federal requirements. Twenty-four states and two territories have adopted their own plans, three of which cover only public employees. For more information visit OSHA's website for a listing of states and territories with approved plans. www.**osha**.gov

2.3 State Regulation

The respective states adopt model codes under two scenarios. These two are:

- Mini Maxi States; and,
- Local control states.

Depending upon the state's decision, there are two mode code families that can be adopted; ICC and NFPA.

The International Code Council (ICC) produces both the International Building Code (IBC) and the International Fire Code (IFC). Section 3301 of both codes address the issue of fire safety during construction, remodel and demolition. Section 3308.2 identifies the responsibility for the property owner to maintain an approved pre-fire plan in cooperation with the Fire Chief. It further states that the Fire Chief and the Fire Code Official shall be notified of any changes affecting the use of the

information contained in pre-fire plans. In states where local adoption is allowed, these requirements may be more specific. In states where state adoption is the minimum and the maximum the fire authority may be more limited. These two code sections may require further interpretation at the local level.

In addition, Section 3310 of the IFC provides information on required access and 3312 of the IFC defines water supply requirements.

The National Fire Protection Association publishes NFPA 1. The Fire Code Handbook defines goals and objectives for code compliance in a fashion parallel to the ICC process.

Chapter 16 of the Fire Code Handbook provides guidance for structures undergoing construction, alteration or demolition operations.

2.4 Actions to be Taken

While Section 33 specifies certain activities, it does not spell out how they need to be done on a daily basis. Local fire authorities, once notified of a building that requires the use of these code sections, should maintain an assertive posture in determining whether the conditions of Chapter 33 are being properly met. Failure to obtain compliance could result in conditions where ignition is likely to occur.

3. Definitions

Aerial Apparatus – Fire apparatus that is designed with an aerial device mounted on it. The device can either be a ladder or a snorkel or any other combination of technology that will allow the company to reach upper floors on a fire and to provide a master stream platform to be operated from above.

Automatic Aid - A plan developed between two or more fire departments for immediate joint response on first alarms.

AWWA – American Water Works Association

Command Post - The location where the incident commander and associated staff are located during an emergency incident.

Defensive Attack – This is a decision to fight a fire from the exterior of a building and to protect exposures exposures because of several factors; there is no life safety involved and potential injury or danger to firefighters is recognized.

Fire Flow - The flow rate of a water supply, measured at 20 psi (138 kPa) residual pressure that is available for fire fighting.

First Due – The engine company that would normally be dispatched to a specific site; the closest fire station to a working site.

GPM – Gallons Per Minute; a measurement of nozzle discharge

Incident Commander - The person who is responsible for all decisions relating to the management of the incident and is in charge of the incident site.

Incident Command System (ICS) - A management system designed to enable effective and efficient on-scene incident management by integrating a combination of facilities, equipment, personnel, procedures, and communications operating within a common organizational structure.

Initial Action - The actions taken by those responders first to arrive at an incident site

Initial Attack - Fire fighting efforts and activities that occur in the time increment between the arrival of the fire department on the scene of a fire and the tactical decision by the Incident Commander that the resources dispatched on the original response are insufficient to control and extinguish the fire, or that the fire is extinguished.

ISO – Insurance Services Office

Line of Duty Death (LODD) - This is an acronym utilized by the National Fallen Firefighter Foundation to describe a person who is killed in the line of duty

Master Stream – Large bore nozzles that discharge more than 1,000 gallons per minute. They can be operated from the ground or from aerial apparatus.

Mutual Aid - Reciprocal assistance by emergency services under a prearranged plan

NFF – Needed fire flow

Near Miss Reporting System - This is a system that documents close calls and provides training

information to prevent reoccurrence of similar incidence.

National Fire Information Reporting System (NFIRS) - A national system that collects information from local, regional and state organizations on causes of fire, information on characteristics of fire spread and fire loss statistics.

Offensive Attack – This is a decision to fight the fire by engaging in interior operations based upon a need to save lives or protect extreme values that can be performed safely. The variable factors in offensive attack include the use of the two in two out rule and having effective SOPs for firefighter safety.

SOP/SOG – Standard Operating Procedures/Standard Operating Guidelines

4. Fire Prevention Bureau Activity

4.1 General

The fire department has two roles in dealing with fires in buildings under construction. The first role is carried out between the builder and the fire prevention bureau. The second is carried out between the construction staff and the operations division.

The following are suggested as key activities for the bureau's consideration.

Model code provides that the private party person who is responsible for Fire Protection Plan activity at a specific site shall develop and maintain an approved fire plan including and approved pre-fire plan in cooperation with the Fire Chief. This concept of fire prevention activity means many things to different people according to local policies and procedures.

4.2 Pre-Fire Planning from a Bureau Perspective

From the fire prevention officer's perspective this is a fire prevention problem. If we can do everything we can to prevent an ignition, then we don't have the damage or threat to life. But, the minute we do get ignition it's the Operations Officers responsibility. A fire can grow in size and intensity very rapidly because of multiple factors that include open construction and lack of completion of certain mitigation efforts. The phenomena that the fire may burn unobserved for a lengthy period of time is a common scenario.

First off, the Fire Prevention Bureau (FPB) has a different role with an occupancy under construction. The first thing to consider is improving the effectiveness of the working relationship between the FPB and the owner and developer. The fire codes require that there be meetings between the fire service and the on-site developer to be better prepared to deal with the issues that are going to occur during construction. These issues could include, but may not be limited to, problems such as access to the worksite, status of water supplies, the actual reporting of emergencies when they do occur, and the status of built-in fire protection mechanisms such as fire alarms, detectors, and sprinklers at different stages of construction. All of these issues need to be discussed before a single shovel has entered the ground.

Our code enforcement system normally requires that the fire department be involved in the planning for such occupancies, but the bulk of the actual inspection work done on site will be performed by the building inspectors. The reason for conducting the preconstruction meeting with the Fire Department is to lay the groundwork for a pre-fire plan. NFPA 1620 and NFPA 241 are both fundamental documents that should be reviewed during this stage of building the relationship. Among the items that could be discussed would include the timing of the construction, anticipated weather and climatologically conditions that may change during the period of construction and the shifting of content within the building. While this may well fall under the fire prevention bureau to conduct, it is an excellent time for the operations personnel to become well-informed on what is about to happen. During a fire event is not an appropriate time to meet a building contractor for the first time. This strategy may appear overly simplistic, but it has been known to make a significant difference in how the fire department performs when an actual fire occurs.

This technique is not particularly creative, but it is amazing how often it is overlooked in both short and long range planning to handle future fire problems. The role of fire inspectors in this case are to serve as the eyes and ears of the operations division. The Bureau should keep tabs on the scheduling and implementation of construction and they should pass along information to the closest fire station. If this technique is employed on a fairly frequent basis the probability of being surprised becomes diminished quickly.

Lastly, before we leave the fire prevention bureau, we should discuss the role of the fire inspector and interfacing with the building inspector. It is not uncommon for the building inspector to be in a building almost daily; sometimes weekly. The fire inspector may only be on-site on a periodic basis to check the installation of risk mitigation devices such as alarms, detectors and sprinklers. Fire inspectors should engage in dialogue with building inspectors to inform the building inspectors regarding potential fire risks that may occur in this building. Building inspectors generally know a lot about electrical hazards, maybe even flammable liquids and gases, but may have a blind eye to some of the other conditions such as trash build up and potential ignition sources. The following are a list of hazards that the bureau should be focusing its attention on in preventing fires.

4.3 Hazards at Construction Sites

There are a wide variety of hazards that can be present on a construction site. The use of NFPA 241 is highly recommended for use of the fire prevention bureau and the building contractor. The following is an inventory that the fire department should be aware of and prepared to address in reducing hazards:

- Temporary heating equipment
- Smoking
- Waste disposal
- Open burning
- Spontaneous ignition
- Cutting and welding
- Electrical malfunctions
- Flammable and combustible liquids
- Flammable gases
- Explosives

4.4 Built in Fire Mitigation

There are many fire protection devices that are required to be placed in buildings that will not be fully operational until the building is certified for occupancy. These might include standpipes, automatic sprinklers and fire alarm systems. The fire department should be aware of the status of those building components that will be relied upon during fire attack.

Most model codes discuss how to keep standpipes operational and extended as construction progresses. Knowing whether the systems are in service or not, could be the key factor in an Incident Commander's decision to go on the offensive or remain outside using defensive tactics.

Early activation of a sprinkler system may be an important consideration in reducing fire loss.

4.5 Operational Planning

Fire Authorities should identify the following before construction begins and continues to monitor it throughout the entire construction phase.

- The number of fire hydrants and water sources and their location.
- The types of materials present and the methods of storage of that material
- Additional resources needed to help with fire i.e. moving vehicles, moving temporary structures
- Identify how the local fire department will be contacted by the fire safety planner when construction begins. The following information should be collected and shared early on:
  - Contact number for local emergencies
  - Distance from site by first due company

- Verify address is known by dispatch system

Before work begins, several elements must be addressed:

- Do sub-contractors have fire prevention plans as part of their processes?
- Do they have Emergency Response plans as part of their processes?

Proper plans for each of the above would include the following elements:

- Do they conduct training?
- Have they a process for conducting a head-count?
- Have they established a warning system?
- Is fire equipment provided?
- Do they have a Hot-Work permit system?
- Are flash-back arrestors used?
- Are they bringing compressed gasses on the site, if so how are they stored and maintained?
- Are welders inspected and in good shape?
- What Personal Protective Equipment is in place

OSHA has several elements that must be addressed in Emergency Response training, these include:

- Warning employees of potential emergencies
- Identification of proper evacuation for employees
- Where employees will meet after exiting
- Head count of all employees

4.6 During Construction

Some of the elements that must be addressed during the construction phase include, but are not limited to:

- **Constant maintenance of fire protection equipment**. This includes making sure that hydrants are clearly visible, extinguishers are adequate and are being inspected. The inspection process is important as many times employees will discharge an extinguisher either on purpose or accidentally leaving the extinguisher empty.
- **Maintaining clear access to buildings and access onto the site**. In many instances roads may not be paved, thus fire trucks can have trouble getting through the site and gaining access to buildings. All roads should be kept clear of debris and adequately maintained for vehicle use.
- **Keep materials from being built-up around buildings**. Piles of wood or other ordinary combustibles should be kept away from buildings unless they are part of an active construction process. This can also be said for trash piles.
- **Maintain a no smoking policy in or near buildings**. Set-up designated smoking areas for employees. Make sure these areas are covered and protected. If they are not covered you are giving employees an excuse to smoke in the building during inclement weather. Monitor the no smoking policy by conducting audits.
- **Hot Work / Burn permits should be used throughout the construction policy**. An effective policy has the following elements:
  - Pre-inspection of work area
  - Charged fire extinguisher at all times, at the point of the work
  - Monitoring the area for at least 30 minutes after work is conducted. This means a fire-watch remains at the work area for 30 minutes (with a fire extinguisher)

after work has been completed. It may also be required to have a fire monitor at the work area while hot work is occurring.

4.7 Actions to be Taken

There are two roles that the fire department plays in buildings under construction. The first is to be engaged in fire inspection practices aimed at reducing the probability of fire. This involves the fire prevention bureau. The second role is to be able to cope effectively if a fire does occur. Frequent inspection and continued emphasis on fire prevention behaviors are considered instrumental in reducing costs.

5. Fire Flow

5.1 Applied Fire Flow

The determination of basic fire flow is a common practice by fire prevention bureaus. Manual M31 (2008) 4th Edition published by the American Water Works Association (AWWA) addresses how fire flow is determined for an **occupied** structure. The Insurance Service Office (ISO) has a term to describe this flow requirement called Needed Fire Flow (NFF). The NFF is the rate of flow considered necessary to control a major fire in a specific building for the fires duration once it is occupied.

The actual calculation of a NFF in gallons per minute (GPM) considers a multitude of factors including construction type, building size and availability of built-in fire protection (sprinklers). It also assumes that the building has been certified for occupancy. This information package focuses on building under construction which have not yet received a certificate of occupancy, therefore their NFF needs might be greater.

Calculating fire flows for a building assumes all mitigation features are in place. That is not true if the fire occurs when these systems have not been made operational, nor are they even connected. The calculation of fire flow for a finished structure therefore, is not the same as fire flow required when an unprotected building catches fire. This is not a commonly discussed phenomenon, yet review of almost all of the scenarios from fires that burned down during construction contains the observation that "the building was fully involved before we got there" – or, “the heat was so intense that the primary priority was exposure protection”. This observation has led many incident commanders to remark that the decision to "go defensive right away” is justified in their mind. Writers in fire publications have suggested that these types of fires should always be fought from a defensive point of view as a safety issue.

The real issue for fires during construction is that peak heat production occurs differently than it would for an occupied structure and that single factor may determine the effectiveness of initial attack and ultimate strategy.

5.2 Heat Production During Construction Fires

In a structure fire, the amount of energy given off can is commonly measured in two terms. The first is total heat release and the second is peak heat release. Total heat release is the total number of BTU’s released when all of the fuel is consumed. Peak heat release is when the discharge of BTU’s is at its highest rate. Peak heat release rate of a fire is a key factor relating to exposure fires. When buildings reach a peak heat release this is when they are most likely to have an effect on neighboring structures. As a result two different fires may have the same total heat release but can have different peak heat release rates.

For example, a small fire load of lumber could result in a slow burning situation presenting a low peak heat release rate. But, a larger fire load can create a fast burning situation which releases a higher peak heat release rate.

5.3 Action to be Taken

In summary, a building may have two different fire flow demands. One is calculated to protect the building when it is approved for occupancy. The other is the reality of what happens when a building is still under construction. The most important consideration when evaluating the difference between

these two fire-flows is to determine that tactics and strategy may be different because the building is not completed.

Water supply and access will be very important to the ability of the local fire department to deliver fire flow if a fire actually occurs. In many cases this one factor may be what determines whether offensive or defensive tactics are used.

6. Pre Incident Plan

6.1 NFPA 1620

In Section 4, we discussed the role of pre-fire planning in preparation to respond to an emergency. NFPA 1620 is a document that provides criterion for developing pre-incident plans. We have also noted that many communities have adopted their own standard. A pre-incident plan process that focuses attention on site considerations is considered a best management practice regardless of the specific technique chosen. In 1620, it notes that the more appropriate pre-fire plan is to utilize NFPA 241. That standard applies to structures in the course of construction, alteration or demolition, including underground locations. In addition, there is information regarding applicable NFPA Standards to be used as part of the pre-incident planning process.

6.2 Pre-Fire Planning from an Operations Perspective

Pre-incident planning is the process of gathering and recording information that could be critical for public safety personnel making life-saving decisions at an incident. The standard for pre-fire planning is NFPA 1620. It describes a robust inventory of facts. Local fire departments may have their own version of pre-fire planning forms. Operational guidelines based on locally adopted policies and procedures may vary. In all cases, the objective is to develop a common understanding of the facts, probabilities and possibilities of what could occur at a specific site. Pre-emergency planning, therefore, should be developed as a team effort between property owner and fire department.

Among the points of emphasis, should be the consideration that a building under construction is likely to be undergoing constant change when it comes to the specifics that the fire department is interested in when an emergency occurs. This could include, but not limited to:

- Availability of fire protection devices
- Mitigation practices
- Water supply
- Means of access and egress
- Location of hazardous materials.

Copies of the pre-plan should be available on the construction site and a copy provided to the fire companies that will initially respond to fire and medical-aid calls at the specific site.

6.3 Actions to be Taken

In many cases the building contractor can contact the local fire department, they will often times come to the site and train employees on fire extinguisher use. The equipment they bring will show examples of the size of fire that employees can fight with an extinguisher. You can also demonstrate the same by buying a small metal trash basket. By starting a fire inside this container it shows employees the size of fire an employee can put out with an extinguisher.

7. Fire Department Capacity

7.1 Level of Service by Fire Department

Earlier in this publication we referred to guidelines to reduce the frequency and severity of ignitions. However, once an ignition occurs the series of events that results in the mobilization and effective use of the fire department becomes the number one priority. Nothing in the any of the model fire or building codes requires that an assessment be done of local firefighting ability to meet any specific level of service requirement. Every fire department has a capacity that is determined by its resources. The purpose of this section is to suggest that stakeholders should be aware of the strengths and limitations of fire departments that will be likely to respond to a specific location.

7.2 Initial Attack

Therefore, for purposes of this concept firefighters should be prepared to go big quick. What this means is to generate as much fire flow as you can, as quickly as you can. Attacking the fire in a building under construction is no time to be timid. Pulling a booster line when a fire is about the size of a trash barrel may be okay when the trash barrel is sitting in a parking lot. When the fire is in a vertical shaft in a building that has exposed building components a booster line is totally inadequate. The fire code requires that we have access to within 150 feet of areas in her buildings. Most departments have pre-connected 1-3/4" lines that they can place in service within minutes. One guideline for consideration is based upon the need to control the fire quickly. Fire officers may consider a 2-1/2" attack line early on. This concept sometimes is referred to a "going big quick". This tactic also includes the idea of getting master streams and aerial operations into operation as quickly as possible.

Of course there is one limitation to this proposal. If you don't have pre-connects, or if you don't have master streams or aerial apparatus you have one hand tied behind your back. Going back to the fire code there is a reason why water supply and access are so important. You can't do anything without both at the same time.

The next suggestion is based upon the idea that you already have a working relationship with site supervisors. If you conducted the pre-fire plan work sessions then the site supervisor should know where you are likely to be required to operate, but more importantly, should also know how to interface with the incident commander to share information as quickly as possible.

Not all fire departments are the same. Some are staffed on a full time bases and have multiple fire companies that can be brought to a scene. Others are staffed with volunteers and have limited resources. It is extremely important that the individual who prepares the fire safety plan with the developer makes individual contact with the fire department to determine their level of service. Most fire departments will have two separate groups of people that will be interested in the construciton project.

The first of these would be the Fire Prevention Bureau. They are often the first point of contact to a developer. The Fire Prevention Bureau's primary function is in enforcing the International Fire Code. Depending upon the way that the community is organized, the Fire Prevention Bureau may or may not have a relationship with the building department. Depending upon the level of coordination between building and fire the presence of the fire inspectors is a variable.

The second aspect of fire protection is the Operations Division. These are the individuals who respond to an emergency. These forces consist of staff apparatus equipment and an incident command system. Site supervisors when developing a fire safety plan should meet early with the operations bureau to

establish criteria for several components of the plan. That would include discussion of water supply and vehicular access.

A portion of the time that is used to develop the fire safety plan should focus on whether the department has the capacity to handle the type of fire being planned for; or whether it must rely on outside resources in order to have enough capacity to control fire.

7.3 Local Resources and Mutual Aid

Host fire agencies try to develop the ability to cope with their fire problems using their own resources. Whenever a fire problem exists that requires all of the agencies resources to be committed, it is not uncommon for the Fire Chief to use neighbors to bolster the organization. There are two terms that explain this relationship. The first of these is automatic aid and the second is called mutual aid. Automatic aid is an agreement between communities where equipment can be sent automatically to an emergency without the Incident Commander requesting it. It is called automatic because it is programmed into the communication center and "automatically" occurs in accordance with dispatch protocals. The term mutual aid is reciprocal agreement where two departments will agree to help each other, when requested. It is not automatic.

In examining the incidents that led to the development of this report, both automatic aid and mutual aid were exercised in a significant number of cases. However, mutual aid typically took longer to get resources on the fire ground than the automatic aid. When considering the capacity of any fire department their ability to get assistance, especially when it comes to aerial apparatus, may be linked to their mutual and automatic aid agreements.

7.4 Actions to be Taken

All fire departments have a capacity but not all fire departments are capable of coping with their most severe risk. It is important that the fire department pay close attention to the comparison between its capacity and its target hazards. This does not mean that the community should reject large buildings but it does mean that the large buildings deserve protection and a plan of operation.

8. Tactics and Strategy

8.1 Impact on the Community

First we should consider this question: can a fire in a building under construction impact a community?

Answer: yes. The National Fire Protection Association (NFPA) has produced several documents over the last 10 years dealing with construction site fires and/or structure fires in residential properties. The latest report identifies the fact that during a five-year time period from 2006 two 2010 there were an average of 650 fires that occurred in properties that were under construction each year. These fires resulted in an average of one civilian death year, 18 civilian injuries per year, and around $87 million in direct property damage.

But this number is not nearly as important as the image of these incidents. Many of you will have seen news broadcasts where an entire block of apartment buildings are going up in flames due to a fire during construction. A good question to ask here is why?

The simplest answer might be because there were ignitions that occurred in the structures and the fire was out of control before the first responding apparatus had a chance to get on scene. The top three causes of fire, according to the NFPA include cutting or welding too close to combustibles, heat source to close to combustibles, and electrical failure or malfunctions. Of course there were also fires caused by arsonists or by careless smokers also.

The literature review clearly indicates that in the aftermath of these types of fires there is often a negative reaction in the media. Conforming with best management practices to reduce the frequency and consequence of these types of fires reduces a considerable amount of criticism.

8.2 The Basics

The basics of firefighting is as old as civilization. The laws of combustion and the relationship between water and fire have been considered as fundamental truths since the dawn of time. But the manner and method in which firefighters approach fires has undergone many evolutionary changes. Imagine, if you can, what it was like to fight a roaring conflagration with nothing more than a bucket. They did that in London in 1666. Imagine what it must've been like the use hand pumpers on buildings in the great cities of Europe and Colonial America in the late 1700s. Over time the fire problem has changed. The contents of buildings have changed. The construction techniques that allow buildings to get larger and taller have changed tremendously in the last 100 years alone. Our technology for fire suppression has evolved considerably. Our use of technology such as sprinklers and fire detection has grown by leaps and bounds.

It should not be a surprise to anyone that the fires we are fighting today are not the same as the ones that our predecessors fought. At a very basic level, the fire service hasn't changed its basic tools. We use nozzles and hoses to distribute water manually. We make decisions to enter buildings or to stay out of them based on a whole series of factors such as smoke color and flame development. We have become much more refined in understanding the movement of air and hot gases. What is truly changed is the decision-making process in the use of all of these tools in a wide range of firefighting scenarios. Those following the work of NIST and UL Labs recognize some of the changes based on research. This knowledge needs to be applied to fires in buildings under construction.

8.3 Fires During Construction

The tactics and strategy employed by fire departments vary considerably from community to community. There are standards for both staffing and the apparatus and there are many suggested guidelines. The ultimate choice on how a fire department chooses to fight a fire is based upon their knowledge and their policies and procedures.

Much of what we are going to discuss in this section can also relate to fires in buildings that are being remodeled or demolished. There are two very good reasons for studying this type of specific fire. 1) For the most part, these buildings are not occupied except for the labor force that is performing the construction. 2) There is a second reason and that is that almost all of the devices that we install in a building to make it safer once it is occupied will likely be compromised if the building has not been given its certificate of occupancy. We are referencing fire sprinklers, standpipes, fire alarms and even compartmentalization not being to go into service. And, while these devices are not ready for service there are processes going on in that building that can result in fire spread that can overwhelm initial attack forces.

While this section is going to be a discussion of tactics and strategy, we need to spend a few seconds reviewing what the current model codes have to say about this scenario. All model codes have requirements for the building owner/contractor to comply with during construction activities.

If you are a fire marshal you are probably familiar with that. But, if you're an operations person, you may not. Yet both prevention and operation need to be concerned about what these model code sections mean if and when a fire occurs during construction.

8.4 Operations Division

Everything we are talking about in this portion of the discussion falls under the category of pre-fire planning or fire inspection activity. Let's now turn our attention to tactics and strategy. It would be presumptuous to try to turn this publication into a class on tactics and strategy. Without having some understanding of your department's capacity to deliver fire suppression resources, then no recommendations are meaningful. The amount of equipment you possess, the type of equipment you possess, or you may find available through mutual aid is a huge variable from one community to another. Therefore we are only going to focus on a couple of very straightforward observations about fighting fires under these conditions. These observations are based upon conducting interviews of individuals who have fought major fires of this nature. They are lessons that are not necessarily learned in a classroom. They are more likely to be taught on the fire ground.

As you will recall in a previous section, (Section 5) we discussed fire behavior and fire flow. But, there are some differences with respect to what these topics mean to an incident commander in a fire in a building under construction. When fire prevention conducts fire flow calculations for a building they are assuming that it is intact. Fire flow calculations are based upon construction type, area, and other factors so that a number can be set as a target to achieve if the fire is to occur – once the occupancy has been completed and is being utilized. The underlining is on purpose. Take any given building and calculate the fire flow and give proper credit for all of the factors that should be installed and you will get a number. Now, stand back and look at that building take all of the fire protection risk mitigation away and ask yourself; what is the fire flow going to be now?

This is based upon the concept called rate of heat release and peak rate of release discussed earlier. Why is peak rate of release important to this topic? In a fire, the energy given off is typically measured by both of these phenomena; the peak heat release by a fire is a key aspect relating to fires in buildings and the effect of ignition off neighboring structures. Two different fires may have the same total heat released but can have two different rates of peak heat released.

If embers or brands of ignited material can land on neighboring structures, then the ignition of combustible elements of neighboring structure may occur. We usually call this an "exposure fire."

What is really important to realize here is that the exposure is being created from two functions; brand distribution and a very high rate of heat flux that would not normally be present if the building were properly protected by its built-in features and those factors were present to reduce fire flow. Using the information from the footnoted resource a simple relationship can be assumed. That rate of peak heat release and maximum impact of radiant heat is going to result in exposure problems very quickly. In short the higher the peak heat rate the higher the radiant heat – the faster you better cool the fire down

8.5 Actions to be Taken

When it comes to dealing with the fire in a building under construction there is one overriding concern: making sure that your decision making process is as well informed as possible. Some things are going to be the same as an ordinary structure fire. Some things are not going to be the same at all. The more you are able to discriminate between the two more likely you will be able to save what's left of the property at the same time make sure that everybody goes home after the fire is over.

9. Fire Investigation

9.1 In Case of An Event

A fire in a building under construction has the potential of significant damage. Literature reveals that fire losses in fires of this type involve many interests including the insurance industry as well as the local community.[1] Fire suppression operations involving these types of fires is the public image of the event. Conducting an investigation of the cause and origin may involve not only the fire service but law enforcement, insurance industry and others. In the event that a fire is caused by vandals or arsonists, the process involves conducting a law enforcement investigation.

9.2 The Basics

Investigating fire and arson involves a complex process that must be followed in order to assure an appropriate outcome. There is a documented body of knowledge for the collection and preservation of evidence. An excellent example of a document to provide guidance in this arena is published by the US Department of Justice.[2] While most agencies have a fire investigation capability, the level of training and resources available to them varies from jurisdiction to jurisdiction. A fire of the magnitude of the events characterized in this material, may well tax the capacity of a local fire department. With this broad spectrum, public safety personnel being involved in the investigative process there needs to be coordination of information, as well as, resources being brought to bear. Documentation and collection of physical evidence at the scene of emergencies is extremely critical.

9.3 Division of Responsibility

The responsibility for conducting a comprehensive investigation may be shared among a variety of entities. The fire service has the primary civil responsibility to establish the fire's cause. Depending upon facts and evidence the cause may be determined to be the result of a combination that was unintentional. However, it is also possible that the cause may be a direct result of a criminal act. Any transfer of responsibility beyond the original cause requires a commitment by all parties to follow standardized policies and procedures. Uniform guidelines for fire investigation vary from location to location. However, the NFPA issues a standard that affects the basic guidelines in place.[3]

9.4 Preservation of the Scene

It is in the best interest of the fire department, once they have arrived on scene to evaluate all factors relevant to cause and origin, protect the scene from any unnecessary activities that could destroy evidence and document the scene for further inquiry. A multi-disciplinary approach for this process is highly desirable. Applying procedures and recommendations to a specific incident is a top priority. The most desired outcome from any investigation is to clearly identify the causal factors that have resulted in major loss.

[1] See Section 12 Incident Inventory

[2] Fire and Arson Scene Evidence: A Guide for Public Safety Personnel, Technical Working Group on Fire/Arson Scene Investigation June 2000

[3] NFPA 921: Guide for Fire and Explosion Investigations, Quincy MASS: National Fire Protection Association, Current Edition

10. Firefighter Safety

10.1 Offensive vs. Defensive Fire Fighting Operations

The fire record indicates that these types of fires do present a potential for injuries and fatalities. The numbers are not large, but the scenarios are quite dramatic. When a fire occurs in a building that is not occupied, there is reluctance on the part of Incident Commanders to unnecessarily risk the lives of fire fighters. The National Fallen Firefighter Foundation (NFFF) supports the decision process that advocates that firefighters do not enter buildings in which life safety is not an issue. Generally speaking, this translates into a defensive tactic rather than offensive tactic in fighting fires in buildings under construction. If a human life is threatened, firefighters will go to great efforts. If human life is not threatened, decisions may be more cautious.

10.2 Access & Water Supply

Because of the possibility of major delay in identifying alarms, establishing water supply and the ability to use built-in fire protection equipment the tactics and strategy of fires during construction require that safety become the number one priority. One fire that has often been cited to make this point is the Deutsche Bank Fire in New York City in 2007. This fire occurred during demolition rather than construction but the conditions were similar. See YouTube.com/ Deutsche Bank Fire NYC August 18, 2007.

Access for firefighting is an extremely important consideration. It consists of operating externally to the building in almost all cases. Suitable locations for the location of incident command needs to be identified in close proximity with the construction company buildings set aside for site supervision. This allows the contractor and sub-contractor access to the incidence command post and provides the incident commander with access to information.

Maintaining suitable access to the site itself is accomplished by having all-weather driving surfaces that are not less than 20 feet of unobstructed width, and having the ability to withstand the live loads of fire apparatus. Dead-end roads that are more than 150 feet in length should be provided with a turn-around.

10.3 Actions to be Taken

Fires during construction place a big burden on fire department incident commanders for the simple reason that these types of fires are not best case scenarios. While most fire agencies will go through extraordinary lengths to save lives, there is an increasing amount of emphasis on not risking the lives of firefighters to save property. There is no contradiction with this safety concern with respect to construction worker safety. The fire services uses a term “everybody goes home” as a motto for firefighter safety. Recognizing this as a high priority, for incident commanders places even more emphasis on having a good fire safety plan on-site.

11. Site Security

11.1 General

Site security is a top priority for any construction site. Because arson and Hot Work are the two leading reasons for fires, security become extremely important in preventing fires. There are a variety of policies and procedures which should be implemented to assure maximum security. They would include the following:

- Fencing around the perimeter of a job site is a good way to signal the trespassers that they are not welcome. Fencing should be robust. Fencing should be high enough to keep intruders out but they should not be opaque. The reason is that once an opaque fence is scaled they may screen or hide activity of intruders.
- Locks should be provided. Some communities may wish to use a "lock box" so that responding personnel will not have to cut chains or locks to gain entry. Any keys that are issued to security personnel must be marked so that they cannot be duplicated. Master keys should not be identifiable as such. Security guards should check locked gates to prevent illegal entry.
- No trespassing signs should be posted at 75 foot intervals on the fencing or in accordance with local guidelines. Make workers responsible to report if these signs are removed or vandalized.
- A gate that prohibits non-construction traffic from having access to the site during non-working hours
- Perimeter fencing should be installed whenever the site is:
  - Located adjacent to schools, playgrounds, recreational facilities or public assemblies
  - Immediately adjacent to heavily trafficked pedestrian ways
  - Fences should be lighted so that intruders can be illuminated quickly, specifically access gates should be lighted. Lights should be checked daily especially prior to sunset so that any deficiencies can be corrected. Power supply for perimeter lighting should be inaccessible or tamper proof.
- Whenever practical site security should consider the use of technological observations as well as watch personnel. CCTV systems and intrusions monitoring and remote monitoring is recommended even if the site is guarded.
- All construction sites should hold three construction meetings with local fire officials and police departments to assure an exchange of information. It is recommended that the first of these be held before starting the project onsite. The second to be held when framing is started and the third to be conducted just prior to completion.

11.2 Underground Operations

Wherever there are above-ground entrances to an underground operation, there must be a check-in and check-out system. The purpose of this is to assure that individuals who enter the building are tracked. In the event of a fire or structural collapse, this system needs to be accessed to ensure that all employees are out of the building. The location where this check-in occurs should be identified by appropriate signage.

11.3 Role of Security Guards

Regardless of the configuration of the building, there should be a site security plan that monitors the entire structure to identify potential fire starts. A security vulnerability assessment should be used to identify and evaluate potential security threats. The security plan should include, but not be limited to:

- Personal observation
- Log books
- Video technology
- Scheduled routes
- Proper notification procedures

The security guards provided to a site are there for several reasons. They should be provided with copies of the job site emergency contact list and should have been instructed in the system for alerting local fire and police authorities. Whenever Hot Work has been performed during the work day, the afterhour's security officer should be notified as to where Hot Work has been performed. If a security company is being utilized, their orders should include provisions for making routine observation of Hot Work sites as they do their patrolling activities. Policy and procedure should include documentation of these rounds in the log book. Security personnel should be adequately trained to extinguish small fires and to be able to carry out notification of an emergency without delay.

11.4 Actions to be Taken

The security plan is extremely important insuring that a building will be safe from fire. Having adequate policies and procedures in place and focusing on quick response to any event will go a long way in reducing losses.

12. Incident Inventory

The following incidents have been researched and identified as being of interest to those studying or teaching methodology of how to deal with fires in buildings that are under construction. This list will remain dynamic and will be added to any subsequent edition. There will also be a website made available so that these specific fires can be downloaded.

INCIDENT DATA

Montrose, Texas
http://houston.culturemap.com/news/city-life/04-28-14-another-mysterious-montrose-luxury-apartment-fire-raises-questions-under-construction-spots-keep-going-up-in-flames/
http://www.chron.com/news/houston-texas/houston/article/2-alarm-fire-burns-near-downtown-Houston-5347617.php
http://www.khou.com/news/cnn/BREAKING-Massive-apartment-fire-burning-in-Montrose--252279571.html
http://www.chron.com/news/houston-texas/houston/article/3-alarm-fire-burns-near-downtown-Houston-5347617.php
http://news92fm.com/423499/2-alarm-building-fire-burning-in-montrose-area/
http://www.ktrh.com/articles/houston-news-121300/breaking-huge-fire-in-the-montrose-12188391

Irving, Texas
http://www.nbcdfw.com/news/breaking/Warehouse-Catches-Fire-in-Irving-258916341.html

San Francisco, California
http://www.sfexaminer.com/sanfrancisco/report-5-alarm-mission-bay-fire-likely-caused-by-welding-work/Content?oid=2792610
http://sanfrancisco.cbslocal.com/2014/04/18/sf-honors-emergency-responders-for-work-at-massive-mission-bay-fire/
http://www.nbcbayarea.com/news/local/SF-Mission-Bay-Fire-Ruled-Accidental-255360581.html
http://www.sfexaminer.com/sanfrancisco/fire-department-releases-report-on-5-alarm-mission-bay-fire/Content?oid=2770459
http://sanfrancisco.cbslocal.com/2014/03/11/huge-fire-burn-san-francisco-building-under-construction-near-att-park/

Anaheim, California
http://www.ocregister.com/articles/fire-609512-apartment-crews.html
http://california.construction.com/yb/ca/article.aspx?story_id=id:VxjIDcYYSA3Z-98SSDZkCf3cu03__zkEVuild07SRjA3tM3o9s6IbgcTZalPaNWG
http://www.ocregister.com/articles/north-608806-fire-smoke.html

San Diego, California
http://www.kusi.com/story/25414501/downtown-high-rise-under-construction-briefly-catches-fire
http://www.cbs8.com/story/25414996/crews-knock-down-small-fire-downtown

Newport Beach, California
http://www.ocregister.com/articles/fire-613303-building-restaurant.html

Goleta, Calif.
http://www.keyt.com/news/five-buildings-in-constriction-zone-catch-fire/26795246

Sherman Oaks. Calif.
http://www.dailynews.com/general-news/20140715/house-under-construction-in-sherman-oaks-damaged-by-fire

Los Angeles, California
http://www.washingtonpost.com/news/post-nation/wp/2014/12/08/massive-los-angeles-apartment-fire-halts-traffic-on-portions-of-two-freeways/

Rockville, Maryland
http://www.actionnewsjax.com/content/topstories/story/Crews-battle-massive-fire-at-Maryland-condo/v504xEfbLEylQKv7tf_CqQ.cspx
http://www.wjla.com/articles/2014/04/rockville-two-alarm-fire-burning-unfinished-apartment-complex-101717.html

Salt Lake City Utah
http://www.deseretnews.com/article/865596064/Blaze-breaks-out-in-building-under-construction-in-Salt-Lake-City.html
http://www.ksl.com/?sid=28662954

Grand Island, Nebraska
http://www.theindependent.com/news/local/fire-at-nebraska-state-fair-building-under-construction/youtube_7155b57e-79b5-11e3-be5b-001a4bcf887a.html

Hardwick, Vermont
http://www.wcax.com/story/20717761/fire-at-a-new-building-may-set-back-completion

Teton County, Idaho
http://m.tetonvalleynews.net/news/fire-destroys-house-under-construction/article_b91da454-6093-11e0-966a-001cc4c03286.html?mode=jqm

Burlington, Mass.
http://www.lowellsun.com/breakingnews/ci_25562910/one-dead-methuen-house-fire

Tribeca NYC, N.Y.
http://www.dnainfo.com/new-york/20140429/tribeca/fire-breaks-out-at-luxury-tribeca-condo-development-fdny-says

Brier Creek, N.C.
https://www.dropbox.com/s/tvq84v48usljeqd/11%20January%202014%20Brier%20Creek,%20NC%20Condos%20Collapse.pdf

Las Vegas, Nevada
http://lasvegassun.com/news/2014/may/08/fire-does-250000-damage-3-houses-under-constructio/

Mercer, Wash.
http://www.mi-reporter.com/news/258654011.html

West Union, Iowa
http://wcfcourier.com/news/local/update-building-under-construction-collapses-injuring-in-west-union/article_425a0bca-78fe-5c5f-ab54-fa4181dc976f.html

Hamilton, New Jersey
http://www.nj.com/mercer/index.ssf/2014/05/gas_leak_causes_evacuation_at_construction_site_in_hamilton.html

Chicago, Illinois
http://www.chicagotribune.com/news/local/breaking/chi-fire-erupts-at-north-side-building-20140517,0,5717513.story

Branson, Missouri
http://www.news-leader.com/story/news/local/ozarks/2014/05/19/injured-branson-worker-rescued-collapsed-building/9300961/

Hamden, Maine
http://bangordailynews.com/2014/05/23/news/bangor/fire-damages-hampden-condo-under-construction/?ref=latest

Grand Island, Nebraska
http://www.theindependent.com/news/local/fire-at-nebraska-state-fair-building-under-construction/youtube_7155b57e-79b5-11e3-be5b-001a4bcf887a.html

Seattle, Wash.
http://q13fox.com/2014/06/14/smoking-materials-left-in-portable-toilet-caused-capitol-hill-building-fire/#axzz34oIvu2vQ

Waltham, Mass.
http://www.boston.com/news/local/massachusetts/2014/06/18/alarm-fire-destroys-two-buildings-waltham-overnight/K0UhwgOxV3QK4xlXkWJ4mJ/story.html

Vancouver, Wash.
http://www.oregonlive.com/clark-county/index.ssf/2014/06/vancouver_apartment_building_u.html

Benton Township, Mich.
http://www.heraldpalladium.com/news/local/fire-scorches-motel-under-construction/article_7b1a67c3-dddf-5cff-a4a6-0449616771b8.html

McLean, Virginia
http://www.washingtonpost.com/local/crime/firefighters-face-two-alarm-blaze-at-mclean-area-high-rise-building/2014/07/10/c1310090-0898-11e4-8a6a-19355c7e870a_story.html

Beverly, Mass.
http://www.washingtontimes.com/news/2014/jul/14/fire-destroys-house-under-construction-in-beverly/?utm_source=RSS_Feed&utm_medium=RSS

Royalwood, Canada
http://winnipeg.ctvnews.ca/overnight-fire-at-under-construction-apartment-building-causes-50-000-in-damages-1.1907327

Richmond Hill, Toronto, Canada
http://www.cbc.ca/news/canada/toronto/fire-destroys-richmond-hill-homes-under-construction-1.2655248

Regina, Canada
http://regina.ctvnews.ca/equipment-failure-to-blame-for-blaze-that-destroyed-hotel-under-construction-in-regina-1.1767278

Pouch Cove, Newfoundland, Canada
http://www.thetelegram.com/News/Local/2014-04-25/article-3701697/Update%3A-Fire-at-Pouch-Cove-apartment-building-under-control/1

Ottawa, Canada
http://www.cement.ca/en/News/Massive-Kingston-Student-Housing-Building-Fire-Stresses-Wood-Construction-Safety-Risks.html

Edmonton, Canada
http://www.journalofcommerce.com/article/id59822/--police-investigating-suspicious-fire-at-edmonton-site

Fort McMurray, Edmonton, Canada
http://edmonton.ctvnews.ca/fire-destroys-fort-mcmurray-condo-building-under-construction-1.1890051

http://edmonton.ctvnews.ca/cause-determined-in-fort-mcmurray-condo-fire-1.1893736

Minot, South Dakota
http://www.kfyrtv.com/kmot/home

www.kxnet.com/.../**fire**-destroys-part-of-chateau-apartment-c...

www.bakkentoday.com/event/article/id/35806/

APPENDIX

Fire Department KSA

This document identifies the inventory, knowledge, skills and ability necessary for a person to perform at two levels; fire prevention and operational responder. The assumption is that there are two roles for members of the fire service in dealing with a building under construction. The first component consists of engaging in fire prevention best management practices to assure a safe and fire free construction area; the second is to properly prepare operational firefighters in dealing with a fire in a building in which built in mitigation may be absent or compromised.

KSA
Fire Prevention Personnel
Knowledge and skills necessary to properly supervise fire safety activities during construction and demolition.
Knowledge and skills necessary to evaluate the model code provisions of the adopted code.
Knowledge and skills necessary to assure compliance with OSHA safety regulations.
Knowledge and skills necessary to utilize the provisions of NFPA Standard 241.
The knowledge and skills necessary to evaluate and properly utilize standpipes, automatic sprinkler systems, fire alarm systems and portable fire extinguishers.
The knowledge and skills necessary to conduct a fire inspection program in an onsite scenario.
The knowledge and skills to perform oversight for security and guard services.
The knowledge and skills necessary to develop and implement a pre-fire plan in accordance with NFPA 1620.
The knowledge and skills necessary to conduct the training of subordinate personnel in the use of all fire protection equipment.
The knowledge and skills to be able to evaluate the operational status of fire protection equipment that has been approved for the specific site.
The knowledge and skills necessary to supervise Hot Work operations including follow-up on permit processes.
The knowledge and skills necessary to evaluate, access and remedy any impairments to any fire protection system required by the code to be installed.
The knowledge and skills necessary to understand how to protect essential equipment that may be exposed to potential damage.
The knowledge and skills necessary to provide emergency information to the local fire department including interface with the incident command system. This task includes the use of pre-fire information.
The knowledge and skills necessary to evaluate any issue associated with access or water supply that would limit local jurisdictions ability to combat fires onsite.

KSA
Operations Personnel
Knowledge and skills necessary to evaluate the model code provisions ICC and NFPA.
Knowledge and skills necessary to assure compliance with OSHA safety regulations.
Knowledge and skills necessary to utilize the provisions of NFPA Standard 1620.
The knowledge and skills necessary to evaluate and properly utilize standpipes, automatic sprinkler systems, fire alarm systems and portable fire extinguishers.
The knowledge and skills necessary to conduct a fire attack based on an on-site scenario.
The knowledge and skills necessary to conduct the training of subordinate personnel in the use of all fire protection equipment.
The knowledge and skills to be able to evaluate the operational status of fire protection equipment that has been approved for the specific site.
The knowledge and skills necessary to evaluate, access and remedy any impairments to any fire protection system required by the code to be installed.
The knowledge and skills necessary to understand how to protect essential equipment that may be exposed to potential damage.
The knowledge and skills necessary to integrate information from the developer and/or contractor, into the incident command system. This task includes the use of pre-fire information.
The knowledge and skills necessary to evaluate any issue associated with access or water supply that would limit local jurisdictions ability to combat fires onsite.

ISBN Number Here