Assessing Hazards and Risks when Buildings are Under Construction

Introduction

Fires during construction can be even more damaging than a fire occurring in a completed building. This is due to several factors, including but not limited to: fire sprinkler systems might not be fully installed; fire alarms might not yet be installed; adequate fire rated enclosures may not have been provided yet; and fire rated building divisions may not be present. All of these features are designed into a building to function once they are occupied

This condition requires that we understand the concepts of hazard and risk.

Terminology

The terms hazard and risk are often used interchangeably. But they are not the same thing.

Reviewing dictionaries on these two terms often results in some confusion. In actuality, the term hazard can be used for as mundane a topic as a location on a golf course where it is difficult to make effective shots. The more commonplace use of the word hazard has to do with workplace health and safety.

Therefore the purpose of this paper is to provide a definition of what these two terms mean in the context of fire safety for buildings under construction.

The term ***hazard*** is used to describe something that can cause potential damage, harm injury, fatality or adverse health effects under specific conditions that exist at work.

A ***risk*** on the other hand is the chance or probability that an individual we will be injured or experience an adverse health effect if they are exposed to that hazardous condition. Risk also applies to situations such as property loss, including fires.

So, if a hazard can cause harm or adverse effects to individuals that a risk is the probability that it is likely to occur.

Workplace hazards come about because of activity in a given set of circumstances. The following table illustrates the examples that might be generated on a worksite regarding fire hazards.

Workplace Hazards		
The Hazard	*The specific Act*	*Example of Harm*
Use of Tools	Operating a saw	Fire and Injury
Use of Flammable liquids	Spill or leak of liquids	Fire
Source of Ignition	Operating Electrical Equipment	Fire and Injury
Process	Cutting or Welding	Fire
Practice	Operating Heaters	Fire

In essence, the items we have listed here do not represent the entire range of hazards. If the chart were to include just those that can result in injury, it would expand greatly. For purposes of this document we

are looking at ***fires*** in buildings under construction. Therefore, we will not include those that can cause injury.

Fire hazards, in general, are a direct result of fuels being exposed to sufficient heat to cause ignition. Uncontrolled energy such as open flames, sparks, electrical energy and even chemical reactions that are allowed to exist in an area where fuels are not properly controlled is the recipe for a fire hazard.

There are many factors that affect both risk and hazard. Among these are the ideas that the more often a person is placed in a scenario where a ignition of fuels can occur, the more likely there will be an adverse outcome resulting in a fire.

At this point is important to realize that there is a range of outcomes that can result from a hazard. For example, a small fire that is controlled by fire extinguisher may not result in much injury to personnel or damage to the structure, but a fire it gets out of control and requires extensive efforts to extinguish can destroy property and lives fairly quickly.

Risk Theory

The idea that you can identify hazards and can determine risk implies that there are a considerable number of possibilities that can happen. This opens up the possibility of two dimensions that must be considered. They are: frequency and consequence.

What is Risk Assessment?

Using these two definitions (frequency and consequence) risk assessment is the process by which an individual identifies what hazards they are exposed to, analyzes or assesses the probability that something is going to occur; and determines of an appropriate method to mitigate or control the hazard.

But let us use a real world example from a construction site. We all know that the assembly of a structure involves the use of combustible materials. Wood forms for pouring concrete, wood scaffolding, paper, plastic, combustible and flammable liquids and gases, as well as other materials are present in large amounts. We also know that tools will be used on these materials that produce heat, or can release energy that can ignite materials. We know that there is a requirement in many cases to perform hot work to assemble metal objects. Open flames are sometimes involved.

Risk assessment consists of being aware of the relationship between materials and ignition sources and doing everything you can to prevent their combination. The goal of risk assessment to remove all hazards or reduce the level of risk by adding precautionary or control measures through human intervention.

Risk assessment can be done by an individual or by a team. Notably, the risk assessment is done by one individual they must have tremendous working knowledge of worksite. When you introduce a team to the risk assessment process you improve the synergy of observations and actions. What we mean by synergy is that a group of people will almost always perform better assessment because they feed off

each other's ideas and observations. Supervisory or management personnel should work with the team for purposes of accountability.

Risk Reduction or Mitigation

The term for a person or organization attention to detail in removing hazards is called risk reduction or risk mitigation.

The following are considered best management practices in reducing risks.

Keeping adequate separation between combustibles and potential ignition sources is one of the easiest ways to minimize the chances of a fire at construction sites. This is often thought of as housekeeping, but it is also risk reduction!

One of the most important ways to control ignition sources would be to use and enforce a hot work "permit" system.

Ensure that all temporary wiring and heating equipment is turned off when personnel are not present

Do not allow ANY smoking near combustibles.

Properly dispose of any oil-soaked rags, especially linseed oil.

Good housekeeping should include, but not be limited to: cleaning and properly discarding of any packaging; storing combustibles away from active work areas where ignition sources could be present; and regularly cleaning and removing any combustible, shavings, sawdust or scrap wood products that are produced.

Do Risks and Hazards Change over phases of a project?

Yes, they do. At different stages of construction different conditions will exist. The effects of a potential fire can be minimized by coordinating the order in which certain stages of construction are completed. Obviously materials had to be brought on site be utilized by the labor force. Some will come packaged, some will be bundled. Others will be stacked or assembled in staging areas. The site fire prevention manager and the labor force utilizing these materials need to be sensitive to these changes. Moreover, some of these changes could affect the local fire department. An excellent example might be storage that interferes with access to the site, or reduces availability of water supply outlets. It is for this reason that all parties remain alert to the consequences of these changes

How do you Rank or Prioritize the Risk?

Ranking for prioritizing hazards is one way to determine the level of seriousness of the hazard. Once you have observed a condition you should be able to place it in a context of its seriousness. There are many

factors that enter into the assigning a priority to hazards. Many are site-specific. Others vary according to the stage of construction. In either case ranking and prioritizing risk takes into the probability and consequence of events. This relationship has been charted as follows:

This known as the "Risk Model"

The left-hand axis of this chart is the probability is something is likely to occur. The bottom row of this model is the potential consequence of what happens if it does occur

P **R** **O** **B** **A**	**High probability** **Low consequence** **Probably going to happen, but it does not cause much damage.**	**High probability** **High consequence** **Probably going to happen and it will cause a lot of harm**
L **I** **T** **Y**	**Low probability** **Low consequence** **Never going to happen, and if it does not one cares**	**Low probability** **High consequence** **May not happen very often, but when it does the results are catastrophic.**
	C O N S E Q U E N C E S	

When it comes to talking about probability there is a chart for that also. The British Standard organization has produced a table that illustrates this nicely.

Risk assessment probabilities and severity of harm			
Likelihood of harm	**Severity of harm**		
	Slight harm	Moderate harm	Extreme harm
Very unlikely	Very low risk	Very low risk	High risk
Unlikely	Very low risk	Medium risk	Very high risk
Likely	Low risk	High risk	Very high risk
Very likely	Low risk	Very high risk	Very high risk

This chart is supported by the definitions of these terms: **very likely** means that a person is typically going to experience this type of an event once every six months.

Likely means that a person may not experience this is except about once every five years.

Unlikely means that they would typically only experience this type of it in once during their working lifetime.

And **very unlikely** means that you have less than a 1% chance of an individual having an experience of this nature during their working lifetime.

One interpretation of this chart is that individuals are likely to have slight or moderate harm occur to them on a fairly frequent basis, but a really serious incident is not likely to happen very often. The analysis of that observation is that people do not expect extreme harm to come to them frequently. Depending upon their attitude toward safety the behavior of an individual towards removing hazards really begins with their understanding that severe events sometimes have relatively insignificant causes and they must be prepared.

This results in a need to prioritize risk and hazard using some form of definition that is separate from the idea of frequency and consequence. The following definitions might be used in defining how priorities can be identified

Very Low- these are risks that are considered to be perfectly acceptable. No further action is required except to comply with the provisions of fire, building codes and NFPA standards.

Low - there are no additional controls required unless they can be implemented easily. Easily means limited time money and effort is required. To reduce these risks would be a low priority. They would still be expected to be in compliance with the provisions of fire, building codes and NFPA standards

Medium - this is when a set of conditions exists where risk reduction measures should be taken into account. Medium priority means attention to detail. The use of specific tools, or processes, such as salamanders and heating appliances might qualify as a medium risk. Risk reduction measures should be specific rather than generalized

High - this is a situation where substantial efforts have to be made to reduce risk. These risks should be looked at with respect to win the condition begins and when it will end. This is the level of risk where there is a strong need for personal commitment to compliance with fire codes, building codes and NFPA standards.

Very High - these risks are simply unacceptable. They are conditions in which work activity may have to be halted or altered until adequate risk mitigation measures are implemented this type of risk may result in work activity being prohibited.

Once the person assigned to do risk assessment has completed this profile should be able to rank the various elements of risk into groupings that can be used to guide day-to-day activities.

What kinds of actions are required?

After the risk assessment has been complete, the responsible party should detail the process used to assess the risk, identify any deficiencies that need to be overcome**.** This could also involve the use of root causes.

Safety consultants are very familiar with the concept of root causes. This is information that comes from studying past events. A classic example of this concept is found in the aviation industry. Many pilots continue to make the same mistakes over and over again. Those who study aviation accidents will tell

you that there will be no substantially improvements in incidents and violations or the lapses in good judgment, until there is recognition of the human factors contributing to incidents. Incidents in aviation are examined by the National Transportation Safety Board (NTSB). Incidents that result in death or injury in the construction industry are examined by Occupational Safety and Health Agency (OSHA). If a firefighter loses their life in these kinds of situations then an investigation may be conducted by the National Institute of Occupational Health (NIOSH).

Therefore, risk assessment should include reviewing past accidents and statistics to put safety practices into context. Identify and list the root causes you are trying to eliminate!

It takes substantial time and effort to try to mine all of the available databases. However there are a few documents that are readily available to assist in guiding risk assessment. These include reports done by the National Fire Protection Association (NFPA) and the United States Fire Administration (USFA).

Studying incidents can help in the development of risk reduction strategies. A proactive approach to safety requires that no matter how much experience a person has on the job that they respect the data that comes from past review of incidents. Investing in the time to learn from other people's past errors and misfortunes can substantially increase the level of awareness in the risk assessment process.

What about Temporary Solutions?

The building is likely to be equipped with sprinkler protection. However, this is usually not practical, especially in places where freezing conditions can occur. Also, the layout of interior walls and other construction features in the building will determine the location of sprinklers. Additionally, sprinklers may be needed under or in some of the equipment provided. Thus, while fire rated division walls and sprinkler protection should be provided as soon as possible they may or may not be operational until the building is finalized. A general "rule of thumb" is that combustibles should not be introduced in the building until sprinkler protection for the area is operational.

Once sprinkler systems and/or standpipes are installed, the fire protection control valves should be secured with locks to help deter tampering with these systems. For example, construction workers often attempt to use water from a standpipe. This valve could be left open if a water supply is not actively present. When a water supply is activated, this could result in water spilling into the space. This could cause water damage within the space, and could deplete the water supply so that adequate water is not available for fire protection.

Additionally, fire protection impairment procedures should be followed. A fire protection system may be put into service but then impaired for some additional work. Without proper impairment procedures, this system could be left out of service. This would result in adequate water not being available for fire protection. Part of this impairment system should include making sure that as much of the fire protection system is left in service as possible. An example of this can be found in the process of remodeling floors of a high-rise building. Floors that are not affected should be left in service, and as much of the floor that is affected should be left in service as well.

Supplying temporary systems may also help to minimize the damage in the event of a fire. For example, temporary sprinklers could be added to sprinkler piping at the ceiling until the full system can be installed. Stand-pipe systems can be added as floors for high-rise buildings are added. Also, a temporary

water supply could feed water to sprinklers and or stand-pipes until the full water supply can be provided. Temporary fire detection systems can also help to alert the fire department of a fire.

Security

The more valuable the property the more security should be enhanced. The potential for vandalism or spite fires such as arson can be minimized by providing security to the construction site.

This can be accomplished by use of deterrents such as fencing, lights, security guards, motion detection alarms and video cameras.

Prompt Response

A prompt and adequate fire department response is key to minimizing damage in the event of an actual fire, especially if the internal protection systems, like sprinklers are not in service. Keeping the fire department updated with the status of the project will be of extreme value is an incident occurs. The conditions on a construction site change frequently. It will help to speed their response if they are kept informed. Making sure that the fire department has access and water supply on the site during all stages of the project will help firefighters in gaining control of an incident. This includes providing stairwells as soon as possible in multi-storied buildings and allowing access room for their apparatus outside.

All fires should be reported to the local fire authority. Fires that are put out by employees have been known to "rekindle" and destroy projects later in the night. ALL Fires should be reported and responded to by fire department personnel.

Summary

The establishment and maintenance of best possible conditions of work is, no doubt, the responsibility of management. But, it is also necessary that each employee follows prescribed safe methods of work. Have you ever heard the term "taking a risk?" That is when a person decides to do something that can cause someone to become harmed.

All employees should take reasonable care of the health and safety of themselves, of their fellow employees, and other persons who may be affected by the employee's actions at work.
With this in mind, employees should be fire and safety conscious and:

Report – all potential hazards,
Observe- all safety rules, procedures and codes of practice.
Study past incidents and use the lessons learned
And use-with all reasonable care the tools, equipment, safety equipment and personal protective equipment provided by the company.

Each construction project will have its own specific needs. Daily practices are very important in controlling the hazards on a site. Keeping combustibles away from ignition sources, providing adequate protection and detection as soon as possible, and working to ensure a prompt fire department response will all help to minimize the chances of a fire that could cause extensive damage at your construction site.

For additional research see:

Risk Management - Why and How, International Risk Management Institute, Inc. Dallas Texas, www.IRMA.com

All Hazards Risk Assessment Methodology Guidelines, 2012-2013, Public Safety Canada.

http://www.publicsafety.gc.ca/cnt/rsrcs/pblctns/ll-hzrds-ssssmnt/ll-hzrds-ssssmnt-eng.pdf

Quiz

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