Fire Safety and Security

A TECHNICAL NOTE ON FIRE SAFETY AND SECURITY ON CONSTRUCTION SITES IN BRITISH COLUMBIA


















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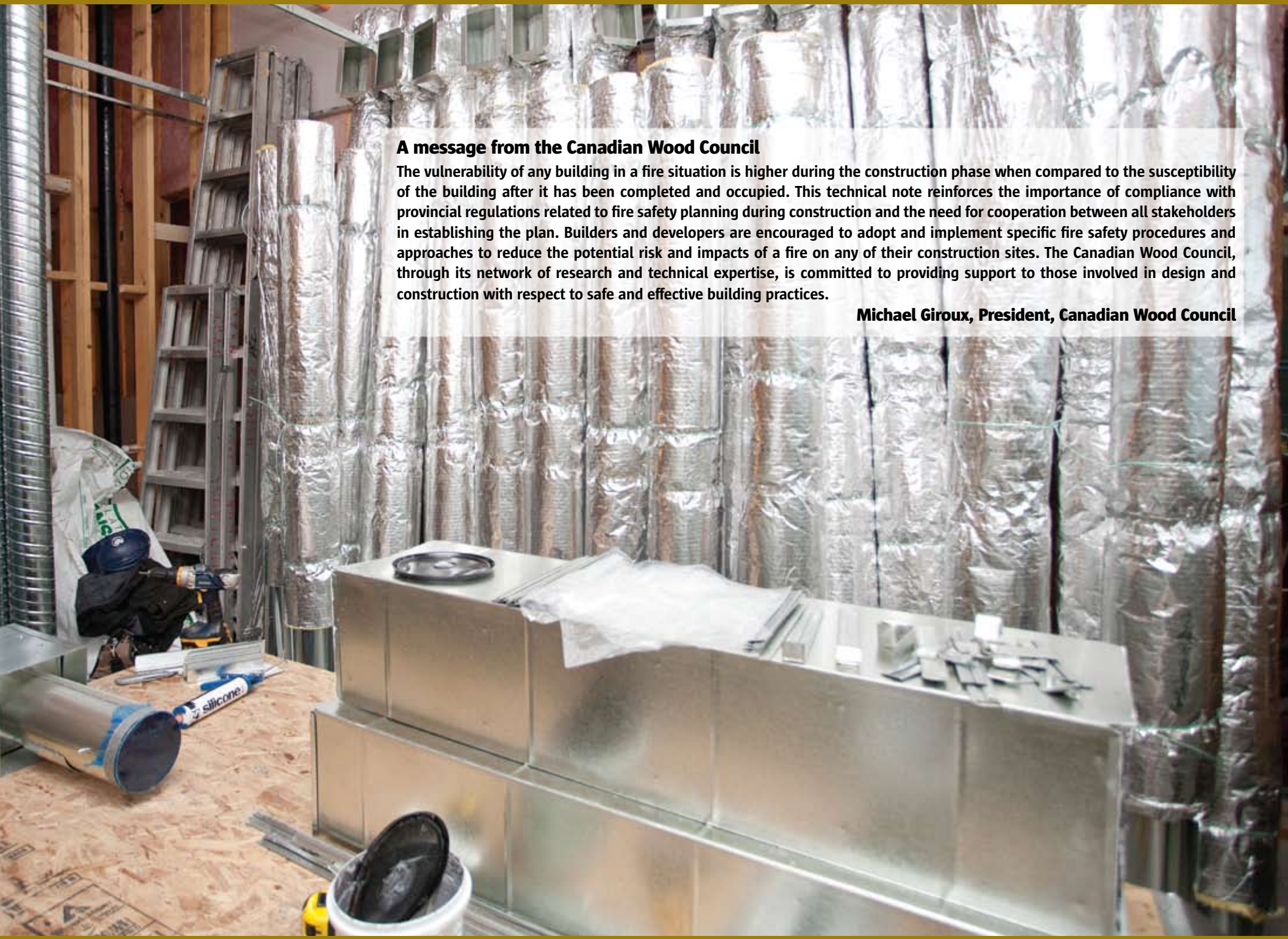


A message from the Canadian Wood Council

The vulnerability of any building in a fire situation is higher during the construction phase when compared to the susceptibility of the building after it has been completed and occupied. This technical note reinforces the importance of compliance with provincial regulations related to fire safety planning during construction and the need for cooperation between all stakeholders in establishing the plan. Builders and developers are encouraged to adopt and implement specific fire safety procedures and approaches to reduce the potential risk and impacts of a fire on any of their construction sites. The Canadian Wood Council, through its network of research and technical expertise, is committed to providing support to those involved in design and construction with respect to safe and effective building practices.

Michael Giroux, President, Canadian Wood Council

1. INTRODUCTION

The construction phase of any building represents a relatively short period of time in the lifespan of the structure during which a unique set of risk scenarios are present. The risks and hazards found on a construction site differ in both nature and potential impact from those in a completed building; and this occurs during a time in which the prevention and protection elements that are designed to be part of the completed building are not yet in place.

For these reasons, construction site safety includes some unique challenges. However, an understanding of the hazards and their potential risks is the first step towards prevention and mitigation.

While there are many types of hazards and risks that require consideration during construction of all buildings, this Technical Note will focus on fire-related aspects.

2. REGULATIONS

Everyone involved in planning and constructing a building needs to understand their roles and responsibilities related to fire safety on the construction site.

The first step is to determine the local regulations applicable to your specific project, and to put in place the necessary measures to ensure compliance to those aspects of the regulations for which you are responsible.[1] In British Columbia, there are several provincial regulations particularly relevant for construction sites and fire safety:

- *2006 British Columbia Building Code (BCBC)*, particularly Division B, Part 8 "Safety Measures at Construction and Demolition Sites" and,
- *2006 British Columbia Fire Code (BCFC)*, particularly Division B, Section 5.6 "Construction and Demolition Sites", under Part 5 "Hazardous Processes and Operations."

The City of Vancouver maintains its own by-laws in these areas:

- *City of Vancouver Building By-law (VBBL) 2007* (By-law No. 9419 and amendments), particularly Division B, Part 8 "Safety Measures at Construction and Demolition Sites" and,
- *City of Vancouver Fire By-law (VFBL) 2000* (By-law No. 8191 and amendments), particularly Sections 2.14 and 5.2.

The requirements of the VBBL and the VFBL are similar to those in the BCBC and the BCFC, respectively; however, the VBBL does have some additional requirements and the VFBL does not contain as many requirements specifically directed at construction sites.

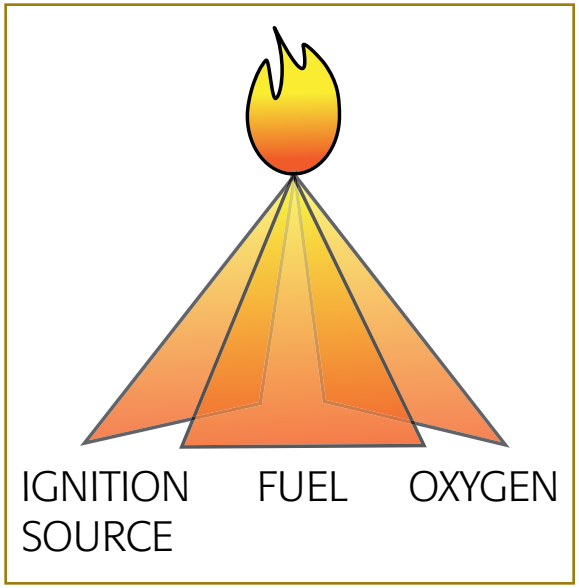
The British Columbia Office of the Fire Commissioner (BCOFC) has produced the OFC Bulletin *Fire Safety Planning for Construction and Demolition Sites*, which provides excellent guidance on the BCBC and BCFC requirements.

Depending on the specific systems and equipment used and the processes and operations taking place on your site, there may be other regulations that are applicable. Some organizations to check with in this regard are the British Columbia Safety Authority and WorkSafeBC. For example, the *Occupational Health and Safety (OHS) Regulation* contains legal requirements that must be met by all workplaces under the inspection jurisdiction of WorkSafeBC, which includes construction sites.

In addition to province-wide regulations, local governments may also have specific laws, regulations or requirements that must be followed. The local fire department often can be a resource in directing you to any additional regulations or requirements that have been implemented in your community.

[1] See the "Sources of Information" section of this Technical Note for additional details regarding documents and organizations mentioned herein.

Of course, the specific applicable regulations provide the base requirements for construction site fire safety. However, consideration should also be given to your project's characteristics, objectives and goals and how fire risks may impact construction at any phase of the work. Safety on a construction site, as in other settings, goes hand-in-hand with quality, productivity and profitability. If this is understood, it can be considered an incentive to meet and exceed the regulated standards. An examination of all possible factors and options can be of benefit. An understanding of some of the basics of fire safety and how to control risk during the construction period can be important to reducing unexpected financial risk and is helpful to the decision-making process.



THE FIRE TRIPOD

3. THE FIRE TRIPOD

For any fire to start, three components are needed: (1) oxygen, (2) a source of ignition – that is, an external source of sufficient energy (e.g. heat), and (3) sufficient fuel that is readily ignitable. These three components make up what is known as the "fire tripod." Take away any one 'leg' of this tripod, and fire cannot start, or similarly, fire can be extinguished if it occurs.

Construction sites tend to have a potential abundance of all three components. However, since it is rather impractical to control the availability of oxygen on a construction site, construction site fire safety usually focuses on the reduction and control of possible sources of fuel and ignition.

4. IGNITION SOURCES

The first line of defense in construction site fire safety is to reduce the potential for ignition to occur. Towards this end, it helps to know some of the causes of fire in these situations.

The three leading causes of fires in buildings under construction are "incendiary or suspicious" (40%); "open flame, embers or torches" (21%); and, "heating equipment" (10%).[1] To a lesser degree, other causes include: smoking materials; natural causes such as lightning; electrical sources such as distribution systems, appliances, or tools; other heat sources, including cooking equipment; and exposure to external fire sources such as forest fires.

Many of the fires in the category of "open flames, embers and torches" are started by "hot work" activities on the site. Section 5.2 of the BCFC and the VFBL includes in the category of "hot work" all activities that involve open flames or produce heat or sparks, including cutting, welding, soldering, brazing, grinding, adhesive bonding and thermal spraying.

In many cases it is possible to "design out" the need for various types of hot work, thereby removing a potential hazard from the site. When hot work is necessary, Sections 5.2 and 5.6 of the BCFC (Section 5.2 of the VFBL) contain specific requirements for particular procedures and protection for such operations, including conformance in many instances to CAN/CSA-W117.2, *Safety in Welding, Cutting and Allied Processes.* As well, the BCOFC Bulletin includes additional guidance on various aspects to be considered when hot work occurs on a site.

Designing and using a heating/drying system that situates the heating equipment outside of the structure under construction can reduce the risk of ignition by one of the major sources of fire on construction sites. When heating/drying equipment is situated inside, care should be taken to maintain appropriate clearance around the equipment and to ensure adequate ventilation and clearances to combustibles if fuel-fired appliances are involved.

In many cases, vigilance and common sense can reduce the hazard posed by potential ignition sources on a site. Maintaining electrical equipment and tools in good condition, limiting or eliminating open burning – particularly of waste materials – and keeping machinery and vehicles with an internal combustion

[1] *Structure Fires in Vacant or Idle Properties, or Properties under Construction, Demolition or Renovation*, NFPA Fire Analysis and Research Division, Quincy, MA, August 2001.

engine a reasonable distance from combustibles are relatively simple ways to reduce the hazard of fire ignition. Cleaning and removal of combustibles from engine compartments can reduce the likelihood of vehicle fires.

Banning smoking on construction sites can be controversial. While smoking materials are a source of ignition, it is recognized that a complete ban may drive smokers 'underground', which may increase the risk of smoking taking place in more vulnerable, less frequented areas of a site. As a result, a designated smoking area either on or just off of the site may be considered an option. In other cases, it has been seen as appropriate to prohibit any smoking materials from being brought onto the site, or ensuring that any smoking materials are kept in a specific, safe location, such as a locker room. If a designated smoking room is used, 'fuel' (see Section 5 below entitled "Fuel Sources") in it should be limited and it should be well-separated from additional fuel sources. It is recommended that a water-filled container or metal container with a self-closing lid be used for disposal of smoking materials. Contents of such containers should be disposed of off-site on a regular basis. In all cases, compliance to local and provincial regulations should be maintained.

5. FUEL SOURCES

The second line of defense in construction site fire safety is to control any readily-ignitable sources of fuel. This reduces the probability of an ignition source starting a fire, and limits the potential for fire spread if ignition does occur.

As with the handling of potential ignition sources, common sense in the management of the quantities of available fuel can significantly reduce the frequency and impact of fire. This can also reduce the fire exposure of structural wood products and wood-based formwork and scaffolding. Such elements do not tend to catch fire easily, but they can become involved if excessive quantities of waste materials, such as paper, wood shavings and flammable materials, are left lying around and become involved in a fire. Consequently, good housekeeping can be one of the most important factors in fire prevention on a construction site – without fuel, the size of a fire is limited and the likelihood of ignition is reduced.

In other words, proper storage of combustible waste on site, and removal of such waste from the site as frequently as possible, reduces the risk of fires. Regular clearance of rubbish can help thwart opportunistic fire setters, as well as reduce the risk of accidental ignitions.

Strict controls on storage of combustible and flammable liquids and gases, as well as any refueling activities, should be observed, and all regulations should be conformed to. For example, Section 5.6 of the BCFC requires fuel supplies for heating equipment and internal combustion engines to conform to either CAN/CSA-B139-M, *Installation Code for Oil Burning Equipment,* or the British Columbia *Safety Standards Act* and its regulations.

Part 4 of the BCFC and the VFBL, *"*Flammable and Combustible Liquids,*"* provides requirements for the storage, handling and use of flammable and combustible liquids, and these requirements are applicable to construction sites.

It can be a good idea to minimize as much as practical the amount of flammable and combustible liquids in or near a building at any given time. Generators and other fuel-fired appliances should be arranged to be sheltered from the rigorous conditions on a construction site. For instance, temporary fuel lines that may be easily damaged, melted or burned, which may result in the leaking of fuel onto a generator, should be avoided and more robust arrangements provided to avoid feeding a fire with an excessive fuel spill.

Lately, there is the desire to continue construction year-round in all weather, and so more temporary enclosures of the site envelope are seen on construction sites. With a variety of such systems in use, it is good to consider the fire performance characteristics of any materials in systems to be used on your site – the fabrics and other materials of some systems are more flammable than others. Contact of such systems with possible ignition sources should also be avoided.

6. ON-SITE FIRE PROCEDURES AND EQUIPMENT

6.1 Fire safety officers

In most of British Columbia, while there is currently no regulatory requirement for a dedicated person to oversee all fire safety aspects on a construction site, it is considered best practice to designate a full-time 'fire safety coordinator' or a 'fire safety officer'. In the past, such a role was sometimes assigned to site managers or site supervisors as an additional function. However, it has been recognized that while the two functions are not mutually exclusive, both have significant levels of responsibility and are time-consuming. As there is typically a requirement for a construction safety officer on site (under health and workplace safety regulations), it is possible that in some cases that person could also assume the role of fire safety officer.

One of the main differences in the VBBL in comparison with the BCBC is that Division B, Part 8 of the VBBL includes the requirement of a full-time Construction Safety Officer whenever a "complex" building (as described in Division C, Subsection 2.2.7. of the VBBL) is being constructed – that is, typically any building that requires a 'registered professional,' as defined by the VBBL. The Construction Safety Officer's responsibilities outlined in the VBBL include aspects of construction site fire safety, but also include oversight of non-fire safety procedures related to such things as traffic control and hoisting equipment.

On larger projects, consideration may need to be given to having an assistant fire safety officer to fulfill the duties of the fire safety officer in their absence.

Such designated persons need to have an understanding of the fire risks on construction sites and of good fire prevention practices. They should also be familiar with applicable regulatory requirements. The responsibilities of such persons can include clear communication of site fire safety requirements and policies to subcontractors and trades, monitoring of the site for fire safety issues, including compliance by everyone working on the site to those fire safety requirements and policies, applying and updating the site's Fire Safety Plan, which sets out those fire safety requirements and procedures (see Section 10 below entitled "Fire Safety Planning"), and liaising with the local emergency services.

6.2 Hot work procedures

There are Code provisions that require 'fire watch' duties to be carried out whenever hot work takes place. Subsection 5.2.3. in Division B of the BCFC requires that "*…a fire watch shall be provided during the hot work and for a period of not less than 60 minutes after its completion…"* and that *"...a final inspection of the hot work area shall be conducted 4 h after completion of work."* However, in practice, since a fire could occur in the three hours between the end of a 60-minute fire watch and a final inspection that takes place four hours after completion of the work, a two-hour watch is sometimes used, with regular checks by designated on-site personnel during the remainder of the four hours. The VFBL requires a fire watch, but has no specific duration or timing requirements.

The BCFC and the VFBL also stipulate that the fire watch is to be performed by "*… personnel equipped with and trained in the use of fire extinguishing equipment."*

A key requirement of the BCFC and the VFBL is the removal of combustibles or covering of combustibles in the area during hot work to prevent ignition. Fire-retardant covering materials are available for this purpose. Since sparks can skip under covers, resulting in ignition, care must be taken in their use.

In the absence of these measures, the BCFC and the VFBL require that the area be thoroughly wetted, since there is the possibility of ignition of fine fuels even when the area is relatively clean. The impact of water on the structure and finishes can be reduced by use of fine water sprays or pressure washers to limit the quantity of water utilized, but wetting should be sufficient to extinguish sparks on contact. It should be noted that in some cases wetting may not be practical, particularly when trying to meet the maximum moisture limits set in order to proceed with the 'closing in' phase of construction.

6.3 Fire extinguishers and standpipe systems

When it comes to fire-related equipment on site, the BCFC requires that portable extinguishers be provided in a variety of locations. As well, it requires that where a standpipe system is to be installed in a building under construction, the system be installed progressively in conformance with the BCBC. The BCOFC Bulletin provides additional guidance on fulfilling the intent of the BCFC.

Plans and specifications should indicate when a standpipe is required during construction. In a cold (i.e. freezing) climate, a 'wet' riser will require insulation and heat-tracing. The advantage of a 'wet' standpipe system is that the water is immediately available and may be used to feed small hoses for firefighting, wetting down of hot work areas and other purposes. For this reason, wet standpipes can have significant advantages over 'dry' standpipes that provide no water until the fire service connects the standpipe to a water source through a pumper truck or other apparatus. As well, with a dry standpipe system, there is the risk that someone will try to use it as a convenient source of water – they may open a valve on the system and then leave it open when there is no water. If a fire subsequently occurs and the dry standpipe is charged, water can be discharged from the valve(s) that have been left open, which may not only result in water damage in a part of the structure not intimate to the fire, but also can mean reduced water pressure available to emergency responders. Therefore, regular checks of the valves to verify that they remain closed may be necessary. However, a manual dry standpipe system does have the virtue of simplicity, particularly in cold climates.

Since the location of and access to a standpipe system may differ somewhat during construction from the final design, it is helpful to communicate this information to the local fire service.

6.4 Fire detection and alarm systems

If a fire occurs during site hours, the primary aim is to make sure everyone on site reaches safety as quickly as possible. This is one reason why the BCFC also requires that a system capable of sounding an alarm that can be heard throughout the building be provided to alert site personnel in the event of a fire. Such equipment and associated response would usually occur in parallel with other emergency procedures to notify the fire service and respond to the fire.

Installation of a fire alarm system that can detect fire as well as notify site personnel can increase the likelihood that personnel will be made aware of a fire before it becomes large enough to compromise escape routes. A significant factor in reducing the potential damage arising from a fire is the speed of detection, together with a reliable means of alerting the fire service. The speed with which the fire service can be made aware of a fire in a building under construction can impact the amount of damage that may occur.

It should be taken into consideration that fire detection devices typically rely on a localized build-up of heat and/or smoke for activation, which may not occur as readily in a building at various stages of the construction process.

Also, some devices may be activated by operations conducted on the site – for example, hot work, which can generate products of combustion. For this reason, some sites de-activate detection systems during work hours, reinstating the protection when the site is relatively unoccupied. Some types of detectors can be easily contaminated by particles/dust created by construction activities, particularly detectors that require products of combustion to enter a detection chamber of some type. Detectors can also suffer physical damage due to material handling and other construction activities, although the addition of guards to detectors can reduce the degree or frequency of damage. Regular cleaning or replacement of detectors may be considered in some cases, such as where smoke detectors

of some kind are used. Some detectors, such as conventional heat detectors, are sealed units and as such are not easily contaminated, although they may still require protection against impact.

Consideration can be given to include supervised wiring to alert to a trouble condition and to provide for automatic notification of a central location, such as an on-site 'command post' (see Section 6.6 below entitled "On-site 'command post'"). The sequence of operation of such systems can be programmed to have this function only after normal working hours, to avoid unnecessary false alarms. It should be noted that the advent of wireless detection and alarm products can reduce the impracticalities related to the installation of wired systems in a building under construction. Distance limits on wireless transmission may need to be considered, but is likely not to be a constraint on most sites, and technology is constantly improving.

PROTECTED SPRINKLER
SUSPENDED FROM CEILING

As can be seen, there are reasons why the fire detection and alarm systems that are contemplated for the finished building are often unsuitable for use during construction. There is an increased risk of damage or contamination of valuable system components if installed too early in the construction phase. For this reason, NFPA 72 *National Fire Alarm and Signaling Code* contains specific language to make designers and installers aware of the potential problems associated with early installation of permanent equipment.

6.5 Fire sprinkler systems

Issues similar to those described for detection/alarm systems and standpipes can also apply to the installation of either temporary or permanent automatic sprinklers and their associated systems at any stage of construction, whenever they might be required in a completed building or considered for use.

There are also specific sprinkler-related issues to be considered in contemplating either the early installation of a permanent sprinkler system, if one is to be present in the completed building, or installation of a temporary sprinkler system, which may be separate from or make use of a permanent sprinkler system's water-supply piping.

For example, the extent of a temporary system installation (e.g. use of temporary sprinkler protection for specific hazards or localized areas, such as material storage spaces), and the complications related to installing sprinklers in a cold environment both may need to be weighed against the level of potential fire risk and the duration of that risk. The size of a project and the length of time that the project will be under construction are also specific factors to consider.

Automatic sprinkler systems that are intended to protect a building, its occupants and its contents once the building is fully constructed and occupied are designed to work with certain construction features already in place, such as finished ceilings. The success of automatic sprinkler systems within completed buildings using the fundamental principles and standards developed over many years is well documented. However, there is little information on what design features would be appropriate for successful performance of a sprinkler system during a fire scenario while a building is still under varying stages of construction. As a result, the prediction of possible outcomes in such scenarios, which is necessary to evaluate the effective risk reduction resulting from implementation of such a strategy, can be difficult.

It is possible that different stages of construction might require different sprinkler system design features, which could require moving or altering parts of a system multiple times during the course of construction. This could cause delays in the construction schedule.

The increased likelihood of a sprinkler system being exposed to adverse climatic conditions when installed in a building still under construction can also greatly increase the potential of system problems arising due to corrosion. Designing a

sprinkler system that has greater corrosion resistance than may be required for a system designed for a typical completed building can greatly increase the cost of the system.

Access to a sufficient and reliable water supply is important to the performance of a sprinkler system, and therefore water supply issues should be taken into consideration. It may be determined that a fire pump is needed to supply enough water at the appropriate pressure to a sprinkler system protecting a building during construction; however, installation and commissioning of a fire pump for use only during the construction phase can be complicated and expensive.

Whereas most permanent automatic fire sprinkler system installations are currently sequenced from the top storey down, buildings are constructed from the bottom up. As a result, installation of temporary automatic sprinkler protection for buildings under construction may need to consider a similar bottom-up approach.

In a sprinkler system designed to be used during both the construction phase and post occupancy, temporary sprinklers are often recommended, as sprinklers commonly need to be subsequently replaced and aligned with finishes in accordance with the standard installation requirements. Sprinklers can be protected by guards to enable a temporary level of protection of the devices to be achieved during building construction, but some guards can affect activation and performance of the sprinklers while in place.

While some sprinklers are as robust as conventional heat detectors, many newer types can be subject to damage resulting in a greater potential for accidental discharge of water. As a result, when it is decided to install an automatic sprinkler system as part of the plan to mitigate fire risk during construction, consideration should also be given to interconnecting it with a fire alarm system to provide an alarm in the event of either sprinkler water flow or trouble condition.

Automatic sprinkler systems, as well as fire detection and alarm systems, are like any engineered tool or system – they are most effective when designed with the specific situation in mind and when used within their limits. Advance planning and design, and coordination with the local jurisdiction helps ensure the timely provision of various aspects of such systems, including water supply for any fire suppression systems.

6.6 On-site ‘command post’

One additional measure that is discussed in the NFPA 241 Standard, *Standard for Safeguarding Construction, Alteration, and Demolition Operations*, that may be useful to consider is the provision of an on-site ‘command post’. Such a post would contain a copy of the fire safety plan, building and site drawings, emergency information, one or more means of communication, keys and other equipment for use by both emergency responders and site fire safety officer(s). When the use of a command post is implemented, its location should be chosen in consideration of emergency access and overall safety during a potential fire event.

7. SITE SECURITY

One hazard that, because of its very nature, is not currently addressed directly by the codes covering building design and construction is the potential for arson.

For the protection of the public, the BCBC and the VBBL contain requirements in Part 8, “Safety Measures at Construction and Demolition Sites”, for fencing or barricades. Such features can help to prevent unauthorized access, thereby reducing the frequency of entry to the site by potential intentional or accidental fire-starters. Good site perimeter control and other security provisions can assist in reducing other financial losses, including material and equipment theft.

Other useful security measures include good lighting or motion-activated lighting. In addition, there is a wide variety of security equipment available, including electronic monitoring and video surveillance. The latter, for instance, has proved useful in detecting intruders via perimeter cameras.

An organized and well-trained security service can be beneficial in discovering a fire in its early stages, particularly at those times that sites are largely unoccupied and fires are less likely to be manually detected. Often, such services are designed to cover all areas of the site at least every hour. Such a service can also notify the fire department of an emergency, keep track of the presence and operational status of on-site fire protection equipment, may identify specific fire hazards, and can review areas where hot work or other hazardous operations have occurred.

8. PROVISION FOR EGRESS

Adequate means of escape for all employees should be provided – from the building(s) under construction, any temporary building(s) and from the site itself.

The BCFC requires that in areas of a building where construction operations are taking place, "*…at least one exit shall be accessible and usable at all times*." An exit in this case is defined as that part of a continuous path of travel, including doorways, provided for the escape of persons that leads from the floor area on any storey of a building to one of the following:

- a separate building,
- an open public thoroughfare, or
- an exterior open space protected from fire exposure from the building and having access to an open public thoroughfare.

Exit routes should be clearly visible, and all site personnel should be instructed on the procedures to follow in the event of a fire emergency.

Multiple exit points around the site perimeter can also be beneficial, since a single exterior exit route can be more easily obstructed in an emergency.

9. ACCESS FOR FIREFIGHTING

The BCFC contains provisions that require that unobstructed access be maintained to on-site fire equipment such as fire hydrants, portable extinguishers and fire department connections for standpipe and sprinkler systems. It also requires that, when there is fencing, "*…provision shall be made for access by fire department equipment and personnel*." This can be accomplished in a variety of ways, including key boxes installed at known or identifiable accessible locations.

Temporary or permanent roads that are free of obstructions (including parked vehicles), made of all-weather material and of appropriate width are important for efficient access of fire apparatus, and dead-end roads may need turnaround provisions.

The BCFC also includes an Appendix Note (Division B, A-5.6.1.4.(2)) that states "…*provision shall be made for the use of elevators, hoists or lifts to assist* [firefighting] *personnel in reaching the upper storeys of the building*."

The BCOFC Bulletin provides additional guidance on several aspects of access for firefighting operations.

10. FIRE SAFETY PLANNING

All construction sites are required by the BCFC and the VFBL to have a Fire Safety Plan (FSP). The site's FSP is the written plan that should set out everything that will be done on that particular project to minimize the risk of fire and to protect the safety of people working on the site. It should take into consideration all relevant regulations (such as those discussed in this Technical Note), as well as anything else that is considered relevant to reduce the risk and impact of fire on the site. In addition, it should include as much information as possible regarding the expected stages of implementation of the various fire protection systems and procedures that are planned.

It should be noted that often a 'one-size-fits-all' approach is not necessarily appropriate when it comes to FSPs – each project and site is unique and those unique aspects need to be considered and addressed in the site's FSP. This may seem obvious for larger projects; however, even smaller projects can present individual features (hazards) that may need special attention.

The BCOFC Bulletin provides an excellent list of questions to consider in the development of a FSP for your site. It includes the reminder that a FSP should not only reflect the unique characteristics of the building design and construction operations and techniques, but should also consider the available firefighting infrastructure. For this and other reasons, the FSP should be prepared in cooperation with the local fire department and other applicable regulatory authorities.

Planning, creating and maintaining effective lines of communication between the various stakeholders in fire safety on a construction site, throughout the construction process, can have a positive effect not only on the probability of an occurrence of a fire event, but on the outcome of an event if one does occur. For example, emergency responders can face significant challenges during a fire situation in a building under construction because the fire protection features and systems are not fully in place and various aspects of the building and site are constantly changing. The more current the information available to them on the existing stage of construction when an incident occurs, the better their decision making can be. This increases the efficiency and effectiveness of their response and enhances the safety of both site workers and emergency service responders. Building relationships that facilitate ongoing information sharing begins with consulting the local fire services during the development of the FSP.

Once the FSP is created, it must be reviewed, and updated as required – for example, at regular intervals as construction proceeds and whenever significant design changes occur.

As the BCOFC Bulletin mentions, it can be beneficial to obtain the services of a consultant who specializes in fire safety planning. Such a consultant should be capable of carrying out a fire risk assessment of the site at various stages, identifying fire hazards, as well as mitigating factors and probable fire scenarios that can vary during the course of construction operations. Such a person should have the experience and training to oversee the development and implementation of any FSP.

The key steps in the creation of a FSP are:

- *Analysis of the site – its risks and factors arising from the construction operations, implementation schedule and phases of work.*
- *Development of the necessary policies, procedures, and systems to prevent and control risks.*
- *Analysis of available resources, both on and off the site, including allocation of key staff to fire and emergency duties. This includes consultation with the emergency services to obtain their feedback and to address any concerns.*
- *Development of a protocol of emergency procedures for various individuals with roles and responsibilities in a fire emergency. This includes procedures for sounding the alarm, calling the appropriate fire and emergency services, shut down of certain hazardous operations/services, etc.*

As projects become larger, more complex, and are developed in several stages, fire protection design tools that have been used in the past for the design of new buildings or for evaluation of fire protection systems in existing buildings are starting to be used to analyze the potential impact of various fire protection

strategies in buildings under construction. One example of such a tool is the Fire Safety Concepts Tree, found in NFPA 550, *Guide to the Fire Safety Concepts Tree*.

Also, the SFPE *Engineering Guide to Fire Risk Assessment* provides guidance for the use of fire risk methodologies that can be used in buildings under construction.

11. EDUCATION AND A 'CULTURE OF SAFETY'

Section 4.16, "Emergency Preparedness and Response – Training," in Part 4, "General Conditions," of the BC OHS Regulation stipulates that all workers must be given adequate instruction in the fire prevention and emergency evacuation procedures applicable to their workplace. And, as mentioned earlier, the OHS Regulation is applicable to construction sites.

Therefore, all parties involved in the activities on the construction site and that have staff on site, including owners, designers, general contractors and subcontractors, should work together to ensure all personnel have received at least the training necessary to conform to this requirement.

It is true, though, that developing a 'culture of fire safety' on any construction site can take a little bit of time, money and effort, particularly at the start. After all, personnel need to be trained, changes may need to be made to some long-standing construction processes and procedures, and maintaining good communication with all the fire safety stakeholders can be time consuming. It isn't always easy; but, the benefits of taking these steps can outweigh the effort.

Fire safety on a construction site is all about teamwork. Explaining why certain policies and procedures are being implemented can go a long way to assuring workers understand their importance, so that everyone involved in a project can understand the benefits to themselves and their co-workers, as well as to the project as a whole.

The work environment that emerges can pay off in many ways, not least of which is increased safety of site personnel. A reduction in fire incidents can also increase productivity, and decreases direct and indirect financial losses related to slowdowns in the construction schedule (or a complete shutdown) that can result from a fire incident. Increased avoidance of slow-downs or shut-downs of a site due to fire incidents also means continued employment for everyone involved. A good fire safety plan that is based on a thorough analysis of fire risks, and that is well implemented and integrated into site practices and scheduling of construction activities, can also demonstrate to an insurance company that the project managers and owners are committed to operating a safe site, which can potentially result in better insurance rates.

12. CONCLUSION

Most construction site fires can be prevented with knowledge, planning and diligence; and, the impact of those fires that do occur can be significantly lessened. Understanding both the general and specific hazards and risks that are potentially limited to a particular construction site and addressing them requires education and training, as well as preparation and perseverance.

Conformance with the local safety regulations is the foundation for the establishment of suitable construction site fire safety. Assessment, selection and successful implementation of various 'best practices', based on the specific needs of your site, builds on that foundation and leads to a culture of fire safety that can be understood and practiced by all.

13. SOURCES OF INFORMATION AND REGULATION ON CONSTRUCTION SITE SAFETY:

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10. *NFPA Fire Protection Handbook*, 20th Ed. – "Section 11 Fire Prevention Practices": "Chapter 3, Building and Site Planning for Fire Safety" and "Chapter 4, Fire Hazards of Construction, Alteration, and Demolition of Buildings", National Fire Protection Association, Quincy, MA, 2008.

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    d. Fleming, R. P. "Fire Sprinkler Systems During Construction," and,
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Photos on pages 7, 8, 9 and 10 of this document were obtained on the construction site of New Gate Apartments, Kelowna, BC, courtesy of Greyback Construction Ltd., Penticton, BC

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