



REPORT FOR:



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**REPORT ON
COURSE OF CONSTRUCTION (FIRE)
BEST PRACTICES GUIDE**

July 25, 2014

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SECTION 1. SCOPE

Our report has been prepared in response to a request for proposal from Mr. Rodney A. McPhee, Director, Codes and Standards, Canadian Wood Council (CWC). The CWC is a national association representing manufacturers of Canadian wood products used in construction.

The CWC has identified a need for “Research into Post-Occupancy and Course of Construction Fires”. Recent fires, and others on record, in wood mid-rise buildings under construction have drawn considerable media attention, due to their spectacular nature. The result is increasing discussion around risk tolerance and risk management. Concerns include:

- Property loss (damaged and/or written off buildings)
- Adjacent property damage (exposures)
- Construction worker injury
- Emergency responder injury

The CWC has engaged Technical Risk Services Inc. (TRS), a full-service risk control consulting firm, to develop a best practise guide to assist and educate the construction industry so that the sector’s overall performance improves. The CWC has also asked TRS to contact private sector insurers for input, in the hope that course of construction insurance costs could be reduced through proactive steps taken by CWC and their members, in partnership with other construction industry stakeholders.

As part of a larger “fire mitigation” strategy, CWC has prepared a draft “Statement of Work”, consisting of several projects. TRS has been requested to assist with this first project, consisting of 2 parts, as noted below:

Part 1: Analysis - Course of Construction Fires

- 1) Analyze readily available data from various sources to find any meaningful implications, trends, and lessons learned.

Part 2: Course of Construction - Best Practice Review

- 1) Collect and populate a CWC database with existing / available course of construction fire safety best practices from Canada, the USA and Europe. This is not intended to be an exhaustive search but rather one that will provide sufficient information to identify trends. This database is also intended to be expandable as new practices are found and added.
- 2) Compare these best practices – using, for example, a simple spreadsheet.
- 3) Determine how each Canadian province adopts the Model Fire Code.
- 4) Review results from Part 1 to find correlation between data sets and effective best practices procedures.

Based on the comparison and analysis, this report will recommend the content for a new Model National Course of Construction (COC) (Fire) Best Practice Guide.

The focus of this study is on construction projects involving buildings of combustible construction, meant to include post-and-beam timber construction, mill construction, cross-laminated timber construction, and the currently more prevalent light wood-frame construction. The term combustible construction is used to encompass all these types.

SECTION 2. INTRODUCTION

2.1 Managing Fire Hazards/Fire Risks On Construction Sites

Currently there are three levels of risk management controls applicable to all construction projects:

1. Minimal: These are the small developments, from single homes up to say 50 unit town homes, which are being built by smaller developers who rarely fence their projects, only hire security when plumbing and wiring is roughed-in and only implement insurance company warrantees when pushed. While these wood frame projects take place in both urban/suburban areas with full-time professional fire services and in smaller communities with part-time and/or volunteer fire services, on site they only have limited fire fighting and control capabilities, namely, fire extinguishers and might even require trades to provide their own fire extinguishers. Rarely is there any emergency planning, site clean-up or orderly onsite construction materials storage. Not because codes and guidelines don't require it, but simply due to lack of resources for follow-up and enforcement. This is perhaps even more prevalent in smaller municipalities and/or rural areas. Without a set of formal guidelines, these contractors are often unaware of what needs to be done. Even if automatic sprinkler systems and fire detection systems are required, they are roughed-in prior to drywall installation and only activated immediately prior to occupancy. When installed, sprinklers conform to NFPA 13R, "Standard for the Installation of Sprinkler Systems in Low-Rise Residential Occupancies".

2. Moderate: These include several large professional developers who typically provide their own project managers, site safety officers, and co-ordinate all activities through proven project management standards. Their sites range from 4 storey wood frame condominium projects with 100 + units to multiple building projects on one site. These are fenced from day one; site security is provided during evenings and weekends as soon as the project starts; and they provide formalized hot work permits, company trained site safety officers with formalized duties such as daily trades toolbox meetings and constant site inspections. They have trades warrantee programs that are strictly enforced and welcome insurance company inspections and warrantees. Site fire protection devices are roughed-in, installed after the floor above is completed. Automatic sprinkler systems are activated in the basement when the first floor is finished and the remainder is finalized and activated prior to occupancy. If any buildings onsite are occupied prior to the remainder being finished, then each building to be occupied has to contain fully functioning sprinkler and fire detection systems prior to occupancy. This appears to be consistently applied across Canada as part of the occupancy permit inspection conducted by the authority having jurisdiction – fire and/or building department requirements.

3. High: These typically larger, risk-managed projects include institutional buildings such as hospitals, schools and related government buildings. They provide their own project managers, site fire protection such as active onsite fire hydrants and fire extinguishers, hot work permits systems and utilize just in time construction materials deliveries. Typically they incorporate some of the best practices addressed in this report. They usually provide an onsite project engineer who works with the project manager supplied by the general contractor. They insist that trades provide their own storage areas, offices and first aid staff. Security is provided from day one of the project and is present during silent times and

weekends. They usually do not permit trades from entering the site when the project manager and site safety officer is not onsite to supervise their activities. Fire and detection systems are installed as the building is constructed with device activation conducted prior to occupancy. Partial occupancy is usually not permitted until completion.

2.2 Mid-Rise Code Changes In Canada and B.C. Experience

The proposed changes to the 2015 National Codes provide the ability to construct five- and six-storey wood-frame buildings in Canada. These buildings are expected to mainly be residential or commercial offices, but can be a mix, and can include elements of mercantile, restaurants, hotels, assembly occupancies, above grade parking garages, and even light- and medium-hazard industrial.

In general, many of the topics discussed in this document are applicable when it comes to construction site fire safety for all construction sites. However, this report will focus on projects of combustible construction, and in particular construction sites of mid-rise, wood-frame buildings. Such projects range from the "minimal" to the "high" categories discussed above. The introduction of higher building heights increases the complexity of those types of projects from a fire protection standpoint, or at least from the regulation of fire protection standpoint, and increases the potential for significant fire loss if the work is not carried out correctly.

Mid-rise wood frame construction projects have been built for many years in the USA and for the past four years in the province of British Columbia. The proposed changes to the National Codes have not become legal requirements yet and therefore we will base our comments, relating to current construction site practices for midrise wood-frame buildings in Canada, on the current British Columbia construction requirements.

The current height restriction in British Columbia for mid-rise combustible construction is 18 metres from the ground to the uppermost floor level of the top storey, subject to further restrictions based on requirements resulting from higher seismic loads. This means that the building will likely be five or six storeys high, with a total floor area, including all storeys, of 7,200 square metres. Additional buildings can be constructed on a single site, either adjacent to or linked to each other. If linked, similar size structures can be repeated, provided there is a two-hour firewall (four-hour firewall required for portions containing mercantile or medium industrial) in place between any two buildings. Due to the heights involved in mid-rise construction, the lower floors must have the studs closer together in order to support the weight of the floors above (or use larger studs, or double-up or triple-up the studs at typical spacings).

Initially construction projects in British Columbia were similar to construction projects elsewhere as lumber was brought to the site by truck and the buildings were assembled on site. The complexity of the project construction (different stud spacing with floor penetrations that had to be continuous through all of the floors) caused many problems and resulted in changes being made to the construction process. The floor and wall construction has mainly changed to panelized assemblies that are constructed off-site in a manufacturing plant and brought to the construction site by truck. The construction process has been streamlined

somewhat as the floors can be constructed faster with much less issues with errors in measurement, etc. The floor panels are typically 12 feet x 45 feet long (longest that can be transported by truck) and the wall panels are typically 12 feet x 22 feet.

There are some manufacturing plants for these floor and wall panels outside of British Columbia but it is anticipated that demand may be too great initially, so some projects will be constructed using the older on-site “stick” method. It will just be a matter of time for panel production to catch up, but both types of construction will be used for some time and the Best Practices for Course of Construction projects must address the needs in both areas.

The current structural requirements in much of British Columbia also include the use of shear walls for the exterior walls and/or interior corridor walls due to earthquake load conditions. This would not be the case in the GTA but could be in Ottawa and eastern Ontario, for example. In British Columbia elevator shafts and stairwells must be enclosed by fire rated walls, minimum 1 hour. Typically they are currently using laminated 2 x 6’s to achieve this fire rating. Under certain conditions such as between different occupancy types, a 2 hour fire rating may be required, however the laminated 2x6’s can still be used subject to modification.

In British Columbia, these buildings are sprinklered to meet the requirements of NFPA 13, “Standard For The Installation Of Sprinkler Systems”, not NFPA 13R, “Standard for the Installation of Sprinkler Systems in Low-Rise Residential Occupancies” since they are greater than 4 storeys, and the scope of NFPA 13R states that it is applicable to residential buildings of 1 to 4 storeys. The exterior wall finish must be non-combustible, or of limited combustibles (meeting criteria when tested to CAN/ULC-S134-13, “Standard Method of Fire Test of Exterior Wall Assemblies”).

2.3 Trends Around The World On Tall Wood Buildings

An October 22, 2010 Canadian federal government report by David Surprenant, Industry, Infrastructure and Resources Division, titled “The National Building Code of Canada: A Tool for Recovery in the Forest Industry?” gave the following table (<http://www.parl.gc.ca/Content/LOP/ResearchPublications/2010-27-e.htm#a1>):

Maximum Number of Storeys for Multi-storey Wood-frame Buildings
Under Building Codes in Selected Countries

Country	Maximum Number of Storeys
Germany, Norway and Sweden	No limit.
United Kingdom	Maximum of seven, exemptions up to nine.
United States	Maximum of six.
Canada, Denmark and Finland	Maximum of four, exemptions allow higher.

Sources: European Centre for Parliamentary Research and Documentation and American Wood Council, 2010.

Other sources report on the growing trend for taller structures being constructed out of engineered wood, referred to as cross laminated timber (CLT), laminated veneer lumber (LVL), or glued laminated timber (Glulam), including a December 23, 2013 article in the

NFPA Today on-line blog (<http://nfpatoday.blog.nfpa.org/2013/12/fire-safety-challenges-of-tall-wood-buildings-examined.html>)

“A new report has just been published, titled [”Fire Safety Challenges of Tall Wood Buildings”](#) and ... Construction is currently underway on a 10-story apartment building in Melbourne, Australia, with taller structures up to 30 stories under design in Norway, Austria and Vancouver.”

“Work has started on the world's tallest wooden apartment block in Central Bergen, Norway. The 49-metre high building is set to eclipse the current record holder in Australia - the 32-metre Forte in Melbourne. The new 14-storey structure ...”

An April 26, 2013 news article also highlights this trend that is expected to grow in Canada, (<http://archrecord.construction.com/news/2013/04/130426-North-Americas-Tallest-Wood-Building-Set-to-Break-Ground.asp>) “The Wood Innovation and Design Centre (WIDC) in Prince George, British Columbia, Canada, is a roughly \$24.5 million (U.S.), 90-foot-tall building ... Though only six stories, architect Michael Green says the height of the design center will be equivalent to a nine-story residential building ... Set to open for the new school term September 2014 ... Though WIDC’s foundation is concrete and there are metal connections between the wood slabs, the building’s columns, beams, and floor will be made of wood. So will the elevator and stair core that form the structure’s lateral bracing ... that even the elevator shaft can be made with these mass timber panels.”

The use of wood in building construction will continue to expand and find new efficiencies for the industry, making it all the more critical to establish suitable protection guidelines to prevent losses from expanding as well.

2.4 Fire Department Concerns and Response To COC Fires

The fire departments that were contacted as part of this CWC project have all agreed that during the construction phase of any given project, of any size, but especially in a mid-rise wood frame project, there would likely only be a defensive firefighting effort put forward. They all felt that without the need for occupant rescue as would be the case in occupied buildings, fire crews would be instructed to try and stop the spread of fire to adjoining buildings first, and secondly fight the construction project fire from the building exterior. Individual circumstances at the scene of the fire would govern, but in general, no attempt would be made to enter the construction project building due to the combustible nature of the building products used and lack of internal fire protection and separations between fire compartments within the building during the construction phase. Those interviewed all stated that fire crew safety is the most important issue in construction projects fire fighting.

The second most related issue for responding fire department personnel is the type of apparatus available to them when fighting mid-rise wood frame construction fires. Many fire departments do not have equipment that will reach the top floors of mid-rise wood frame buildings from the exterior to assist in putting out roof fires or upper floor fires. See the table below which was extracted from a report published by NFPA in November 2011, titled “Fire Departments in Canada, 2008-2010”.

Population Protected	No Aerial Apparatus	1 Aerial Apparatus	2 Aerial Apparatus	3-4 Aerial Apparatus	5 or more Aerial Apparatus	Total
100,000 to 249,999	10.7%	21.4%	35.8%	10.7%	21.4%	100.0%
50,000 to 99,999	38.7%	32.3%	25.8%	3.2%	0.0%	100.0%
25,000 to 49,999	25.5%	60.8%	13.7%	0.0%	0.0%	100.0%
10,000 to 24,999	52.1%	45.2%	2.7%	0.0%	0.0%	100.0%
5,000 to 9,999	72.7%	27.3%	0.0%	0.0%	0.0%	100.0%
2,500 to 4,999	93.7%	6.3%	0.0%	0.0%	0.0%	100.0%
Under 2,500	97.9%	2.1%	0.0%	0.0%	0.0%	100.0%

These fires would only be attacked with exterior hose streams.

Due to the approach likely to be taken by the fire departments in fighting a fire in a mid-rise combustible construction project, it is evident that an enhanced level of construction project risk management controls should be introduced. Any mid-rise project will require very tight rules and protocols to ensure that a fire is prevented from starting. In many cases when a fire does occur, there are means to control, if not extinguish the fire, prior to arrival of the responding fire department. This is the basis for the preparation of the remainder of this document.

It is important to note that it is impossible to prevent or stop all fire incidents from occurring, but a wide range of measures can be taken to significantly reduce the probability of an event. Similarly, once a fire event has occurred, there can be varying control measures in place to help minimize the extent of damage, lower resulting costs to restore the structure, and lessen any potentially negative impact on production and project completion, such as delays and cost overruns.

SECTION 3. ANALYSIS OF COC FIRE/LOSS DATA

Loss data and related information was sourced from general news articles, a wide range of insurance industry reports, and various industry associations. Of course not all losses or events can be captured, as it seems that only sensational fires get detailed attention and wide distribution. By far the majority of fires, losses, and incidents are small, only generally noted and filed away, remaining unknown to the general public. All construction projects by their very nature, whether involving combustible or non-combustible construction, are potential fire risks. The number involving combustible construction appears to be growing, estimated at an average of over 100,000 annually in Canada and over 1,000,000 annually in the U.S.

Relevant facts and statistics collected from a variety of sources include:

- USA = annually 4,500 – 4,800 construction site fires (both combustible and non-combustible construction), causing over \$35M in property damage, multiple sources referencing the National Fire Incident Reporting System (multiple current sources, all reference NFPA, NFIRS and original U.S. Fire Administration 1996-1998 data).
- USA = “On average, fires on construction sites occur more than a dozen times across the USA each day.” Although not specifically cited, this is presumed to include both projects with buildings of combustible construction and projects with non-combustible construction. (http://www.ehow.com/about_5692077_types-construction-fire-safety.html#ixzz2zpLfmMuy)
- UK = With reference to construction sites in general, “there are around 11 construction site fires every day in the U.K., ... an estimated £400 million a year, or over £1 million a day.” (Aviva UK, March 18, 2011)
- USA = < 1% of construction site fires involve buildings slated for demolition (NFIRS)
- Alberta = from 2000–2009, pertaining to construction sites in general, annual average 31 fire losses in buildings under construction at an average loss of \$227,000. (Office of the Fire Commissioner, Public Safety Division, Alberta Municipal Affairs)
- Alberta = from 2000–2009, pertaining to construction sites in general, “1% of all structural fires were in buildings under construction ... and 2.2% of the \$3.1B in direct property damage.” (Office of the Fire Commissioner, Public Safety Division, Alberta Municipal Affairs)
- Alberta = from 2000–2009, pertaining to construction sites in general, “Most fires (60%) started between 8 p.m. to 8 a.m., and these fires accounted for the largest property losses 60%.” The highest concentration of fires and damages was in the midnight to 4 a.m. period, over 33% each. (Office of the Fire Commissioner, Public Safety Division, Alberta Municipal Affairs)
- “The leading property uses associated with construction site fires ... is vacant construction properties.” (NFIRS)

The loss data collected points to some specific causes and trends from which useful guidelines can be extrapolated, essentially lessons on how not to repeat the same incident.

3.1 Canada and USA

In the past 15 years, wood frame construction projects have experienced several large fire losses. The information below, sourced from publicly available news reports, highlights some of these incidents and also looks at statistical data.

3.1.1 Events/Fire Trends

The following is a list of just some of the major wood frame construction project fires in Canada:

- March 2001 – 160 bed nursing home, Hamilton, ON – propane heaters - \$7M
- April 2001 – 245 unit Liberty Walk townhome project, Toronto, ON – roofer's torch - \$10M
- September 2001 – school renovation, Wainwright, AB – roofer's torch - \$11M
- October 2001 – hotel/convention centre, Sun Peaks, BC – propane heater - \$15M
- May 2002 – 208 unit condo/townhouse project, Erlton (Calgary), AB – roofer's torch – \$66M
- November 2002 – 125 bed nursing home, Calgary, AB – propane torch - \$30-40M
- April 2003 – Alliston Park condo complex, Calgary, AB – arson – over \$10M
- July 2004 – 135 unit retirement home, Winnipeg, MB – arson - \$4M
- January 2005 – 134 unit condo complex, Toronto, ON – cause unknown - \$6M
- August 2005 – 32 townhomes on both sides of street, Calgary, AB – cause unknown - over \$3M
- September 2006 – 30 unit waterfront condo, Nanaimo, BC – arson – over \$5M
- July 2007 – 149 unit MacEwan Gardens condo project, Edmonton, AB – arson - \$20-25M
- November 2007 – 12 unit condo project, Nepean, ON – cause unknown - \$2M
- October 2008 – 4 storey condo complex, Surrey, BC – cause suspicious – over \$3M
- February 2011 – trucks and materials in subdivision project, Hopedale, NL – arson - \$1M
- May 2011 – Remy 188 unit, 6 storey condo project, Richmond BC – cause suspicious - \$38-60M
- March 2013 – Health Sciences Centre expansion, Winnipeg, MB – arson - \$1M
- September 2013 – condominium complex, Rutherford (Edmonton), AB – arson - \$20M
- December 2013 – 5 storey student residence, Kingston, ON – smoking - \$30M
- March 2014 – condominium complex, Edmonton, AB – cause unknown - \$6M
- April 2014 – Comfort Inn hotel, Regina, SK – propane heater - \$1M
- April 2014 – Seniors residence, Pouch Cove, NF – unknown cause – \$1M
- May 2014 – 4 homes in residential subdivision, Richmond Hill, ON – welding – over \$2M

The following is a list of just some of the major wood frame construction project fires in the United States:

- May 2000 – Ybor 450 unit apt. complex, Tampa FL - forklift collision – over \$20M
- August 2002 – Santana Row complex, San Jose, CA – cause suspicious – \$90M
- January 2007 – 4 storey, 39 unit apartment, California – tar kettle on roof - \$12M
- March 2007 – 4 storey 151,600 sq. ft. seniors complex, Wisconsin – arson - \$15M
- April 2007 – 4 storey apartment building, Massachusetts – cause unknown - \$11M
- May 2007 – 3 storey, 147 unit condo, Nevada – arson - \$19M
- June 2007 – large two storey single family house, California – cause unknown - \$10M
- June 2007 – 4 storey, 80 unit hotel, California – cause unknown - \$9M
- September 2007 – 3 storey 116,000 sq. ft. seniors complex, Massachusetts – arson - \$14M
- March 2009 – 6 storey apartment, Indianapolis, IN – arson/incendiary - \$28-38M
- June 2009 – 5 storey apartment, Renton, WA – hot work by roofers (roofers torch) - \$12M
- October 2009 – 4 storey apartment, Edmond, OK - \$10M
- November 2009 – middle school renovation, Bellingham, WA - \$20-\$40M
- 2009 – 2 storey block of stores being renovated, MT – embers from hot work - \$10M
- December 2013 – apartment complex, Glendale (Denver), CO – cause unknown – over \$1M
- March 2014 – 396 unit apartment project, Houston, TX – roofer’s torch – over \$15M
- February 2014 – 4 storey apartment complex, Salt Lake City, UT – arson - \$2M
- February 2014 – 3 storey apartment, Lower Heidelberg, PA – arson – over \$2M
- March 2014 – 4 storey 396 unit apartment, Houston, TX – unknown cause – over \$2M

The following is a list of just some of the major non-combustible construction project fires in Canada and the United States with features relevant to wood frame construction:

- September 2007, New Jersey – a protected, non-combustible, 40 storey, hotel casino under construction - “incendiary fire was set in plastic sheeting on the exterior of the building. The fire spread up the outside of the building. ... Workers were at the site when the fire broke out. ... There was no automatic suppression equipment.” - \$12M
- March 2009 – Riverboat Casino \$50M renovation, Joliet, IL. The fire is understood to have started in a portion being renovated, containing combustible construction - welding - \$81-340M

- March-April 2014 – various projects, Ottawa, ON – “Four recent fires at construction sites involving the same contractor are being investigated ... why the company appears to have been targeted.” Two of the projects were of non-combustible construction, and the other two were understood to be of mixed construction. - arson – \$1M

3.1.2 Causes of Loss

Arson. A wide range of reports and statistical analyses have shown, that with respect to construction sites, arson has been found to be the number one cause of construction fires.

- At 41% of known causes of USA construction fires, arson is the most frequently cited cause of ignition. (NFIRS)
- In Alberta, “Arson was the leading cause of fires (35%) and property losses (46%).” (Office of the Fire Commissioner, Public Safety Division, Alberta Municipal Affairs)
- “... explained most arson fires were at unattended jobsites.” (Edmonton Fire Rescue Services)

Other main causes have been shown as follows:

- open flames, including roofer’s torch, heaters, burning garbage (30%, NFIRS)
- hot work activities (ranging 7-12%, accounting for 20-29% of property damage)
- combustibles including trash/garbage “placed too close” (11-26%)
- portable heaters (15%)
- careless smoking
- faulty wiring, poor electrical habits, inadequate electrical maintenance
- cooking: a report by a California life safety, alarm and security contractor Hue & Cry Inc. put this in the top 5 causes of construction fires “You’d be amazed how many fires are started because contractors are cooking with construction equipment. Have a policy against cooking with construction equipment. Also check trailers to ensure coffee machines, hotplates and other items are turned off after use.”

3.1.3 Lessons Learned

In many cases of fire loss, the cause was considered unknown or undetermined. Where the cause was determined, loss prevention lessons were also often identified. Although each scenario painted a slightly different unique picture of what could have been done differently to prevent the fire or limit damage, there were some common themes that could be determined:

- supervise hot work activities
- restrict smoking
- include physical fire separations or breaks between buildings or sections

- keep hydrants in service and accessible
- provide access for firefighters
- reduce access by unauthorized persons
- improve housekeeping and garbage collection
- use heating equipment properly and safely
- don't leave sites "vacant" i.e. unattended

3.2 Outside North America

Although less data was collected for other countries or regions, the scenarios and extent of damage resulting from construction site fires involving wood based construction was similar to that in North America, as were the causes of loss and contributing factors from which loss prevention lessons can be extrapolated.

3.2.1 Events/Fire Trends

The following is a list of just some of the major wood frame construction project fires in the United Kingdom:

- November 2009 – construction adjacent to new homes, Peckham, England – over \$3M
- January 2010 – 5 storey apartment complex, Peckham, England – over \$3M
- August 2010 – block of houses, Glasgow, England – over \$3M
- May 2012 – block of houses, Lower Hillgate, Stockport, England – over \$5M
- June 2012 – 6 storey apartment complex, Camberwell, England - \$5M
- September 2013 – 4 storey complex, Basingstoke, Hampshire, England – over \$3M

3.2.2 Causes of Loss

The main causes of loss pertaining to the UK data/info collected were noted to be essentially the same as that reported in North America and specified above in Section 3.1.2. Arson and hot work were the two most common causes cited. One additional interesting fact stood out:

- "HSE data estimates two out of three fires in construction industry premises are arson." (Aviva UK, March 18, 2011)

3.2.3 Lessons Learned

Similarly, loss prevention strategies arising from the loss information was found to be essentially the same as that coming out of the North American experience (see Section 3.1.3 above), with potentially one difference. In the UK there appeared to be a higher emphasis on site security, not leaving the sites "vacant" or unattended.

SECTION 4. COC BEST PRACTICES IN PLACE TODAY

Where available and accessible, a variety of sources (including industry associations, municipal, provincial, federal, state, and international guidelines, insurance company guidelines, manufacturer and industry specifications, etc.) were reviewed for information pertaining to the currently available Best Practices in use today.

Information was found from various jurisdictions, and is provided in two tables, one specific to fire protection features, and the other specific to site security issues. See the following spreadsheets, titled:

“COC Best Practices - Fire Prevention”

“COC Best Practices – Site Security Measures”.

Where none of the referenced sources contained any information concerning the specific category it has been noted as “No information found”.

Where multiple sources contained information concerning the specific category, to avoid duplication and in the interest of brevity only the most encompassing reference is cited.

COC Best Practices - Fire Prevention

Category	Canada (1) (2) (3) (4) (5)	U.S.A (6) (7) (8)	Europe (9) (10) (11) (12)	Asia (13)
1. Access for Firefighting - Fire Department Liaison	<p>The constructor shall give a copy of the floor plan to the fire department located nearest to the project. Streets, yards and roadways provided for fire department access shall be maintained so as to be ready for use at all times by fire department vehicles. Vehicles shall not be parked to obstruct access of fire department vehicles and signs shall be posted prohibiting such parking.</p> <p>Access panels or windows provided to facilitate access for firefighting operations shall be maintained free of obstructions at all times. (2)</p>	<p>Before the project begins, meet with the fire service to describe the location and arrangement of the site, the types and nature of fire hazards to be present on the site during the course of the project, and protection features planned for the site. Protection features should include:</p> <ol style="list-style-type: none"> 1. Access to the site. 2. Access to the buildings or structures. 3. Location of private fire hydrants. 4. Locations of planned risers serving sprinklers and hose connections. 5. Location of fire department connections for planned fire systems. (7) 	<p>In some cases, it will be appropriate for those managing construction work to liaise with the local fire service before work starts. Where there is liaison, it is important that the fire service is kept informed of any changes affecting access and fire-fighting facilities as the work progresses. (11)</p>	<p>Employ and train emergency personnel:</p> <ul style="list-style-type: none"> ▪ Ensure emergency procedures are documented and issued ▪ Display emergency telephone numbers (13)
2. Construction Processes and Procedures - Fire Walls/Separations	<p>The BCBC requires floor and wall assemblies to have FRR to prevent premature structural collapse in case of a fire. The BCBC also requires fire rated separations (compartmentation) in order to reduce the probability of fire spread which could lead to delays in the evacuation or movement of occupants to a safe place, as well as to fire emergency response operations.</p> <p>Examples of fire separations in buildings include but are not limited to: floor assemblies, loadbearing walls, firewalls, suite party walls, corridor walls, elevator walls stair enclosures, horizontal or vertical shafts, service rooms, amenity rooms, etc. (5)</p> <p>Infill projects – minimize exposure to adjacent structures. Fire breaks in large developments. (2)</p>	<p>Fire walls and exit stairways, required for the completed buildings, shall be given construction priority. Fire doors, with automatic closing devices, shall be hung on openings as soon as practicable. (6)</p>	<p>Vertical containment measures within timber frame buildings are considered one of the most logical and practical solutions for high risk sites, once all the usual site security, fire detection and suppression measures have been adopted. The sub-division of the frame by fire-resisting barriers (offering a minimum 30 minutes' fire resistant insulation, integrity and stability) must be considered as part of the strategy for minimising the risk of fire spread during construction. (11)</p>	<p>No information found.</p>
3. Control Ignition Sources - Hot Work Programs	<p>A fire watch shall be provided during the hot work and for a period of not less than 60 min after its completion. A final inspection of the hot work area shall be conducted 4 hr after completion of work. Combustible materials that cannot be removed or protected against ignition shall be thoroughly wetted where hot work is carried out. (2)</p>	<p>Hot work permits should be used in areas that are not designed and arranged for hot work. The Site Fire Prevention Program should authorize the Fire Prevention Program Manager to designate Hot Work Permit Required areas. These are areas that possess combustible construction features or combustible contents.</p> <p>Coordinate additional guard tour activities in any area where hot work was underway in the previous 24- hour period. (7)</p>	<p>Conduct routine hot works, e.g. steel cutting, in a designated area away from combustible material and the main structure. A "Permit to Work" system must be adopted where hot work is being undertaken unless there is no risk of damage to any surrounding property. Any area of hot work must be actively monitored for at least one hour after completion and the area must be re-visited two hours later. (11)</p>	<p>Never store flammable gases or combustible materials in common areas, stairways or exits. (13)</p>

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Category	Canada (1) (2) (3) (4) (5)	U.S.A (6) (7) (8)	Europe (9) (10) (11) (12)	Asia (13)
4. Control Ignition Sources - Smoking Policy	Smoke only within designated areas. Use large non-tip ashtrays and empty them only when you are sure the ashes, matches and butts are cold. Make sure that no one, including visitors, has left cigarettes smoldering in waste-baskets or on furniture. (3)	Develop and include guidelines for a "No Smoking" program in the Site Fire Prevention Program. Post and maintain "No Smoking" signs in accordance with the "No Smoking" program, and pursue infraction of the "No Smoking" program through the Fire Prevention Coordinators. Arrange designated smoking areas as follows: 1. Use non-combustible construction for any enclosure or seating 2. Provide adequate separation from combustibles 3. Post signs to indicate smoking is permitted 4. Provide marking of the designated smoking area boundary 5. Provide adequate receptacles for the collection of discarded smoking materials. (7)	Operate a safe smoking policy – allow smoking only in designated smoking areas and prohibit smoking elsewhere. In accordance with current UK legislation, a 'no smoking' policy must be established. Any designated safe open air locations where smoking is allowed should be of a low fire risk design, away from any combustible or flammable materials and provided with metal ashtrays filled with sand. (11)	Keep work areas free from rubbish and obstructions. Scrap wood or chips, saw dust waste, and paper bags or cartons should be removed from the immediate work area as the work progresses. All solvent waste, oily rags and flammable liquids should be kept in fire resistant covered containers until they are removed from the worksite. (13)
5. Control Ignition Sources - Electrical Installations	Be alert around electrical equipment. When electrical equipment is not working properly or if it gives off an unusual odour - often the first sign of a problem that could cause a fire - disconnect the equipment and call an appropriate maintenance contractor. Promptly replace any electrical cord that is cracked or has a broken connection. When using extension cords, protect them from damage: do not put them across doorways or any place where they will be stepped on or chafed. Check the amperage load specified by the manufacturer or the "listing laboratory", and do not exceed it. Do not plug one extension cord into another, and do not plug more than one extension cord into one outlet. (3)	The employer shall ensure that all wiring components and utilization equipment in hazardous locations are maintained in a dust-tight, dust-ignition-proof, or explosion-proof condition, as appropriate. There shall be no loose or missing screws, gaskets, threaded connections, seals, or other impairments to a tight condition. (6)	Electrical installations, especially temporary ones, should be of sufficient capacity for the intended use and designed, installed, inspected and maintained by competent personnel. The installation should meet BS 7671: 2008 requirements for electrical installations, which includes a special section on construction sites. Do not allow ad hoc additions or alterations to the electrical installation by personnel who are not competent. (11)	Provide adequate fire alarm and communication system. (13)
6. Control Ignition Sources - Heating, Ventilation and A/C	Except for self-contained systems within dwelling units, disconnect switches for mechanical air-conditioning and ventilating systems shall be operated to establish that the system can be shut down in an emergency. (4)	When heaters are used in confined spaces, special care shall be taken to provide sufficient ventilation in order to ensure proper combustion, maintain the health and safety of workers, and limit temperature rise in the area. (6)	In both new build and refurbishments, closing doors, windows and other openings not required for ventilation, particularly out of working hours. (11)	No information found.
7. Management Guidelines - Site Inspection	It is considered best practice to designate a full time fire-safety co-ordinator or fire safety officer. They shall inspect all escape routes, fire point locations, alarm systems, fire detection and fire fighting systems, fire extinguishers, fire signage, fire brigade access before, every 2 hours and on completion of the work. (1)	Program Manager to conduct a daily site inspection to verify that fire protection equipment is available, accessible, and in service. Authorize the Fire Prevention Program Manager to pursue fire protection deficiencies through the Fire Prevention Coordinators. (7)	The principal contractor, or Fire Safety Co-ordinator, is responsible for checks, inspections and tests throughout the construction of the site. • The checks may be weekly, daily, or at the end of each shift. • Where 24 hour security is provided, fire checks should be done throughout the night, as well as during holiday periods and weekends, times when sites are most vulnerable to arson. • Written records must be maintained on training, fire drills and other procedures. (9)	No information found.

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Category	Canada (1) (2) (3) (4) (5)	U.S.A (6) (7) (8)	Europe (9) (10) (11) (12)	Asia (13)
8. Management Guidelines - Training	Workers must receive Workplace Hazardous Material Information System (WHMIS) training and Materials Safety Data Sheet (MSDS) must be on site. (2)	No information found.	You must provide adequate fire safety training for your staff. The type of training should be based on the particular features of your premises. (12)	No information found.
9. Fire Safety Plan - Fire Instruction Notices/Fire Protection Plan	It is highly recommended to develop a fire safety plan. Key Steps: 1. Analysis of Site 2. Development of policies and procedures to minimize risks 3. Analysis of available resources 4. Emergency protocol for various individuals (4)	Develop and include a Fire Protection Plan in the Site Fire Prevention Program. Authorize the Fire Prevention Program Manager to conduct a daily site inspection to verify that fire protection equipment is available, accessible, and in service. Authorize the Fire Prevention Program Manager to pursue fire protection deficiencies through the Fire Prevention Coordinators. (7)	The fire instruction notices are only intended to serve as a reminder. All people on site, even if they are there for just a few hours, should receive sufficient information to know what to do in the event of fire. (11)	No information found.
10. Flammable and Combustible Liquids, Gases, and Hazardous Materials - Handling Flammables	No more than one work day's normal supply of a flammable liquid shall be stored in a building or structure on a project unless it is stored, (a) in a container that is suitable for the particular hazards of the liquid; and (b) in a controlled access area or a room, (i) that has sufficient window area to provide explosion relief to the outside, and (ii) that is remote from the means of egress from the building or structure (2)	Only approved containers and portable tanks shall be used for storage and handling of flammable liquids. Approved safety cans or Department of Transportation approved containers shall be used for the handling and use of flammable liquids in quantities of 5 gallons or less, except that this shall not apply to those flammable liquid materials which are highly viscid (extremely hard to pour), which may be used and handled in original shipping containers. For quantities of one gallon or less, the original container may be used, for storage, use and handling of flammable liquids. Flammable liquids shall not be stored in areas used for exits, stairways, or normally used for the safe passage of people. No more than 25 gallons of flammable liquids shall be stored in a room outside of an approved storage cabinet. Quantities of flammable liquid in excess of 25 gallons shall be stored in an acceptable or approved cabinet. (6)	Keep flammable liquids and gases which are not in use in dedicated storage areas, externally, where only the appropriate staff are allowed to go, and keep the minimum required for the operation. Small quantities (for example up to 50 litres) of flammable materials such as paints, solvents, petrol and adhesives can be stored in lockable steel chests. (11)	No information found.
11. Flammable and Combustible Liquids, Gases, and Hazardous Materials - Handling Fuels	No information found.	Filling of fuel containers for trucks or motor vehicles from bulk storage containers shall be performed not less than 10 feet from the nearest masonry-walled building, or not less than 25 feet from the nearest building or other construction and, in any event, not less than 25 feet from any building opening. (6)	Operating and refuelling (especially with petrol) should not take place within a confined space; no refuelling on scaffold or escape routes, it should be in the open air or in well-ventilated spaces away from ignition sources. Bulk flammable liquid storage tanks should be banded (vented) to current standards. Do not operate petrol-fuelled generators or tools indoors or in poorly ventilated areas. (11)	Avoid storage of excess quantities of flammable substances at worksites and establish storage procedures for flammable substances. Store gasoline and other flammable liquids in a safety can in a ventilated place or an approved storage facility. Ensure that leaks or spills of flammable or combustible materials are cleaned up promptly. (13)

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Category	Canada (1) (2) (3) (4) (5)	U.S.A (6) (7) (8)	Europe (9) (10) (11) (12)	Asia (13)
12. Flammable and Combustible Liquids, Gases, and Hazardous Materials - Compressed Gases	<p>A storage cylinder for compressed gas shall be secured in an upright position.</p> <p>The control valve of a storage cylinder for compressed gas, other than a cylinder connected to a regulator, supply line or hose, shall be covered by a protective cap that is secured in its proper position.</p> <p>A spent storage cylinder shall not be stored inside a building. (2)</p>	<p>When LP-Gas and one or more other gases are stored or used in the same area, the containers shall be marked to identify their content. Marking shall be in compliance with American National Standard Z48.1-1954, "Method of Marking Portable Compressed Gas Containers To Identify the Material Contained." (6)</p>	<p>Keep areas containing flammable gases well ventilated, e.g. LPG cylinders should be kept outdoors in a secure cage. Minimise the storage of LPG on site; LPG cylinders are readily available and in most cases can be delivered without significant delay. Storage areas on all timber frame sites must be at least 15 metres from any building (not just from the timber frame building), and containers and drums must not be stored within 6 metres of any building or boundary fence unless the boundary is a wall with at least 30 minutes' fire resistance. (9)</p>	No information found.
13. Housekeeping and Waste Management - Waste Management	<p>Waste material and debris shall be removed to a disposal area, and reusable material shall be removed to a storage area as often as is necessary to prevent a hazardous condition arising, and, in any event, at least once daily. Do your part to keep storage areas, stairway landings and other out-of-way locations free of waste paper, empty cartons, dirty rags and other material that could fuel a fire. (2)</p>	<p>Remove waste from work areas at least by the end of each shift. NFPA 241 stipulates more frequent removal rates where needed for "safe operations". Combustible scrap and debris must be removed at regular intervals during the course of construction. A safe means must be provided for removal. Containers must be provided for the collection and separation of waste, trash, oily and used rags, and other refuse. Containers used for garbage and other oily, flammable, or hazardous wastes, such as caustics, acids, harmful dusts, etc., must be equipped with covers. Garbage and other waste must be disposed of at frequent, regular intervals. (7)</p>	<p>Develop a formal system for the control of combustible waste by ensuring that waste materials and rubbish are not allowed to build up and are carefully stored until properly disposed of, particularly at the end of the day, e.g. in lockable metal skips. (11)</p>	No information found.
14. Private Fire Protection and Safety - Hose Stations	<p>As construction proceeds in a building with two or more storeys, a permanent or temporary standpipe shall be installed to within two storeys of the uppermost work level. (2)</p>	<p>One hundred feet, or less, of 1-1/2-inch hose, with a nozzle capable of discharging water at 25 gallons or more per minute, may be substituted for a fire extinguisher rated not more than 2A in the designated area provided that the hose line can reach all points in the area. If fire hose connections are not compatible with local firefighting equipment, the contractor shall provide adapters, or equivalent, to permit connections. (6)</p>	No information found.	No information found.

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Category	Canada (1) (2) (3) (4) (5)	U.S.A (6) (7) (8)	Europe (9) (10) (11) (12)	Asia (13)
15. Private Fire Protection and Safety - Sprinklers	<p>Sprinkler design is often provided on a design-build basis; that is, a sprinkler engineer is typically engaged after a building permit is issued. NFPA 13 has several provisions and restrictions relating to combustible concealed spaces. Some of these provisions may have a significant cost impact, or pose design issues impacting architectural features of the building. For mid-rise wood frame projects, it is recommended that a sprinkler engineer, or an FPE taking on the responsibilities of a sprinkler engineer, be engaged early in the design development stage in order to coordinate various design features. An FPE should remind the project architect, CRP and the owner of the benefits of engaging a sprinkler engineer early in the design stage. In cold climates subject to freezing, a wet riser requires insulation and heat tracing. Since the location of and access to a standpipe may differ somewhat during construction from the final design, it is helpful do communicate this information to the local fire service. (4)</p>	<p>Automatic fire sprinkler systems, where planned for the completed structure, should be installed and activated before introducing combustibles. Systems should be placed in service before commissioning or hot testing operations (e.g. starting up fuel fired equipment) are conducted and as soon as practicable before the building is occupied. Coordinate the activation of the sprinkler system piping as soon as the framing for each floor is finished.</p> <ol style="list-style-type: none"> 1. Chain and lock sprinkler control valves in the open position. 2. Coordinate the installation of plywood lateral bracing as each floor of the building is completed (eliminates open spaces that allow fire to travel). (7) 	<p>If the facility being constructed includes the installation of automatic sprinkler protection, the installation shall closely follow the construction and be placed in service as soon as applicable laws permit following completion of each story. (10)</p>	<p>No information found.</p>
16. Private Fire Protection and Safety - Portable Fire Equipment (Extinguishers)	<p>At least one fire extinguisher shall be provided:</p> <ol style="list-style-type: none"> (a) where flammable liquids or combustible materials are stored, handled or used; (b) where oil-fired or gas-fired equipment, other than permanent furnace equipment in a building, is used; (c) where welding or open-flame operations are carried on; and (d) on each storey of an enclosed building being constructed or altered. (2) 	<p>Portable fire extinguishers are to be provided and maintained in serviceable condition. Provide extinguishers suitable for all classes of fires present in accordance with NFPA 10. Portable fire extinguishers shall be inspected periodically and maintained in accordance with Maintenance and Use of Portable Fire Extinguishers. (7)</p>	<p>The first line of defence against fire is the provision of portable fire extinguishers and/or permanent hose-reels. Clearly such equipment can only be used during working hours when staff are on the premises (or by security staff if present when the building is closed). For this equipment to be effective it is essential that some, if not all, staff are trained in its use. (11)</p>	<p>Ensure all extinguishers and fire fighting equipment serviced and marked. Provide fire extinguishers near all welding, oxy - acetylene cutting or other sources of ignition. Keep fire extinguishers easy to locate and reach in case of an emergency. (13)</p>
17 Private Fire Protection and Safety Fire Detection	<p>Hot work can generate products of combustion, such as heat and smoke. For this reason some site de-activate detection systems during work hours, reinstating the protection when the site is relatively unoccupied. (4)</p>	<p>An alarm system, e.g., telephone system, siren, etc., shall be established by the employer whereby employees on the site and the local fire department can be alerted for an emergency. The alarm code and reporting instructions shall be conspicuously posted at phones and at employee entrances. (6)</p>	<p>Fire alarm systems will often be fitted as part of the construction work. Alternatively, buildings may have a wired-in fire alarm system already installed. Try and plan the work to install the fire alarm system as early as possible and, where a system is already installed, keep it in working order for as long as possible. (11)</p>	<p>No information found.</p>

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Category	Canada (1) (2) (3) (4) (5)	U.S.A (6) (7) (8)	Europe (9) (10) (11) (12)	Asia (13)
18 Public Fire Protection - Public Water/Hydrants	Some municipalities will not issue building permits until fire hydrants are operational. Should confirm hydrants are charged if relying upon them in the event of a fire. (2)	Private or public fire hydrants are to be available and in service to protect the site as soon as combustibles are brought on site. (7) Hydrants should be placed on the right hand side of the roads and intersections whenever possible, considering the most likely direction of response by a fire engine. Hydrants shall not be further than 15 feet from an approved access road. UFC Section 903.4.2.4 Hydrants and fire department connections shall not be obstructed and shall have not less than three feet of clear space around them. UFC Section 1001.7 There shall be a hydrant within 70 feet of a fire department connection. The fire department connection and the fire hydrant should be on the same side of a fire access road. (8)	Rising and temporary mains must be provided where planned. It may be necessary to move the fire brigade inlet point to rising mains as work/construction progresses. (10)	No information found.
19. Public Fire Protection - Water Supply	No specific information found, but various articles and other sources such as insurer guidelines expect water supplies, either public or private, to be adequate for sprinkler and hose stream demands.	An approved water supply capable of supplying the required fire flow for fire protection shall be provided to all premises upon which facilities, buildings or portions of buildings are hereafter constructed or moved into this jurisdiction. On-site fire hydrants and mains capable of supplying the required fire flow shall be provided when any portion of the facility or building protected is in excess of 250 feet from a water supply on a public street, as measured by an approved exterior route around the facility or building. (8)	Adequate water supplies for fire fighting must be available. All water supplies should be tested periodically. (10)	No information found.
20. Storage Guidelines - Material Storage	Construction site fire safety usually focuses on the reduction and control of possible sources of fuel and ignition. (1) Sensibly managing quantities of available, easily ignitable fuel can significantly reduce frequency and impact of fire. Good housekeeping can be one of the most important factors in site fire prevention. Proper storage and removal of combustible waste onsite reduces the risk of fires. The regular removal of construction waste can also help thwart opportunistic fire-setters. (4)	Combustible materials shall be piled with due regard to the stability of piles and in no case higher than 20 feet. The entire storage site shall be kept free from accumulation of unnecessary combustible materials. Weeds and grass shall be kept down and a regular procedure provided for the periodic clean-up of the entire area. When there is a danger of an underground fire, that land shall not be used for combustible or flammable storage. Method of piling shall be solid wherever possible and in orderly and regular piles. No combustible material shall be stored outdoors within 10 feet of a building or structure. Portable fire extinguishing equipment, suitable for the fire hazard involved, shall be provided at convenient, conspicuously accessible locations in the yard area. Portable fire extinguishers, rated not less than 2A, shall be placed so that maximum travel distance to the nearest unit shall not exceed 100 feet. (6)	There has to be enough material at hand to do the work, but this needs to be balanced against the need to reduce the risk of fire. Limit the material present at worksites to what is needed for half a day or a single shift and return unused material to the stores when the work is finished. (11)	No information found.

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Category	Canada (1) (2) (3) (4) (5)	U.S.A (6) (7) (8)	Europe (9) (10) (11) (12)	Asia (13)
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Sources:

- (1) *Fire Safety and Security: A technical note on fire safety and security on construction sites in Ontario* , Canadian Wood Council and Wood Works!, 2013; http://cwc.ca/wp-content/uploads/publications-Fire_Safety_Security_Ontario.pdf
- (2) *Construction Site Fire Safety* , CMH Fire Consultants Ltd., November 27, 2012; http://www.wood-works.ca/wp-content/uploads/content/ON/WSF/Construction_Site_Fire_Safety_-_regulations_and_best_practices.pdf
- (3) *Fire Safety Plan Template v1*, Nanaimo Fire Rescue Department, October 2011; <https://www.nanaimo.ca/assets/Departments/Fire~Rescue/Fire~Prevention/Ref-017FireSafetyPlanTemplatev1.docx> and <https://www.nanaimo.ca/EN/main/departments/Fire-Rescue/1959/businessownersmanagersinformation.html>
- (4) *Creating a Fire-safe Construction Site* , Steven Craft, PhD, P.Eng., Ineke Van Zeeland, M.Eng., ASPFE, and Steven Street July 2013 Construction Canada Vol 55., No.5; <http://www.kenilworth.com/publications/cc/de/201307/files/74.html>
- (5) *APEGBC Technical & Practice Bulletin: Structural, Fire Protection and Building Envelope Professional Engineering Services for 5 and 6 Storey Wood Frame Residential Building Projects (Mid-Rise Buildings)* , APEG Professional Engineers and Geoscientists of BC, April 2009; <http://www.boabc.org/assets/Latest~News/5and6StoreyWoodFrameBulletin.pdf>
- (6) *Subdivision F - Fire Protection and Prevention* , Oregon Administrative Rules, Oregon Occupational Safety and Health Division; http://www.cbs.state.or.us/osh/pdfs/rules/division_3/div3f.pdf
- (7) *Risk Topics: Preventing fires in buildings under construction or renovation* , Zurich Services Corporation, November 2011; <http://media.zurich.com/zna/znaprograms/1-Preveningfires.pdf>
- (8) *Fire Flow and Fire Hydrant Requirements* , Fire Marshall's Offices, Tualatin, OR; <http://www.tualatinoregon.gov/sites/default/files/fileattachments/building/webpage/12123/fireflowhydrants.pdf>
- (9) *16 Steps to Fire Safety on Timber Frame Construction Sites: UKTFA Guidelines and Recommendations*, UK Timber Frame Association, March 2011; <http://www.bernardsimsassociates.co.uk/files/bsa/uploads/16%20steps%20to%20timber%20frame%20fire%20safety.pdf>
- (10) *European Guideline: Fire prevention on construction sites, CFPA-E No. 21:2012F* , The Confederation of Fire Protection Association Europe (CFPA-Europe); <http://www.cfpa-e.eu/cfpa-e-guidelines/>
- (11) *Fire safety in construction: Guidance for clients, designers and those managing and carrying out construction work involving significant fire risks*, Health and Safety Executive (HSE), UK, 2010; <http://www.hse.gov.uk/pubns/books/hsg168.htm>
- (12) various documents <http://www.westsussex.gov.uk/default.aspx?page=9485>
- (13) *Construction Site Safety Handbook* , The Real Estate Developers Association of Hong Kong and The Hong Kong Construction Association, 2005 http://www.safetypartnering.com/smd/pdf/handbook_e.pdf.

COC Best Practices - Site Security Measures

Category	Canada(1) (2)	U.S.A (3) (4)	Europe (5) (6) (7) (8)	Asia (9)
1. Management Guidelines - Self Inspection	Conduct education and training to construction personnel on proper methods of securing building materials, equipment and tools. (2)	No information found.	Security measures should be inspected regularly to ensure that they are in good working order. Any deficiencies should be remedied at once. If this is not possible, equivalent safety measures should be taken. Such inspections should be carried out with the aid of a check list. (5)	No information found.
2. Management Guidelines - Security Managers	No information found.	It is crucial to have a security supervisor on site at all times. If the contractor does not have an employee on site whose sole responsibility is security, he should appoint a person who will be on site for the majority of the project as security supervisor. An example would be the construction superintendent or a foreman. (4)	It is important that one person is made responsible for security. They can delegate responsibility for certain aspects to others, but they need to retain overall accountability and control. Assuming a proportion of site crime is committed by people with links to the industry, the site supervisor has a large responsibility for minimising the risk of theft and trespass. (8)	No information found.
3. Site Security - Site Access	Good site perimeter controls and other security provisions can assist in preventing financial losses. In addition to perimeter control, covering windows and installing temporary doors can secure the building after the first storey has been constructed, making unauthorized entry difficult. All persons carrying out work on the site must complete an "Employee Registration" form and be in possession of a Site Pass. (2)	No information found.	Access to the works premises should be controlled to deny access to unauthorized persons. In large companies control cannot be carried out effectively by guards alone so that all personnel should be issued with electronic access control cards/tokens. To relieve the gatekeeper, an electronic turnstile (or a mechanical turnstile) system is desirable which allows staff access through the enclosure. Employees can gain access on their own by using card/token readers; visitors must report to the reception and can thus be recorded effectively. With electronic turnstile systems of this type, it is additionally possible to cordon off areas with high security requirements within the works, such as for example computer centres. (5)	No information found.

COC Best Practices - Site Security Measures

Category	Canada(1) (2)	U.S.A (3) (4)	Europe (5) (6) (7) (8)	Asia (9)
4. Site Security - 3rd Party Security Services	No information found.	No information found.	Consider the use of security patrols or manned guarding undertaken by approved security personnel licensed under the Private Security Act 2001. (8)	No information found.
5. Site Security - CCTV Surveillance Systems	No information found.	No information found.	At the outset, it's important to consider what the CCTV system is there to achieve. It can offer a deterrent against malicious damage, arson, or theft attacks. It can also help provide prosecution evidence for the police. (8)	TV monitoring and videotaping for public access at the guard house. (9)
6. Site Security - Alarms	No information found.	A consideration of local monitoring is that someone must be on-site 24/7. If the site is remote or located in a high crime area, remote monitoring is recommended, even if the site is guarded. (4)	Wherever practical, it will usually be preferable to utilise or adapt an existing conventional electronic security system for the monitoring of an empty building. However, where this cannot be achieved, temporary electronic security systems can be an effective means of monitoring, particularly when coupled with appropriate physical security measures and suitable deterrent warning signs on site. (6)	No information found.
7. Site Security - Fencing	Site fencing must be adequately braced and/or secured to withstand site conditions including wind. Perimeter fencing around excavation sites should be a minimum of 2.4 meters (8 feet) in height. This may be accomplished by using plywood affixed to jersey barriers or may be secured to vertical supports positioned at intervals no greater than 3.0 meters (10 feet) on centre. Fencing must be set back an appropriate distance from the edge of an excavation which varies depending on site conditions. (1)	Erecting fencing around the perimeter of the job site is a good way to signal to trespassers that they are not welcome. Fencing should be sturdy and should be taken down only when and where it's absolutely necessary to perform work. Common sense, to the point signs are the most effective. For example the following have been used; "Private Property - Unauthorized Entry is Prohibited". Make every worker responsible to report downed warning signs to the site supervisor. (3)	Boundaries need to be strong enough and high enough (2.4m) to keep intruders out. Security fencing is the best form of perimeter protection, although opaque fencing should be avoided as, once scaled, this may provide a screen to hide criminal activity. (8)	Erect suitable barricades, fencing, and hoarding. (9)

COC Best Practices - Site Security Measures

Category	Canada(1) (2)	U.S.A (3) (4)	Europe (5) (6) (7) (8)	Asia (9)
8. Site Security - Signage	Adequate signage must be placed outside the hoarding, warning of all hazards that may exist. Hoarding must be marked clearly "No Trespassing - Construction Personnel Only". (1)	Along with perimeter security, the presence of warning signs is important. (3)	Where security precautions are in place, notices should be displayed around the perimeter warning this is the case. (8)	Proper signage and lighting in suitable places when passers-by or entry by public is likely. (9)
9. Site Security - Lighting	No information found.	Both sides of the fence must be lighted so that an intruder may be detected at 100 meters. Any access gates must be illuminated. Lights must be checked daily, prior to darkness, so that deficiencies may be corrected prior to their use. The power supply for perimeter lighting must be inaccessible or tamperproof. For example, if using light tower/generator set trailers, they must be secured in place and the control doors locked. (4)	Providing external lighting on the site can also deter potential intruders, especially where the site is overlooked by other nearby property. This is particularly important in vulnerable areas. Lighting needs to be installed as high up as possible. Where lighting itself is obviously vulnerable to attack it needs to be adequately protected against physical damage. Armoured cable should be used if malicious damage is a risk. (8)	<ul style="list-style-type: none"> ▪ Adequate and free from glare ▪ Lighting clean and efficient ▪ No flickering ▪ Maintain steady lights ▪ Provide and maintain all emergency lighting systems. (9)
10 Site Security - Locks	Gates must be locked and the perimeter fencing secured to provide security against public access during off work hours and monitored in high traffic areas during operation. (1)	The contractor security supervisor should have overall authority for the issue and replacement of all locks and keys for the construction site. Key recipients must sign an acknowledgment that they will report any lost keys and that they may not duplicate any keys. Master keys should not be identifiable as such. Spare locks and keys should be double locked (i.e. in a locked container in a locked room). Padlocks should be locked to a hasp or staple when door or gate is open to prevent substitution. Locks on inactive doors or gates should be checked regularly for evidence of tampering. (4)	Wherever possible, locks should comply with current British standards. However, even the best locks do not stand a chance against some items of plant e.g. butane torches and heavy plant. Anticipate such plant being used against locks. Mitigate the risk by removing from the site keys for secure areas and plant that could be used to break into these secure areas. (8)	<ul style="list-style-type: none"> ▪ Lighting clean and efficient

COC Best Practices - Site Security Measures

Category	Canada(1) (2)	U.S.A (3) (4)	Europe (5) (6) (7) (8)	Asia (9)
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Sources:

(1) *On Site Construction Safety - Best Practices 2nd Edition* , Calgary On-Site Construction Safety Committee, May 2012;

http://www.cca.cc/media/3189/Best%20Practices_SafetyGuide_2012_final.pdf

(2) *Creating a Fire-safe Construction Site* , Steven Craft, PhD, P.Eng., Ineke Van Zeeland, M.Eng., ASPFE, and Steven Street July 2013 Construction Canada Vol 55., No.5;

<http://www.kenilworth.com/publications/cc/de/201307/files/74.html>

(3) *Contractors' Risk Management Practices - An Educational Guide* , DBH Resources Inc., January 2008; http://lucienwright.com/Contractors_Risk_Management_Guide.pdf

(4) *Best Practices for Project Security* , National Institute of Standards and Technology (NIST) GCR 04-865, - Stephen R. Thomas, Jonathan R. Sylvie, Candace L. Macken,, July 2004;

http://www.google.ca/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=OCBwQFjAA&url=http%3A%2F%2Fwww.tisp.org%2Findex.cfm%3Fpk%3Ddownload%26pid%3D10261%26id%3D10910&ei=f5HIU57mBqed8gHD44G4Bw&usg=AFQjCNGVebBX6qc_G4RDzAIXMhDtxzZfNQ&bvm=bv.71198958,d.b2U or <http://www.tisp.org/index.cfm?pk=download&pid=10261&id=10910>

(5) *Arson Document - CFPA-E®-Guidelines 01 : 2010/S* , European Fire and Security Advisory Council (EFSAC), January 2010; [http://www.cfpa-e.eu/wp-](http://www.cfpa-e.eu/wp-content/uploads/files/guidelines/Guidelines_Arson_Document_01_-_2010-S_%282%29.pdf)

[content/uploads/files/guidelines/Guidelines_Arson_Document_01_-_2010-S_%282%29.pdf](http://www.cfpa-e.eu/wp-content/uploads/files/guidelines/Guidelines_Arson_Document_01_-_2010-S_%282%29.pdf)

(6) *Security Systems For Empty Buildings - CFPA-E®-Guidelines 03 : 2010/S* , European Fire and Security Advisory Council (EFSAC), January 2010; [http://www.cfpa-e.eu/wp-](http://www.cfpa-e.eu/wp-content/uploads/files/guidelines/Guidelines_Electronic_Security_Systems_Security_Systems_Empty_Buildings_03_-_2010-S_%282%29.pdf)

[content/uploads/files/guidelines/Guidelines_Electronic_Security_Systems_Security_Systems_Empty_Buildings_03_-_2010-S_%282%29.pdf](http://www.cfpa-e.eu/wp-content/uploads/files/guidelines/Guidelines_Electronic_Security_Systems_Security_Systems_Empty_Buildings_03_-_2010-S_%282%29.pdf)

(7) *Protection of Empty Buildings - CFPA-E®-Guidelines 02 : 2010/S* , European Fire and Security Advisory Council (EFSAC), February 2010; [http://www.cfpa-e.eu/wp-](http://www.cfpa-e.eu/wp-content/uploads/files/guidelines/Guidelines_Protection_of_Empty_Buildings_02_-_2010-S_%282%29.pdf)

[content/uploads/files/guidelines/Guidelines_Protection_of_Empty_Buildings_02_-_2010-S_%282%29.pdf](http://www.cfpa-e.eu/wp-content/uploads/files/guidelines/Guidelines_Protection_of_Empty_Buildings_02_-_2010-S_%282%29.pdf)

(8) *Site Security - Best practice guidance for construction companies* , Zurich Insurance plc, November 2012; datatag.co.uk/PDFs/Zurich_Site-Security.pdf

(9) *Construction Site Safety Handbook* , The Real Estate Developers Association of Hong Kong and The Hong Kong Construction Association, 2005

http://www.safetypartnering.com/smd/pdf/handbook_e.pdf.

4.1 Insurance Industry Guidelines

The insurance industry, specifically commercial property and casualty insurers, brokers and consultants, continuously evolves and expands its fire protection and loss prevention guidelines. These guidelines, both formal and informal, have and will continue to address concerns with construction processes and job sites, including wooden building structures.

Practically all major insurers work with confidential internal guidelines, along with providing formal documentation to their insured customers. Some even make this documentation publicly available. Others simply adopt accepted standards such as NFPA or those of other insurers. A sample of some existing guidelines addressing exposures pertaining to construction sites of combustible structures includes:

- **AIG** – A handbook titled “Construction Fire Safety and Security”, along with an internal Property Engineering Manual and several additional guidelines.
- **Aviva** – “Prime HardHat Loss Control Guide” provides recommendations specifically directed at contractors and construction sites.
http://www.avivacanada.com/sites/default/files/aviva_pdf/en/prime_hardhat_losscontrolguide_en.pdf
- **Encon** – A handbook titled “Construction Fire Safety and Security Handbook” as part of their Wood Frame Builders Risk Insurance Program.
- **FM Global** – Data Sheet 1-0 “Safeguards During Construction, Alteration, and Demolition”, along with numerous other Data Sheets that address specific hazards including when they are present at, or pertain to, construction sites.
<https://www.fmglobal.com/fmglobalregistration/>
- **Munich Re** – “Bulletin November 2003 – Space Separation for Wood Frame Construction”, along with “Bulletins” aimed at various loss prevention issues that are also applicable to construction sites, available to member companies.
- **Royal SunAlliance** – Internal loss prevention guides pertain to project construction, in addition to guidelines for customers. <http://www.rsabroker.com/property> and <http://www.rsagroupni.com/RiskManagement/pdf/HealthSafety/RMG07.pdf>
- **Zurich** – In addition to focussed bulletins such as “Construction Fleet Management” and “New Construction and Extensions – Plan Review”, they offer a series of helpful guidelines “RiskTopics” covering a range of issues, many of which are applicable to construction sites. <https://www.zurichvlr.com/signin.aspx>
- **XL Group** – Publishes a broad range of risk control guidelines called “XL GAPS”. In addition to numerous topic specific guidelines, including several that are also applicable to the construction industry, focused guidelines include “GAP.1.5.0.A Loss Control During Construction (9/1/09)” and “GAP.17.6.2 High-Rise Building Construction (12/1/09)”, available solely to customers.

With no known exceptions, the insurance industry uses the NFPA guidelines as a base reference, which specifically includes NFPA241, Standard for Safeguarding Construction, Alterations and Demolition Operations. However, best practices are routinely utilized to supplant or enhance these guidelines.

4.2 Insurance Industry Direction

Physical space separation is a key limiting factor in developing fire loss scenarios. The industry considers exposure by, or of, a building of combustible construction to be a very serious exposure. Guidelines taken from major property and casualty insurers, consistently specify the following:

- In order to consider 2 structures as independent of each other from a major fire standpoint, a minimum distance of 100 to 200 ft. is required between buildings of combustible construction, depending on the hazard severity of the operations within the buildings and extent of combustible loading.
- When the exposing building is of non-combustible or fire resistive construction, the minimum physical separation can be reduced to 50 to 75 ft. depending on various conditions.
- When addressing storage of combustible materials (such as idle wood pallets or lumber storage) in the yard outside a building, guidelines prescribe a minimum 100 ft. clearance away from combustible buildings. Under varying conditions, this distance can be reduced to 50 ft. for non-combustible construction and/or protected occupied buildings.

While these guidelines are intended mainly for occupied buildings, they are applied during the construction process as well. Obviously such generous space separations will not always be attainable at construction sites and will have to be considered in the initial design stage when applying for permits.

The insurance industry has had a long standing “offer” for the construction industry (which at times becomes a “requirement”) which provides loss prevention and risk control review of construction, renovation and demolition proposals. The reviews have traditionally focused on reducing and controlling fire and other exposures within the finished structure/site, however, the service does encompass addressing these exposures during the course of construction as well.

4.3 Other Standards And Guidelines

Other standards and guidelines currently in place, and publicly available, include:

- California - tied to Article 87 of the California Fire Code, the document is titled “Standards for Construction Site Fire Safety”. <http://www.unidocs.org/fire/un-024.pdf>
- UK – initially published in July 2008 by the UK Timber Frame Association (now known as the Structural Timber Association), revised in March 2011, titled “16 Steps to Fire Safety on Timber Frame Construction Sites – UKTFA Guidelines and Recommendations”, is in addition to numerous member only documents available at: <http://www.structuraltimber.co.uk> The 2008 document is publicly available at: <http://www.sidey.co.uk/tncsite/downloads/brochures/UKTFA16StepsFireSafety.pdf> .

- British Columbia – a July 2011 guideline released by the Surrey Fire Chief and supported by the Fire Chief’s Association of British Columbia titled “Construction Fire Safety Plan Bulletin”.
http://www.surrey.ca/files/DCT_Construction_Fire_Safety_Plan_Bulletin_w_Form_07_8A.pdf which adds to an April 2009 Information Bulletin published by the Office of the Fire Commissioners titled “Fire Safety Planning on Construction and Demolition Sites”. <http://www.embc.gov.bc.ca/ofc/services/bulletins/pdf/firesafeplan.pdf>
- Canada – a publication of the Canadian Wood Council titled “Fire Safety and Security – A Technical Note on Fire Safety and Security on Construction Sites in British Columbia”. http://cwc.ca/wp-content/uploads/publications-Fire_Safety_and_Security_BC.pdf

SECTION 5. MODEL CODES - NFC & NBC - REQUIREMENT SUMMARY

5.1 - National Fire Code Of Canada 2010 (NFC)

The NFC, which is a companion document to the National Building Code of Canada (NBC) deals with the issue of buildings undergoing construction, alteration, or demolition in **Section 5.6, Construction and Demolition Sites**. The degree of application should be established in advance with the authority having jurisdiction.

The proposed changes to the 2015 National Codes, if approved, will provide the ability to construct five- and six-storey wood-frame buildings in Canada. Consequently, enhanced requirements, particular to the code provisions for these mid-rise buildings, have been proposed pertaining to: designated smoking areas, site identification, combustible refuse, water supply, hydrant access, construction stairways, site security, firefighting access routes, portable fire extinguishers, and hot work.

The requirements of the current NFC pertaining to all construction, alteration and demolition as contained in Section 5.6.1 may be summarized as follows:

Protection of Adjacent Buildings

Protection of buildings that would be exposed to an unacceptable level of risk due to a fire originating from buildings undergoing construction needs to be considered. Sufficient protection may be provided by the construction site fire safety measures outlined by the NFC, but protection may also include additional measures such as spatial separation, water curtains, methods and material including gypsum sheathing or a temporary fire barrier.

Fire Safety Plan

A fire safety plan is required at the start of construction for the site and must contain the organization of site personnel who will carry out fire safety duties (including fire watch if needed), the emergency procedures to be followed in event of fire, the measures for controlling fire hazards in and around the building, and a maintenance procedure for firefighting measures.

Access for Firefighting

In order for firefighters to perform their duties effectively, unobstructed access to fire hydrants, fire extinguishers, and fire department connections (for both standpipes and sprinkler systems) is needed. As well, a means to allow firefighters to perform their duties on all floors, and use of elevators is required. Access routes for fire apparatus, and access via normally restricted fenced entry is needed.

Portable Fire Extinguishers

Fire extinguishers are required in various areas: where hot work is carried out; where combustibles are stored; near internal combustion engines; where flammable and

combustible liquids are stored; and where fuel-fired equipment is used. Ratings required are 2-A: 10-B: C on moveable equipment and 4-A: 40B: C in other locations.

Standpipe Systems

This section sets out the requirements on how standpipe systems are to be progressively installed in buildings under construction, and has specific conditions pertaining to the parts of the building that are occupied versus not occupied. It is not expected that hoses and nozzles will be available in the building undergoing construction, alteration, or demolition as they will be brought to the relevant floor/s by the responding fire department.

Hot Surface Applications

Roofing operations that involve heat sources and hot processes are considered “hot works” and must conform to the requirements in Section 5.2. This section applies to hot works involving open flames or producing heat or sparks, including cutting, welding, soldering, brazing, grinding, adhesive bonding, thermal spraying and thawing pipes. There are requirements on equipment maintenance, location of operations, protection of combustible and flammable materials, fire watch, fire extinguishing equipment and fire safety measure.

Also, bitumen kettles are not allowed on roofs, and there are specific restrictions on their use.

Ignition Sources

Heating equipment, internal combustion engines, and any other devices capable of producing ignition, must be kept a safe distance from combustible material. Minimum clearances shown on the heating equipment or as prescribed by code (NBC) are required between combustible materials and temporary heating equipment.

Building Services at Demolition Site

Except for water supplies for firefighting, building services must be terminated at a point outside of the building being demolished, with advance notification to service companies in case they need to maintain service by relocating as needed, and to protect from damage. This section also requires temporary electrical installations to conform with CSA C22.1, “Canadian Electrical Code”.

Similar requirements apply to “Excavation”, and are covered under Section 5.6.2 of the NFC.

Fuel Supply

Fuel supplies for heating equipment and internal combustion engines need to conform to requirements of CSA B139, “Installation Code For Oil-Burning Equipment” or CAN/CSA-B149.1, “Natural Gas And Propane Installation Code”.

Tanks Piping and Machinery Reservoir Safety at Demolition Sites.

This section sets out the requirements for tanks, piping and machinery reservoirs at demolition sites. Of particular importance is the need to take this equipment out of service, drain combustible and flammable liquids and purge with inert materials.

Fire Separations in Partly Occupied Buildings

The requirement here is to have a separation with a minimum 1-hour fire rating between occupied parts of buildings and the areas under construction, alteration, or demolition.

Protection During Shutdown

Fire protection systems that are provided are required to remain operational during construction, alteration, or demolition where reasonably practical.

Watch

A security watch with tours at maximum 1-hour intervals is required throughout demolition sites when there are occupants in the portion of the building not being demolished. A similar watch is required when a portion of the building is occupied during construction operations, where a fire alarm system does not exist. Person on watch must be provided with a means to notify occupants and communicate with the fire department during emergencies.

Smoking

Smoking is permitted only in areas where it does not pose a fire or explosion hazard, and where an adequate number of ash trays are provided. Signs prohibiting smoking must have black lettering not less than 50mm high with a 12mm stroke on a yellow background.

Provisions of Egress

At least one exit, accessible at all times, is required in areas of a building undergoing construction, alteration or demolition operations. One stairway, usable at all times, is required in a building being demolished.

Fire Warning

A means to alert site personnel of a fire is required and must be capable of being heard throughout the building.

Storage and Use of Dangerous Goods

The requirements for the use and storage of combustible and flammable liquids, and dangerous goods, must comply with Parts 3, 4 and 5 of the fire code.

Temporary Enclosures

Fabrics and films used to enclose buildings must be securely fastened to prevent contact with heaters or ignition sources.

Disposal of Combustible Refuse

Combustible refuse that constitutes a fire hazard must be moved to a safe location.

5.2 - National Building Code Of Canada 2010 (NBC)

The NBC deals with the issue of buildings undergoing construction, alteration or demolition in **Part 8, Safety Measures at Construction and Demolition Sites**. The focus is on fire safety and protection of the public.

The requirements of the NBC pertaining to construction may be summarized as follows:

GENERAL

The NBC requires that fire safety at construction and demolition sites conform to the NBC.

PROTECTION OF THE PUBLIC

- **Covered Way Construction**

Where construction may constitute a hazard to the public, work shall not commence on the construction, alteration, or repair of a building until a covered way is provided and meets the following: clear height of not less than 2.5 m; clear width of not less than 1.5 m; constructed to support all loads, but in no case less than 2.4 kPa on the roof; have a weathertight roof sloped towards the site, or if flat, a splash board not less than 300 mm high on the street; be totally enclosed on the site side; have a railing 1,070 mm high on the street side where the covered way is supported by posts; and, have adequate lighting.

The exception to the above is where the work is being done in a solid enclosure, the building is at a distance of 2 m or more from a public way used by pedestrians, or the site conditions warrant a greater distance.

- **Fencing, Boarding or Barricades**

Where construction or demolition activity may constitute a hazard to the public and is located less than 2 m from a public way, a strongly constructed fence, boarding or barricade not less than 1.8 m high is required between the site and the public way or open sides to construction site. The barricades require a smooth surface facing the public way and have no openings except those required for access. Access openings must have gates that remain closed and locked when site is unattended.

- **Special Hazards**

Where it is not possible to protect the public from special hazards that might exist, persons need to be employed to prevent the public from entering the danger zone at all times.

- **Work Shutdown**

When work on a construction site is suspended or ceases during normal working hours the hazardous part of the site needs to be protected by covering all windows, doors and other openings located within 3 m of the ground to prevent access to the building, with a securely fastened barricade or a 1.8 m high, strongly constructed fence.

EXCAVATION

- **Water Removal**

Excavations need to be kept reasonably clear of water.

- **Protection of Adjoining Property**

Adequate underpinning, shoring and bracing is required where the stability of adjoining buildings may be an issue due to the excavation.

USE OF STREETS OR PUBLIC PROPERTY

- **Safe Passage Past Site**

Provisions require safe passage for pedestrians and vehicles past the site at all times.

- **Overhead Activities**

Hoisting major components onto a tall building, or other similar overhead activities which pose danger to pedestrians below and from which the public cannot be protected by barricades, covered ways or similar means, cannot be carried out until the street or other public way is closed.

- **Barricades**

Excavations in streets or public property must be properly barricaded and have warning signs or lights.

- **Restoration and Repair**

Damaged sidewalks, street or other public property must be repaired, and any obstructions must be removed when the need for them has ended.

- **Warning Lights**

Warning lights are required at all obstructions on streets or public ways.

DIRECTION OF VEHICULAR TRAFFIC

- **Hazards to Vehicular Traffic**

Where a hazard is created due to vehicular traffic on a public way due to work on a construction site, warning signs, barriers, lane control devices or flashing lights/flares and one or more workers is required.

- **Flags Used for Directing Traffic**

Flags used to direct traffic must be red, not less than 450 mm by 500 mm, mounted on a minimum 1 m long staff and maintained in a clean and untornd condition.

- **Signs Used for Directing Traffic**

Signs used to direct traffic must be diamond shaped and made of minimum 6 mm plywood, not less than 450 mm by 450 mm in size and mounted at one corner on a minimum 1.2 m long pole, and be red on one side with black corner areas with the word “STOP” or “ARRET” marked in white letters not less than 150 mm high located centrally.

- **Worker Directing Traffic**

Workers directing traffic must: be instructed in the use of signals to control traffic; be provided with instructions; and direct traffic by using a flag or sign.

- **Clothing While Directing Traffic**

Workers directing traffic must wear a vest, or sleeves that extend from above the elbow to the wrist, in blaze orange or fluorescent red in colour.

WASTE MATERIAL

- **Control of Waste Material**

Waste material must not be allowed to fall freely from one storey to another.

- **Removal of Waste Material**

Waste material must be removed as quickly as possible in appropriate containers, and enclosed shaft or chute or by a hoisting apparatus if pieces are large.

- **Enclosures for Waste Material**

Waste material must be deposited in an enclosure to prevent material from projecting outside the enclosure, and must not be accessible to the public.

SECTION 6. MODEL FIRE CODES - NFC & NBC - ADOPTION BY PROVINCE

In Canada, the model National Construction Codes (Fire, Building, Plumbing and Energy) are prepared centrally by the Canadian Commission on Building and Fire Codes for use by the provinces and territories. The design and construction of new buildings as well as the requirements for fire safety systems in existing buildings is the responsibility of the provincial and territorial governments who are free to adopt and enforce the Canadian or other model codes in their entirety or in equivalent parts to suit their needs.

As a result, while many design and post-occupancy building requirements are similar across Canada, there can be significant differences between the various provinces and territories because they each alter the Canadian model requirements to varying degrees.

The table below provides a brief overview of the extent to which provinces and territories have adopted the National Fire Code (NFC) and the National Building Code (NBC), or published their own codes based in large part on the model codes.

While some examples of differing requirements are provided, a detailed analysis of the provincial and territorial design and post-occupancy requirements is beyond the scope of this project.

A detailed analysis of the provincial and territorial requirements related to construction site safety will be developed in a separate phase of the project.

Province/Territory	Extent to which Provinces/Territories Adopt/Publish National Model Codes	Adoption of NBC	Adoption of NFC	Example Modifications or Additions to Provincial or Territorial Code Construction and Construction Site Requirements
Alberta	Province-wide building and fire codes adopted that are substantially the same as the national model codes with variations that are primarily additions.	Adopted 2005 edition of NBC as Alberta Building Code, with modifications, effective September 2, 2007. Since then the code has been consolidated/amended as per O.C. 104/2009 A.R. 49/2009.	Adopted 2005 edition of NFC as Alberta Fire Code, with modifications effective September 2, 2007. Since then the code has been consolidated/amended as per A.R. 118/2007sl;50/2009.	The ABC limits height of combustible residential buildings to 9m above exit level. Sprinklers are mandated for all part 3 buildings containing residential occupancies.
British Columbia	Province-wide building and fire codes adopted that are substantially the same as the national model codes with variations that are primarily additions.	Adopted 2010 edition of NBC as BC Building Code, with modifications effective December 20, 2012.	Adopted 2010 edition of NFC as BC Fire Code, with modifications effective December 20, 2012.	The BCBC allows some seniors residential buildings to be classified as Group C occupancy that would be classified under Group B by the NBCC. The 2012 BCBC retains specific permission and requirements for midrise wood buildings first adopted in 2009. See Note 1 below.

Province/Territory	Extent to which Provinces/Territories Adopt/Publish National Codes	Adoption of NBC	Adoption of NFC	Example Modifications or Additions to Provincial or Territorial Code Construction Site Requirements
Manitoba	Province-wide building and fire codes adopted that are substantially the same as the national model codes with some minor modifications and additions.	Adopted 2010 edition of NBC as Manitoba Building Code, with minor modifications, effective April 1, 2011.	Adopted 2005 edition of NFC as Manitoba Fire Code, with minor modifications, effective December 1, 2011.	
New Brunswick	Province-wide building and fire codes adopted that are substantially the same as the national model codes with some minor modifications and additions.	Adopted 2005 edition of NBC as NB Building Code, with minor modifications, effective 2009.	Adopted 2010 edition of NFC as NB Fire Code, with modifications, effective December 1, 2011.	
Newfoundland & Labrador	Province-wide building and fire codes adopted that are the substantially the same as the national model codes with some modifications and additions.	Adopted 2010 edition of NBC effective June 1, 2012.	Adopted 2010 edition of NFC effective June 1, 2012.	NBC Part 9 relative to one- and two-family dwellings within Group C is not adopted. For “use and operation of buildings, processes areas and vehicles” the 2009 edition of the NFPA 101 Life Safety Code is adopted along with the 2010 edition of the NFC. “Means and egress” requirements for new construction are to comply with NFPA 101.
Nova Scotia	Province-wide building and fire codes adopted that are substantially the same as the national model codes with some modifications and additions.	Adopted 2010 edition of NBC as NS Building Code, with minor modifications in December 2013, effective December 31, 2014.	Adopted 2010 edition of NFC with minor modifications, effective June 2011.	NSBC requires greater sprinklering of all large (Part 3/4) buildings.
Northwest Territories	Territory-wide building and fire codes adopted that are substantially the same as the national model codes with modifications and additions	Adopted 2010 edition of NBC effective April 1, 2011.	Adopted 2010 edition of NFC effective April 1, 2011.	
Nunavut	Territory-wide building and fire codes adopted that are substantially the same as the national model codes with modifications and additions	Adopted 2010 edition of NBC effective June 8, 2012.	Adopted 1995 edition of NFC effective 1995.	
Ontario	Publish their own province-wide fire & building code based on national model codes but with significant variations in content & scope.	Province-wide building code, in part based on 2010 NBC, in force on January 1, 2014.	Province-wide fire code, in part based on NFC, in force on January 1, 2014.	Unlike the NFC, there are not specific provisions in the OFC on construction site safety. Requirements are contained in the Occupational Health and Safety regulations. See Note 2 below.

Province/Territory	Extent to which Provinces/Territories Adopt/Publish National Model Codes	Adoption of NBC	Adoption of NFC	Example Modifications or Additions to Provincial or Territorial Code Construction and Construction Site Requirements
Prince Edward Island	No province-wide building code; province working towards province-wide adoption of NBC. Some major municipalities adopt the NBC. No specific model fire code adopted.	Charlottetown, Stratford and Summerside have adopted 2010 NBC effective July, 2011.	Provincial Fire Prevention Act of May 30, 2012 does not cite a specific model fire code or set of regulations.	
Quebec	Publish their own province-wide building and fire codes that are substantially the same or more stringent than the national codes. Major municipalities adopt the NFC.	Quebec Construction Code (Chapter 1), which includes 2005 NBC, with modifications for Quebec. In force since November 7, 2000 and last updated December, 2012.	Quebec Safety Code, Chapter VIII in force since March 18, 2013 and includes 2010 NFC, with amendments for Quebec. Major municipalities adopt code.	See Note 3 below.
Saskatchewan	Province-wide building and fire codes adopted that are substantially the same as the national model codes, with some modifications and additions	Adopted 2010 edition of NBC effective May 1, 2013.	Adopted 2010 edition of NFC effective September 11, 2013.	See Note 4 below.
Yukon	Adopt NFC & NBC territory-wide with modifications and additions.	Adopted 2010 edition of NBC effective April 1, 2011.	Adopted 2010 edition of NFC effective April 1, 2011.	

Notes:

1) British Columbia:

New BC Building Code requirements increasing the maximum permitted height for residential buildings of combustible construction came into effect on April 6, 2009. Along with this change additional requirements pertaining to the automatic sprinkler protection, height limits, combustibility of cladding, energy efficiency, seismic design and structural material design came into effect.

2) Ontario:

Requirements pertaining to safety at construction and demolition sites contained in Occupational Health and Safety Act, Ontario Regulation 213/91, "Construction Projects" and R.S.O. 1990, Chapter 0.1.

http://www.e-laws.gov.on.ca/html/regs/english/elaws_regs_910213_e.htm

3) Quebec:

Building code requirements in Quebec are contained in the Quebec Construction Code, Chapter 1, “Building, and National Building Code of Canada 2005 (amended)”. Quebec has adopted this very comprehensive code document which contains significant amendments to the National Building Code of Canada 2005 including 300 +/- changes/additions which apply to construction and renovation of buildings in that province. The code has been in force since November 7, 2000. Quebec has also adopted the “Safety Code for the Construction Industry”, and a Code that applies to worker health and safety on construction sites.

Fire code requirements are contained in the Quebec Safety Code, Chapter VIII, “Building, and National Fire Code of Canada 2010 (amended)”. Amendments deal with Quebec-specific provisions, which distinguish as to whether the provisions of the NFC (Section 5.6) and the Quebec Safety Code (Sections 342 and 370) or Quebec Safety Code for the Construction Industry are to be applied to a particular type of construction and renovation project.

<https://www.rbq.gouv.qc.ca/en/laws-regulations-and-codes/construction-code-and-safety-code.html>

4) Saskatchewan:

Requirements set out in NBC and NFC apply except that, The Uniform Building and Accessibility Regulations contains the following Article:

“8.1.1.4 Occupational Health and Safety

1) In the case of conflict between the provisions of this part and *The Occupational Health and Safety Regulations, 1996*, the provisions of *The Occupational Health and Safety Regulations, 1996 govern.*”

In other words, any construction site safety requirements in The Occupational Health and Safety Regulations, 1996 take precedence over Part 8 of the NBC, “Safety Measures at Construction and Demolition Sites.”

SECTION 7. CRITICAL MILESTONES IN THE CONSTRUCTION PROCESS

There are existing operational and safety protocols that are currently being used at mid-rise construction projects involving combustible construction. Many of these are not necessarily in writing and some have not been formalized. This section looks at critical milestones pertaining specifically to wood frame construction, but it's important to note that most of these milestones are common to all construction projects. The points discussed below were established based on our extensive insurance company course of construction inspection experience. We have also interviewed construction superintendents, construction companies and developers. The protocols required at various stages, as noted below, pertain to both operational and safety issues, which include fire prevention and control.

These milestones come into consideration only after the building design has been approved, permits have been issued, and the project is ready to proceed. It is expected that there will be no exceptions to the minimum building code requirements for

- (i) providing automatic sprinkler protection and standpipes; and,
- (ii) internal fire rated separations; and,
- (iii) adequate water supply for fire fighting;

as proposed for all mid-rise combustible construction projects.

1. Site Preparation - Before Construction Begins

- Where there is a municipal water supply, a standard connection to the underground system, yard mains and hydrants are onsite prior to construction starting, at least before any framing is begun or other substantial combustible load is introduced to the site. This also applies when a private water supply is available.
- Site fencing is installed prior to the construction starting.
- Site security is on site prior to the construction starting.
- Designated storage areas are defined for building materials, flammable liquids and combustibles.
- A Hot Work protocol is established and agreed to by all trades, contractors and subcontractors in writing.
- Designated site entry points and routes for fire fighting responders are established.
- Site maps are produced, depicting the location of fire fighting equipment, and storage, as well as evacuation routes from all areas of the project.
- Once the protocols for site development have been established and agreed upon by the owner, the authority having jurisdiction and the builder, it creates a base from which the next phase can proceed.

2. First Phase of Construction - Basement

- Daily written site management and safety officer reports are maintained on all activities conducted that day, plus what materials were delivered to the site and where they were placed/stored.
- When basement concrete has cured and forms removed, a suitably sized water main is installed in the building water room and connected to either the municipal water supply or approved alternative.
- A water main (as per pre-established design) is installed to service the entire building, to facilitate eventual installation of automatic sprinkler systems and standpipe and hose systems.
- A milestone at this time is confirming the amount of water and pressure available at the base of the riser, which will then dictate the size of fire pump where one is required. Where a pump is required, it will then be installed along with a power supply suitable for the systems' requirements. Wood frame, or other combustible, construction should not proceed until this issue has been completed.

3. Construction of Ground Floor and Above:

- Protocols are established for the implementation of through-floor service openings and the fire stopping required for each service opening such as water, phone and power lines. An appropriate fire stop system is chosen that has been tested to CAN/ULC-S115. As each floor assembly is completed, fire stopping is installed.
- The fire hose connection piping is activated prior to the next floor being erected. Active hose stations are on each floor prior to the next floor construction proceeding. Each hose station is provided with a suitable length of hose and a variable fog nozzle.
- The hot work protocol, established prior to the start of construction, is strictly followed and adhered to on every occasion, and all activities involving hot work are logged in the project manager's or engineer's daily logbook.
- As each floor is finished, the floor surface is placed over the wood deck. This includes wood frame balconies if installed. No torch-down membranes are permitted on balconies without a non-combustible surface installed.
- As each floor assembly is completed, all fire separations are to be completed, including installation of fire rated doors.
- Each floor exit is clearly marked with signage and directional light depicting the exit. As the project proceeds past the 2nd floor, temporary exterior stairs are installed and all workers informed as to their exit and evacuation routes. No employee or contractor is permitted in the building until they have been provided such information. This requirement is benchmarked by the building site manager or site safety officer, prior to any employee or contractor being permitted onsite.

- The building designer is encouraged to provide a roof covering that does not require hot work as part of the installation. If hot work is required then a separate roofing protocol is established prior to any hot work being permitted.
- Protocols are established for fire blocking any concealed spaces in order to restrict the spread of fire.
- During the finishing of the building, gypsum board is installed as soon as practically possible, in order to reduce the amount of combustible materials immediately accessible in the event of a fire.
- One of two methods of providing building heat will be required. Heating can be provided from within the building or from outside the building. A protocol is established for heating the building, especially if any interior heating device is to be utilized. Exterior heaters are the preferred method of heating the building utilizing flexible hosing/ducting, which can then be directed to the required area. This is normally conducted after all exterior doors and windows have been installed. A less desirable method is enclosure, installing plastic shrink-wrap around the building to hold in the heat utilized to dry the building during the drywall stage. However, shrink-wrap is highly flammable and should not be used if at all possible. The shrink-wrap, if used, must not enclose the emergency stairways that were erected exterior of the building.
- Although sprinkler systems and fire detection devices are physically roughed-in prior to interior finishes, they are not activated (such as sprinklers installed and systems tested) until after the interior finishes have been installed. However, the sprinkler systems should be activated prior to progression of upper floor construction. Climate and weather conditions must be taken in to consideration. The milestone is thus to complete gypsum board installation first, allowing sprinkler installation and system activation, followed by remaining interior finishing, before proceeding to the next level. (It was felt by several project engineers interviewed that this would be possible when the penetrations in the floor above have been fire stopped and the concrete finish has been applied to the wood deck floor surface. Also, the water migration from a rain occurrence could be mitigated if those two features were completed as the building was erected.) Effective planning and coordination of the various subcontractors is important.

SECTION 8. INSURANCE INDUSTRY FOCUS GROUP

The private Property and Casualty insurance industry writes over 45 billion dollars of premiums in Canada and pays out approximately 60% of these revenues in claims. The industry has had a longstanding concern over large and devastating condominium and apartment fires and are cautious when writing this line of business, particularly for buildings under construction.

With the changes being introduced into the building code allowing buildings up to six storeys with combustible construction, for light hazard occupancies, the CWC understands the need to invite the insurance industry as a key stakeholder in this project. On May 26th, 2014, Technical Risk Services (TRS) invited a large segment of the property and casualty insurance industry to a 2½ hour focus group to provide input on a Best Practices Guide for mid-rise buildings of combustible construction. Industry input was sought with respect to fire protection features, risk avoidance, management and control, as it pertains to the construction process of these soon to be increasingly popular structures.

The insurance industry's input emanating from the focus group has been taken into consideration in preparing Section 9, Findings - Best Practices Guide (BPG) For Construction.

The focus group session was led by Mike Jarcew, P. Eng., MBA, CRM, Executive Vice-President, Risk Management, TRS. Other representatives from TRS included Bruce Gilder, P.Eng. CRM, President, and Gilles Proulx, B.Sc., FCIP, RF, Executive Vice-President, Client Services.

Insurer participants had both strong underwriting and loss prevention backgrounds, and including the two largest private Property and Casualty insurers in Canada. All the insurers present currently provide Course of Construction (Builder's Risk) insurance coverage, representing a broad segment of the industry.

Participants included:

- 1) Bill Tzaferis, Senior Risk Consultant, Arch Insurance
- 2) Paul Johnston, CET, CRM, CIP
Regional Manager, GTA/SCL, Risk Management, Loss Control, AVIVA Canada
- 3) Richard Cantin, CIP, CRM, C.TECH
Regional Manager, Non-GTA, Risk Management, Loss Control, AVIVA Canada
- 4) Lisa Wild, CIP, Underwriting Specialist, Property and Inland Marine Division
Great American Insurance Group
- 5) Pamela Brooks, Senior Specialist, Corporate Commercial Lines, Intact Insurance
- 6) Sue Reinhardt, Compliance Consultant, Loss Prevention, Intact Insurance

- 7) Christopher Mastro, Team Leader, Risk Services Solutions, Northbridge Insurance
- 8) Rob Welch, CIP, CRM, Portfolio Executive–Construction Risk Services, Zurich

During the focus group discussions, no discernable distinction was made between light wood-frame construction and other heavier wood building styles, all were generally categorized together as combustible construction. The major concerns voiced by the insurance community participants were concentrated on prevention and containment of fires in their initial stages. A summary of those concerns, presented as a list of guidelines to mitigate the concerns, is as follows:

- The site water supply should be assessed in the planning stages to ensure that there is sufficient water to supply the sprinkler system, the standpipes & hose and fire department requirements, both during construction and post occupancy.
- A fire plan for the construction phase should be in place before construction commences and reviewed before the construction advances above ground level.
- The site must be manned 24/7 with regular tours of the entire jobsite.
- No smoking should be permitted inside the fenced job-site perimeter.
- The standpipes and hose should be installed and activated as the structure is being built, i.e. one floor below the floor being constructed.
- Sprinkler systems should be installed and activated floor by floor as the structure is erected, i.e. two floors below the floor under construction.
- Sprinkler systems should be installed as designed (wet or dry), but temporarily used as dry-pipe systems and only converted to wet systems when the risk of freezing is no longer present.
- When hot work is being performed in non-sprinklered areas, manned, charged fire hoses should be in place. Possibly use off-duty fire fighters to man the hoses.
- No open flame heating should be used.
- The erection of the fire barriers/separation walls should be prioritized on each floor and fire doors should be installed as soon as the door's framing is in place. Protocols should ensure that the fire doors are then kept closed after normal working hours.
- Firewalls with parapets, or equivalent, which are integral to the approved project design should be installed using a two-storey lag.
- To help reduce the amount of project values susceptible to any single fire loss, when multiple buildings are involved on the same site, construction should be staggered so as to create a 100 ft. fire break during construction, until active fire protection and the non-combustible exterior are installed, then fill-in the remaining buildings. Specifics will vary per site.

- Prefer a contractor certification program, at least until this type of construction becomes more common, but ideally continuing on. The certification is intended to apply to all trades working on the job site. The idea of an audit was introduced to monitor the certification program.
- Regular progress reports, construction and loss prevention, posted to website.

SECTION 9. FINDINGS - BEST PRACTICES GUIDE (BPG) FOR CONSTRUCTION

Based on a review of related documents and standards, and insurer input both during and after the focus group, TRS has put together a set of statements for developing a BPG intended to outline minimum critical safeguards for the construction of wood mid-rise buildings. The statements provided are not intended to constitute a "completed" BPG, but rather are a starting point.

The development of a Best Practice Guide based on this set of statements would likely include the following tasks:

- 1) Review of topics/categories presented, and identification of any additional ones;
- 2) Review of individual statements/points within each topic/category, and identification of any additional ones;
- 3) Development of detailed discussions related to the various aspects to be considered under each topic/category and each statement/point; and,
- 4) Development of any sample forms and/or report templates identified to be of assistance in carrying out recommended best practices.
- 5) A Best Practice Guide should not discourage the evaluation and use of new/emerging technologies/products/processes that are developed to assist in construction site fire safety.

These guidelines would not be intended to replace applicable federal, provincial or territorial requirements, but rather to supplement those requirements and assist the wood industry and contractors in implementing fire prevention and loss control measures specifically aimed at construction projects. An expected consequence of implementing appropriate measures should be the ability to obtain the most competitive rates from insurance companies.

The following points have been presented in alphabetical order solely to facilitate the reader's ability to locate a specific item, it does not relate to relative importance.

ACCESS FOR FIREFIGHTING (AFF)

Despite implementation of fire prevention practices and installation of control systems, construction job sites rely heavily on the fire department response to combat fires when they do happen. Thus it is necessary to ensure ease of fire department access.

AFF-1 All sites should be clearly identified, and readily accessible to the responding fire department.

CONSTRUCTION PROCESSES AND PROCEDURES (CPP)

Hazards on a combustible construction project can be addressed well before the first shovel goes in the ground, through careful risk assessment, design and planning. Many decisions, that can improve job site fire safety, can be made early on and incorporated as part of the on-going construction process.

- CPP-1 Coordinate the installation of fire protection equipment (such as standpipes, hose stations, sprinkler systems, alarms) in stages to provide active fire control and suppression in synch with the development of the structure itself.
- CPP-2 Prioritize the installation of fire barriers, separation walls, and fire doors on each floor, as soon as possible, to progress in step with structure development. Fire doors should be installed at the same time as their frames.
- CPP-3 Fire blocking should be installed immediately where necessary, and smaller openings identified, marked and scheduled for fire stopping as soon as the area/section is completed.
- CPP-4 Any non-combustible finishes to be installed, both internal and external, should follow in stages as the project progresses.
- CPP-5 Consider alternate construction materials and methods to reduce fire risk, such as: using 5-ply built-up roof covering instead of single-ply membrane roofs, thus not requiring hot work on the roof; and, using panelized wall and floor assemblies constructed off-site rather than site-built assemblies, thus reducing amount of stored on-site combustibles and construction time.
- CPP-6 Where multiple buildings are involved, stagger the sequence of building construction to create physically separate fire areas, minimum 100 ft. apart, so that there is no concentration of buildings under construction. Where physical space is restrictive, alternative methods should be considered.

CONTROL IGNITION SOURCES (CIS)

This is possibly the most critical of all guidelines for helping prevent fires.

- CIS-1 Establish and enforce “no smoking” rules.
- CIS-2 Implement a site-specific Hot Work Permit System.
- CIS-3 Establish and enforce roofing protocols.
- CIS-4 Establish procedures to control access by, and monitoring of, trades, sub-trades, and one-off contractors.
- CIS-5 No open flame type heaters inside buildings. Establish guidelines for use of temporary heating systems.

CIS-6 Establish guidelines for proper installation and use of electrical services and equipment, both temporary and permanent.

FIRE SAFETY PLAN (FSP)

The need for a fire safety plan appears well understood, however, there is varying interpretation on the extent of formality, how detailed it should be, what should be included, and who should be involved.

FSP-1 A formal written FSP should be prepared prior to construction and a copy provided to the fire department. The plan should include a full-time Fire Safety Officer (FSO).

FSP-2 All trade groups should be trained and required to sign-off that they have read, understood, and will comply with the plan.

FLAMMABLE AND COMBUSTIBLE LIQUIDS, GASES AND HAZARDOUS MATERIALS (FCLG)

Correct identification, storage and handling of flammable and combustible liquids and gases, as well as other hazardous materials, is a critical aspect of fire safety on any construction project.

FCLG-1 Clearly identify of all such hazardous materials (types, quantities, acceptable uses etc.) that are to be part of construction project.

FCLG-2 Develop and designate safe storage areas, including appropriate segregation.

FCLG-3 Develop guideline for safe practices when handling hazardous materials.

HOUSEKEEPING AND WASTE MANAGEMENT (HWM)

Poor housekeeping and unnecessary accumulation of combustible materials has consistently been found to be a significant contributor to, if not a cause of, fires on construction sites.

HWM-1 Provide designated areas and facilities for storage of waste materials.

HWM-2 Prepare guideline on waste handling instructions. No burning.

HWM-3 Maintain necessary clearances between storage of combustible materials and any ignition sources.

HWM-4 Conduct daily clean-up of work sites to remove waste materials and unnecessary combustibles.

MANAGEMENT GUIDELINES (MG)

As has been proven consistently effective in all areas of loss prevention and control, buy-in from senior management is critical. Each project should feature a corporate Commitment To Loss Prevention statement. Research references and loss results have noted the dangers of complacency, which can set in after extended periods (years) without incidents.

- MG-1 Develop a corporate Commitment Statement addressing health and safety, environment, fire protection, and general loss prevention.
- MG-2 Ensure design procedures and policies include inviting input from insurer risk control representatives and submitting substantial drawings for review prior to start of the project.
- MG-3 Ensure that the Commitment Statement is readily accessible, prominently displayed, and disseminated to all staff and trades at the on-set and throughout the term of the project.
- MG-4 Conduct regular self-inspections of the entire construction site, both inside and outside, using a site-specific checklist for reference and maintaining a copy of the inspection results on file at the site.
- MG-5 Create training programs that include fire prevention, security, and general loss prevention in addition to site safety, for all site participants, especially new employees.
- MG-5 Develop, and review prior to each project, a formalized maintenance program for all equipment and machinery used on the jobsite.

MOBILE EQUIPMENT (ME)

A variety of mobile equipment can be found on a job site, some common, some unique depending on project needs. If not used wisely, all have a common potential to expose the job site to unwanted hazards.

- ME-1 Develop protocols for handling, parking, and storing mobile equipment.
- ME-2 Provide guidelines for maintenance of mobile equipment.
- ME-3 Ensure all mobile equipment is equipped with suitable fire protection features.

PRIVATE FIRE PROTECTION AND SAFETY (FP)

Fire protection equipment should be part of the “design” of the project, incorporating temporary measures to be employed during construction, that lead to, or are replaced by, permanent fire protection features as the site becomes occupied.

- FP-1 A water supply analysis should be conducted prior to the development of the project to ensure an adequate water supply is available.
- FP-2 Water mains/connections (which will feed hydrants, sprinklers, and hoses) should be installed, tested and left in service prior to introduction of any combustible elements.
- FP-3 Adequate automatic sprinkler protection should be provided throughout.
- FP-4 Where insufficient public hydrants are provided, yard hydrants should be installed.
- FP-5 Standpipes with fire department connections should be installed inside the building.
- FP-6 Hose stations should be installed, for use both inside and outside the building.
- FP-7 A suitable complement of portable fire extinguishers is required throughout.
- FP-8 Monitored fire alarm systems should be installed in stages, as soon as practical.

PUBLIC FIRE PROTECTION (PFP)

Structure fires in buildings under construction come with a unique set of circumstances that require pre-planned tactics and strategies. Fire protection systems (hydrants, standpipes, sprinkler systems) may not be in place in the early stages, and fires may be well-developed by the time the fire department arrives. As such, the following needs to be addressed:

- PFP-1 Adequate and reliable water supplies combined with well equipped and organized fire department response is required.
- PFP-2 Public water supplies, including public hydrants, tested and verified, should be in place before ground breaking of the job site. Same applies to yard hydrants provided in lieu of public hydrants.
- PFP-3 When the site is remote and an adequate and reliable public water supply is not available, an alternative means of providing the water supply should be established, or means should be found to reduce the exposure.
- PFP-4 Pre-fire planning with the local fire department is a critical step to be taken before any substantial development of the site.

SITE SECURITY (SS)

A variety of measures can be used to establish site security. These can vary significantly from one site to the next, dependent on each site's unique features.

- SS-1 Prior to the start of construction the entire site should be fenced and secured.
- SS-2 Security guard services to be introduced upon initial development of the project. Also, monitored CCTV cameras can be used on larger sites.
- SS-3 Secure the site against arson potential.
- SS-4 Secure the site against intruders.
- SS-5 Secure the site against burglary and theft.
- SS-6 Implement additional measures (such as lighting, eliminating attractive nuisances) where required by Fire Safety Plan.

STORAGE GUIDELINES (STG)

Combustible storage is inherent to construction job sites, and is so commonplace that it is often not addressed as a separate exposure. Carefully controlling the storage of combustible materials on any job site can significantly lessen the fire hazard.

- STG-1 Designated areas should be established for storage of combustible materials, employing accepted standards for clearance, heights, arrangement, etc.
- STG-2 As much as is possible, all combustibles not yet incorporated into the building under construction, should be kept a minimum distance away from buildings, both existing and under construction.

SECTION 10. RECOMMENDATIONS

The steps undertaken in preparation of this report have led to the content for a new CWC Model National Course of Construction (Fire) Best Practice Guide.

Based on the information collected, comparisons made, and analyses conducted, Technical Risk Services (TRS) strongly recommends development of two new, thorough, and detailed guides to serve as best practices with respect to combustible building construction, as follows:

- 1) CWC Model Best Practices Guide – Fire Loss Prevention For Construction Projects of Combustible Construction
- 2) CWC Model Best Practices Guide – Fire Loss Prevention For Post-Occupancy of Buildings of Combustible Construction

CWC Model Best Practices Guide:
Fire Loss Prevention For Construction Projects of Combustible Construction

This guide should cover, as a minimum, the following main topics:

- 1.0 Access for Firefighting
 - 1.1 Clear Identification of Facilities and Resources
 - 1.2 Accessibility Of Site
- 2.0 Construction Processes, Procedures and Stages
 - 2.1 Coordination of Fire Protection Equipment Installation
 - 2.2 Prioritization of Fire Barrier Installations
 - 2.3 Prompt Fire Stopping
 - 2.4 Coordinate Installation of Internal and External Finishes
 - 2.5 Alternate Construction Materials and Methods
 - 2.6 Intra-site Separations for Larger and Multi-Structure Projects
- 3.0 Control Ignition Sources
 - 3.1 No-Smoking Rules
 - 3.2 Hot Work Permit System
 - 3.3 Roofing Protocols
 - 3.4 Contractor Access
 - 3.5 Heaters
 - 3.6 Electrical
- 4.0 Fire Safety Plan
 - 4.1 Formal Written Fire Safety Plan
 - 4.2 Development of an Emergency Response Plan
 - 4.3 Training and Compliance
 - 4.4 Duties of The Fire Safety Officer (FSO)

5.0 Flammable and Combustible Liquids, Gases, and Hazardous Materials

- 5.1 Identification of All Such Materials
- 5.2 Storage and Segregation
- 5.3 Handling Guidelines

6.0 Housekeeping and Waste Management

- 6.1 Designated Facilities for Waste
- 6.2 Storage and Handling Guidelines
- 6.3 Housekeeping Efforts

7.0 Management Guidelines

- 7.1 Corporate Commitment Statement
- 7.2 Insurer Risk Control Involvement
- 7.3 Communication To Workers
- 7.4 Self-Inspections
- 7.5 Training Programs
- 7.6 Preventive Maintenance Programs

8.0 Mobile Equipment

- 8.1 On-Site Use
- 8.2 Maintenance
- 8.3 Fire Protection for Mobile Equipment

9.0 Private Fire Protection and Safety

- 9.1 Water Supply Analysis
- 9.2 Water supply Installation, Public and/or Private
- 9.3 Automatic Sprinkler Protection
- 9.4 Public and Private Fire Hydrants
- 9.5 Standpipes and Fire Department Connections
- 9.6 Hose Stations
- 9.7 Portable Fire Extinguishers
- 9.8 Fire Alarm Systems

10.0 Public Fire Protection

- 10.1 Public Fire Department Response
- 10.2 Public Water Supply
- 10.3 Alternate Resources
- 10.4 Pre-Fire Planning With Local Fire Department

11.0 Site Security

- 11.1 Fencing
- 11.2 Lighting
- 11.3 Security Guard Services
- 11.4 Monitored CCTV Cameras
- 11.5 Security Against Arson
- 11.6 Security Against Intruders
- 11.7 Security Against Burglary and Theft
- 11.8 Additional Measures

12.0 Storage Guidelines

- 12.1 Designated Facilities for Short-Term Storage
- 12.2 Designated Facilities for Long-Term Storage
- 12.3 Storage Guidelines
- 12.4 Mobile Equipment