



Identification and Analysis of Safety Hazards on the Virtual Construction Worksite

- A Facilitator Guide



CONTENTS

01 INTRODUCTION	4
02 USAGE	5
03 MODULE 1: SLIPS, TRIPS AND FALLS	6
LEARNING OUTCOMES	
DISCUSSION QUESTIONS	
04 MODULE 2: STRUCK BY, CAUGHT BETWEEN	7
LEARNING OUTCOMES	
DISCUSSION QUESTIONS	8
05 MODULE 3: FIRE, EXPLOSION, TOXICITY AND ASPHYXIATION	9
LEARNING OUTCOMES	
DISCUSSION QUESTIONS	10
06 MODULE 4: ERGONOMICS, ELEMENTS, AND NOISE	11
LEARNING OUTCOMES	
DISCUSSION QUESTIONS	12
07 MODULE 5: ELECTROCUTION	13
LEARNING OUTCOMES	
DISCUSSION QUESTIONS	14

INTRODUCTION

The International Brotherhood of Electrical Workers, the Piping Industry Technical College UA Local 254, and the Boilermakers Local 555 set out to change safe work practices of new entrants in construction by identifying, controlling and reporting incidents of safety hazards on the worksite. There are 5 modules developed for this hazard awareness resource that uses the latest virtual reality technology.



THE FIVE MODULES INCLUDE THE FOLLOWING HAZARDS:

1. Slips, Trips and Falls
2. Struck by, caught between
3. Fire, explosion, toxicity and asphyxiation
4. Ergonomics, elements, noise
5. Electrocutation

LEARNING OUTCOMES:

- ✓ an increased awareness of safety hazards
- ✓ access to innovative safety tools by organizations who support youth transition to work in construction
- ✓ improved safe work practices of youth working on construction sites

BACKGROUND

The International Brotherhood of Electrical Workers (IBEW) in partnership with Boilermakers, the Piping Industry Technical College of Manitoba/UA Local 254 and the Construction Safety Association of Manitoba developed a series of virtual reality resources that will allow youth and new entrants in construction to spot hazards, assess risk and develop a plan to prevent injury. With the use of 360-degree imagery, youth will virtually walk through a worksite. They will look up, down and around the site using oculus lenses. They will spot hazards, assess the risks and as a result, they will be able to explain how to work more safety on a construction site.

When youth focus on the icon they will learn about each hazard and what needs to be done to avoid injury. This is an

interactive way to teach safety and one that is as close to real life situations without actually being there. It is not enough for youth to hear about the hazards on the worksite. They have to see it and experience what it looks and feels like. This will provide another tool for youth to learn about safety and one that is completely in line with the way youth learn today.

It is important for youth to see hazards from trades outside of their own scope. This is because trades work collaboratively on the same site and youth may start in one trade and switch to another trade over time. Exposure to all hazards is of greatest importance. This will not replace current safety training only serve to supplement and enhance the way safety is taught to our youth and new entrants.

Note: This application is intended as an awareness application and does not replace safety training at local safety associations or on the job training. Content is specific to the Province of Manitoba and uses examples that may not apply to all situations.

USAGE

The application is intended to be used in 2 ways:

1. **In classroom training** – Deployed to students in the class room using either the student's own smart phone or supplied devices
2. **Offsite training** – Using loaned devices or the student's own device.

Once launched the smart phone should be placed inside a Google Cardboard capable viewer. The application does not work without a virtual reality display.

Virtual Reality may cause dizziness for approximately 30% of students. It is advised the facilitator takes time to discuss each module to allow for a break between each VR experience. In addition, the discussion time will allow for reflection and application of new learning. Guiding questions are provided for each module.

ACKNOWLEDGEMENTS

ADVISORY COMMITTEE MEMBERS

We would like to acknowledge the contributions of the advisory committee who guided the direction of the project including:

Chris Taran, International Brotherhood of Electrical Workers (IBEW) Project Lead

Steve Ducharme, Piping Industry Technical College, UA Local 254

Craig Beauchamp, Boilermakers, Local 555

Mike Jones, Construction Safety Association of Manitoba (CSAM)

Doug McKay, IBEW

Peter Malagus, Safe Work Manitoba

WORKING GROUP MEMBERS

We would like to recognize the contribution of the subject matter experts who spent countless hours compiling information, participating in shoots on the worksites and validating content.

Ted Stark, Boilermakers

Rob Fletcher, ABCO, IBEW

Craig Gertley, Piping Industry Technical College, UA Local 254

Chad Wiebe, Piping Industry Technical College, UA Local 254

Jason Rice, McCaine Electric, IBEW

Matt Lothian, CSAM

Steve Ducharme, Piping Industry Technical College, UA Local 254

Craig Beauchamp, Boilermakers, Local 555

Marc Lagasse, Boilermakers, Local 555

Doug McKay, IBEW

This project was supported by a grant from the Research and Workplace Innovation Program of the Workers Compensation Board of Manitoba



MODULE 1 SLIPS, TRIPS AND FALLS

LEARNING OUTCOMES

Students will be able to identify, control and report incidents relating to slips, trips and falls safety hazards

VIRTUAL REALITY CONTENT

- There will be a variety of different signage on site. It is important that you are aware of the signs, what they mean. If you don't understand the sign, ask your supervisor for direction.,
- Safety is a language we can all speak.,
- On this spring morning the water on the surface can be frozen in the morning, and melt throughout the day; controlling this can be a difficult task.,
- You must control transition of uneven floors; for example, the entrance to a building
- You want a mechanical means of moving materials whenever possible. For example, use a pallet jack to move this material.,
- Avoid working in poorly lit areas by using either temporary or task lighting.,
- Cell phones are a major distraction on a busy job site; leave it behind or off during working hours.,
- When training a new person with any type of language barrier make sure they repeat the directions back to you. It is important that everybody understands the risks.
- The potential for slips, trips, and falls is significantly higher in poor lighting conditions.,
- When you are carrying materials, make sure you know the path first. There is always the potential for other material, cords, and, debris in the way. ,
- Working at heights can be extremely dangerous, whether you are working at 10 feet or 1000 feet, make sure you are tied off, wearing your PPE, and are aware of your surroundings.,
- Poor lighting can make it difficult to work in a cluttered space.,
- Ensure you always have sand on site to control freeze-thaw situations with water on the job site.,

DISCUSSION QUESTIONS

- ❓ What types of signage will you encounter on a construction site? Discuss the meaning of signs on the construction site.
- ❓ What are some of the hazards associated with slips, trips and falls we need to be aware of? How can these be controlled?
- ❓ What does it mean when they say, safety is a language we can all speak?
- ❓ Are you aware of any incidents relating to slips, trips and falls? How could these incidents have been avoided?

MODULE 2 STRUCK BY, CAUGHT BETWEEN

LEARNING OUTCOMES

Students will be able to:

Identify, control and report incidents relating to struck by, caught between safety hazards



VIRTUAL REALITY CONTENT

- Should we put this in each to be consistent? Welcome to module 2: struck by, caught between. This module explores a commercial job site where you will identify hazards and learn about how you can work safer on the job.,
- Always know where overhead hoisting and rigging is taking place to avoid the possibility of falling objects.,
- Strong winds can cause flying debris to fall off roofs like this bundle of foam; ensure materials are properly secured.,
- Weather conditions will determine if roofing cranes are operable or not.,
- You must be properly trained before operating any machinery on a job site.,
- Be aware of overhead falling materials,
- Working around machinery can be dangerous; ensure you are wearing proper reflective gear and attempt to make eye contact with the operator whenever possible.,
- Always be aware of potential pinch points when working with machinery,
- Operators may have limited visibility; pay attention to backup sirens.,
- Wind can blow through job sites and cause debris, materials, and equipment to blow over.,
- Be aware of trip hazards such as cords. They should be lifted off the ground to avoid trips and injuries. This eliminates a lot of problems.,
- If a ladder falls on cords, there is the potential for shocks if the cord is cut.,
- Be aware of unfinished ceilings during transition seasons. Frost can be on the bottom of a steel roof and ice or water can fall from the roof,
- Be aware of uneven grounds and tip points. When you are driving on uneven ground, a person could be thrown from the machine,
- This cord is laying in the water with debris over top of it, there are multiple hazards present.,
- A subfloor is installed for HVAC installation,
- Be aware of red tape. Red tape is used as a warning of a hazard. Where is the hazard and why is it on the floor? Is the hazard tape still required?
- Yellow tape means caution, red tape means stay away from that area. There is a note to identify the hazard.,
- Under certain weather conditions, water may freeze and cause slippage. Free standing water needs to be cleaned up,
- Metal framing beams need to be braced to prevent from rolling,
- Wheels on cabinets, can roll over feet. Wheel locks should be set in place,
- Be aware of existing tile ceilings. You can find everything and anything on top of the tiles such as old

chunks of concrete, pipe, old wiring, cables, and dead animals,

- When cutting above your head, you have very little control. Overhead cutting could cause a worker to be struck. What's keeping the blade from binding?
- Here is a reel of wire that has no chocks. The wire is the????unclear second level in pile
- Watch your fingers when laying down reels
- Reels are all different sizes and some of them are full and some empty. Make sure half reels are at the top and full reels at the bottom. The full reels are more stable.,
- You should never horse around on machinery. Always be aware of where your tools are because a falling tool can be dangerous.,
- Stray cords on the ground can be a hazard if machinery drives over them. Keep cords up and out of the way.,
- Long materials can be dangerous to carry. Be aware of your surroundings, and be aware of others who are carrying materials to avoid being hurt.,
- These wheels are not locked, which means this is not secure and safe!
- This machine is missing the kick plate; this can cause falling debris.,
- A length of pipe is being used to lift materials which is unsafe.,
- When operating a scissor lift be aware of your height; you can strike your head on objects if you are working too high up for the environment.,
- Leaving tools up top on the vents, causes a future fall hazard. The cut off lengths (sheet metal) need to be removed,
- Material leaning against the wall should always be tied off.,
- Here is material laying on the floor. Why is it out in the middle of everything? This is a potential hazard for the scissor lift operator.,
- Safety cable is running along the edge. Wire rope can have steel chards coming off it or it could be slippery. It needs to be tight. If it has a sag point, then it is not safe, and needs red tape or flags along the rail,
- Watch floors when there is risk of freezing water or where snow can blow in,
- Be aware of light materials that can blow off the roof,

DISCUSSION QUESTIONS

? Identify situations where a worker could be struck by or caught between something on a worksite.

? When is red and yellow tape used on a job site?

? What incidents are you aware of that resulted in a worker being struck by or caught between? How could these incidents have been prevented?

MODULE 3 FIRE, EXPLOSION, TOXICITY AND ASPHYXIATION

LEARNING OUTCOMES

Students will be able to:

Identify, control and report incidents relating to explosion, toxicity and asphyxiation safety hazards



VIRTUAL REALITY CONTENT

FIRE

- Be trained in the use of a fire extinguisher,
- Fire extinguishers should be properly rated for the work being performed. A – Combustibles (paper), B – Flammable liquids (gas), C – Electrical, D – Chemicals,
- You should be able to identify what started the fire,
- If you remove ignition, fuel source (combustible material), or oxygen there is no fire.,
- Do not fight fires you're not properly trained,
- If a fire cannot be put out in the first 30 seconds, vacate (evacuate) and report,

TOXICITY

- When dealing with controlled products, reference the appropriate MSDS sections for exposures.,
- An employer must provide emergency washing facilities at a workplace where hazardous, irritating or corrosive substances are used.,
- An employer must ensure that a worker who may be required to use emergency washing equipment is trained in the use of the equipment in accordance with the requirements of ANSI Standard Z358.1-04, American National Standard for Emergency Eyewash and Shower Equipment; and the equipment manufacturer's specifications.,

EXPLOSION

- Compressed gasses should be stored according to the fire code. Examples include: (Spray paints, oxygen, spay foams),.
- You should always be aware of location of fuel sources,
- Explosive areas can cause a fire. Flammable gasses, somebody walking by with flammable clothing, or something in the air or vicinity could cause an explosion or fire.
- Know the density of the gas at your work location. Some gasses (like propane) are heavier than air,
- Appropriate PPE may include a dust mask, respirator, goggles / glasses, shields, gloves, hazmat suit, and/or an air monitoring system.,
- Carbon monoxide is heavier than air,

ASPHYXIATION

- Make sure you have proper ventilation and air movement,
- Nitrogen is used for purging lines for eliminating excess gas,
- Make sure you have proper ventilation and air movement,
- Asphyxiation can happen gradually, you may not know that you are running out of oxygen,
- Welding or cutting (galvanized steel) can cause toxic smoke. Wear respirators and have proper ventilation,
- Cad welding creates toxicity and possible asphyxiation and if there is not proper ventilation, there is potential for fire,
- Suffocation is the state or process of being deprived of oxygen, which can result in unconsciousness or death.,

DISCUSSION QUESTIONS

- | | |
|--|--|
|  Name some controlled products used on a construction site. What are the potential hazards? |  What is the appropriate PPE for an environment with controlled products? |
|  What are the 3 required elements for a fire? |  What do you do in the case of a fire? |
-

MODULE 4

ERGONOMICS, ELEMENTS, AND NOISE

LEARNING OUTCOMES

Students will be able to:

Identify, control and report incidents relating to ergonomics, elements and noise safety hazards



VIRTUAL REALITY CONTENT

ERGONOMICS

- Ergonomics is the study of people's efficiency in their working environment. Issues can be caused by lifting heavy/awkward objects, carrying heavy/awkward objects, installation of heavy/awkward objects, repetitive motion, entering awkward spaces, constant ladder use, repetitive power tool use, long periods of time on your feet with improper footwear, or improper shoveling techniques
- Rolling paint can cause back strain and/or shoulder strain, if poor ergonomics are used,.
- Hammer drills or jack hammers can cause vibration which can result in a **Muscular Skeletal Injury (MSI)**.,
- While working take 2 – 5-minute breaks to avoid MSIs,.
- Pre-shift stretching helps reduce the risk on an MSI,.
- While standing at your workstation, you can use anti fatigue matts,.
- Don't grab the tool too tightly, allow the tool to do the work to avoid an MSI,.
- Shoveling can result in an MSI,.
- Holding tools incorrectly can bypass the fatigue relief,.
- If using a power tool with vibration and it is used incorrectly it could result in an MSI,.

ELEMENTS

- Be aware of elements that may affect your safety. These include the spring and fall freeze, thawing that creates slippery conditions, cold and hot extreme temperatures, rain and snow, ice, wind, and lightening,.
- Working over waterways result in dangers relating to the waves and current and water temperatures,.
- Make sure you are dressing appropriately for the work conditions, layer appropriately,.
- Watch out for insects such as mosquitoes and wasps; be aware of people's allergies,.
- Make sure you are well hydrated while working as improper hydration can cause cramping or injury,.

NOISE

- If a worker is likely to be exposed to noise in a workplace that exceeds 80 dBA Lex but does not exceed 85 dBA Lex, the employer must (a) inform a worker about the hazards of the level of noise; and (b) on the request of the worker, provide him or her with (i) a hearing protector that complies with CAN/CSA Standard-Z94.2-02, Hearing Protection Devices — Performance, Selection, Care, and Use, and (ii) information about the selection, use and care of the hearing protector,.
- If you cannot be heard at a normal conversation level and distance because of the ambient sound around you, it is louder than 85 dB,
- Be aware of the noise of power tools, hydraulic tools, hand tools, mobile equipment, large or industrial fans, and onsite equipment ie. mechanical rooms. Types of hearing loss, both long term and acute hearing loss is due to an explosion or high dB,.
- Working in an enclosed area may result in higher decibels. For example, grinding will be a lot louder because of echoing,.
- Clean your hearing protection, clean your safety glasses and replace PPE as needed to make sure its effective. ,
- An employer must post a warning sign indicating that any person entering the workplace or work area risks exposure to a noise level that is harmful to hearing at the entrance to any workplace or work area where the noise level is more than 85 dBA,
- When it is not reasonably practicable to implement sound control measures, or the sound control measures implemented by an employer do not reduce the worker's noise exposure to 85 dBA Lex or less, an employer must at the employer's expense, provide the worker with the following audiometric tests: (i) an initial baseline test as soon as is reasonably practicable but not later than 70 days after the worker is initially exposed to that noise level, (ii) a further test at least once every year after the initial baseline test,.
- Most commercial electricians will have hearing loss in one ear or the other from hammer drilling, chiseling concrete, or another repetitive noisy task,

DISCUSSION QUESTIONS



What are hazards associated with waterways?



What hazards are associated with exposure to the elements? How do you control them?



Give examples of ergonomic injuries. How can these be prevented?



At your workplace, what noise hazards exist and how do you control them?

MODULE 5 ELECTROCUTION

LEARNING OUTCOMES

Students will be able to:

Identify, control and report incidents relating to electrocution safety hazards



VIRTUAL REALITY CONTENT

- Warnings and signs with the use of barricades can be useful in preventing access to a dangerous area.,
- A safety watch person might also be posted to warn of danger of electrical contact,
- Arc flash sign,
- Arc flash and shock training may be required.,
- Signs should be posted and clean up personal should be instructed that conductive cleaning materials should not be used without extreme caution around electrical equipment,
- Ensure all switch gear has been properly locked and tagged by all the different trades that are working on that specific piece of equipment.,
- An example of equipment that could have multiple trades working on it is a motor.,
- All workers should have their personal locks attached to the equipment they are currently working on.,
- You should only be locked out on the equipment that you are currently working on.,
- Locking out prevents accidents caused by rotating equipment or energized equipment while they are being worked on.,
- You must always remove your lock when done working on the equipment for the day or when the job is complete.,
- Workers should be alert and not impaired by fatigue, sickness, or for any other reason,
- Workers need to complete tasks in well-lit areas which does not impair vision of live circuits.,
- Workers should not be wearing conductive articles of clothing or wearing jewelry such as watches, bracelets or necklaces,
- Insulated tools and personal protective wear should always be in 100% condition,
- Always inspect PPE and tools for wear and tear, defects, and damage before every work assignment.,
- Any defect will render your tool or PPE unusable until it is repaired or replaced.,
- You should never be wearing flammable clothing, Try to wear cotton based clothing. Synthetic clothing can melt to your skin.,
- Contact lenses cannot be used on the job site, they can become fused to your eye.,
- Only completely qualified and trained electricians familiar with the work assignment shall be allowed to work on live circuits or equipment.,
- Personal protection is used including insulated tools,
- When working in an extremely hazardous electrical situation, there should be two or more people with at least one posted as a safety watch.,
- Refer to rule 2-306 in the Canadian Electrical Code for information regarding shock and arc flash protection,

- Arc flash or shock is caused when a worker touches a live wire or a live wire comes in contact with another live conductor or ground.,
- Always ensure you are using your PPE when on the job site.,
- Never mix water with electricity. Wearing wet gloves can cause a shock.,
- Portable ladders that are metal or have dangerous conductive parts (wooden ladders) cannot be used near or while working on exposed energized circuits.,
- Protective barriers and shields shall be used to insulate workers from accidental contact with live circuits.,
- Doors, panels, man-entry gates to confined spaces housing exposed electrical circuitry shall be secured from swinging into the worker while working in the enclosure.,
- Dielectric (insulated) tools prevent electrocution, shock, or arc flash.,

DISCUSSION QUESTIONS



When is arc flash or shock caused?



What are dangers associated with electricity?



What advice would you give to workers who are near live circuits or equipment?



**MANITOBA
CONSTRUCTION
SECTOR COUNCIL**

1000 Waverley Street
Winnipeg, Manitoba R3T 0P3
tel 204.272.5091
www.mbcsc.com