



Analysis of Incident and Accident Prevention in Construction Industries

S. Asrafali¹, J. Gunasekaran M.E²

M.E Student (M.E Industrial Safety Engineering)¹, Assistant Professor²
Department of Mechanical Engineering
Cauvery College of Engineering and Technology, Trichy, India

Abstract:

In construction industries play a vital role in the world. Most of the products are heavy civil infrastructure. In most of the project workmen i.e (welder, carpenter, fitter, plumber, helper, supervisor etc) play vital role in constructing infrastructure. In this project accident/incident is most important lagging factor for the project performances. How this accidents are happening at project sites. And what are the factors are affecting for the accident/incident, there are three major factor which affecting project EHS performance i) human factor ii) physical condition iii) management factors and analysis the incident happened at multiple construction industries. Now EHS performance (Accident / Incident) ratio shall reduce by implementing effective EHS risk management system. a) Risk assessment shall be prepared by the risk management by team. b) Safe work methods need to be preparing 7 days prior to start the work. c) Pre start verifications briefing shall be given to work force prior to start the work. d) Training shall be given to employees about the EHS Risk management system. e) By tracking system to be followed if any unsafe condition and unsafe act inspection not complied shall be feed to the system and compliances shall be track using java software. I have been taken CMRL projects as a model for the project. CHENNAI METRO RAIL has two corridor they are corridor 1, corridor 2 corridor 1 is elevated corridor 2 is underground. I have been underground corridor 2 package BW.UG.03 (L&T Construction) project value is 640 core. Project date 31st july 2017, projected started Dec 2015.

Keywords: construction industries, accident/incident, lagging factor, EHS performance, human factor, physical condition, management factors

1. INTRODUCTION

Development of safety for personnel in construction environment is recognized as a major factor for tranquility of staff and should be adhered precisely in accordance safety regulations. Despite the mechanization, the construction industry is still based on labor intensive, while working environments are often changing and include several different parties. The construction workers are one of the most vulnerable members in a project and are faced with a wide variety of hazards during their work. A common approach for prevention of construction accident is to predict the upcoming event under given circumstances. The accuracy of such predictions is based on knowledge about past accidents. It has been proved that the main reasons for accidents in the construction industry are resulted from the unique nature of the industry, human behavior, difficult work-site conditions, and poor safety management which result in unsafe work methods and procedures. The construction engineers and projects managers should be fully aware of hazards and prepared to deal with accidents when they occur. They should apply proper investigations and reporting procedures afterwards because the probability and severity of accidents in construction are higher in compare with other industries. From another aspect, accidents not only cause horrible human disasters but also create substantial economic losses. These financial losses are due to the impact of accidents and damages on plant equipment and workers. Moreover, there is also a loss of productive work time until the normal site working environment and morale return to the initial state. Hazard is defined as potential situation that may cause unintentional injuries or deaths to people, or damage to, or loss of an item or belongings. Therefore the estimation of the

safety level at construction sites can be applied by specifying all on-site hazardous elements. Therefore, Safety performance of each element should then be studied and measured by evaluating the relevant on-site hazard factors. By reducing the potential hazard of elements, its safety performance improves. On the other hand, safety development in the construction industry occurs only when all workers in the operation of construction sites change their behavior, respect to regulations and try to improve safety level in their personal activities. Moreover, the management support to the workers is also very important in providing the best solution for the safety related problems. The main purpose of this paper is to identify main factors which contribute to safety development and provides a continuous approach to reduce risk and potential hazard of elements by six stages which will be discussed later. For the purpose of this study, at first the causes of accident are explained from literature. The second part describes the eight factors influencing safety performance level in construction project and finally an applicable approach is discussed to obtain safer workplace.

1.1 SAFETY PROCEDURE AS PER CODES AND STANDARDS

Management and planning is one way to avoid unplanned events. Since accidents are unplanned events, an effective safety management can help avoid job injuries. Safety management must be through, and it must be applicable to all aspects of the job, from the estimating phase of the project until the last worker has left the premise at the completion of the project. All parties to a construction project must be included in some way in the safety program every party is responsible. The construction industry continues to be one of the most physically demanding and dangerous industries in the

India. The Construction activities in developing countries, such as Pakistan, China and India, are more labour intensive than in the developed areas of the globe, involving 2.5-10 times as many workers per activity. Typically workers tend to be unskilled and migrate in a group, with or without their families, throughout the country in search of employment. In fact, they are usually divided into various factions. Communication problems related to difference in language, relation and culture tend to inhibit safety on the work site. Construction safety in India is still in its early years because safety laws are not strictly enforced. The contractors ignore basic safety rules and regulations. Although, to improve working conditions, the government has enacted specific legislation like the Minimum Wages Act, the Workmen's Compensation Act of 1923 (modified in 1962), and the Contract Labour (Regulation and Abolition) Act of 1970, very little of these are put into practice. National Building Code of India 2005 provides guidelines for regulating construction activities across the country NBC. Even then, workers' safety in the Indian construction industry is frequently pushed to the bottom stage of priorities by builders, contractors, and engineers. In developing countries, safety rules usually do not exist, if exist; regulatory authorities are unable to implement such rules effectively. Therefore, effective safety knowledge among construction professionals can reduce accidents that directly or indirectly reduce project cost. Especially in developing countries like India, efforts should be made to raise the level of awareness among the workers and the employers about the importance of health and safety-related issues. Therefore, objective behind this paper was to create awareness among construction workers about the safety problems and injuries in the construction industry. The safety knowledge available on the subject has been categorized and discussed in subsequent sections.

2. PROBLEM IDENTIFICATION

The construction industry has been identified as one of the most hazardous industries in many parts of the world, as measured by work-related mortality, workers' compensation, injury and fatality rates. Accident is the main issue to consider in any industries, construction industry is no exception. It is a high-risk industry that covers a wide range of activities involving construction, modification, and/or reparations. There are three major factors which affect project EHS performance: i) human factor ii) physical condition iii) management factors. Analysis of the incident happened at multiple construction industries. Due to the above risk in the construction sites, the new method called risk management systems works on the principle by converting log indicator to lead indicator techniques by the programmes like C++ and Java. By this technique, we can prevent human error and enhance safety.

3. CAUSES OF ACCIDENTS IN CONSTRUCTION SITE

3.1 CAUSES OF ACCIDENTS

Nowadays statistics of accident in construction industry encourage researchers to find new ways for improving or enhancing safety performance in construction industry. Furthermore, both of direct and indirect cost of accident adds more expenses to construction projects that are because of improper safety performance in construction sites. Most of these accidents, nearly 99 percent, are caused because of unsafe act, unsafe condition or both. In order to improve safety

performance in construction industry, we require to identify the root causes of construction accidents. This kind of equipment and machinery, site condition, nature of the industry, management attitude and method, and human elements can directly influence the safety performance in construction industry. Working at height, inadequate safety devices, poor management, lack of obedience on site, negligence of workers, and employing unskilled workers is so common in construction industry that causes to increase the risk of accident and making damage and injuries. It is stated that the causes of accidents are related to worker turnover and wrong acts, lack of safety performance, unsuitable or unclean materials, no maintenance tool, and weak supervisory and inspection. On the other hand, we can divide the causes of accidents into human and physical factors. Human factors are related to personal duty and responsibility such as neglect to use protective equipment, utilizing machines and equipment without permission, rushing in operating and doing work, personal factors, service moving and energized equipment, remove safety device, select unsafe position in working, utilizing improper equipment and other unsafe acts. While, physical factors were addressed to wrong acts of another person, unconsidered accident sources, disregard to special procedure, clothes hazard, environment hazard, fire hazard, wrong method or arrangement, assignment of personnel in wrong position, no safety guard in site and other unsafe conditions. The cause of the accident in construction sites is directly related to inadequate safety regulation, no force to use the regulation in site, no safety consideration by personnel on site, no encourage professional people to work in site, mechanical problem of construction machinery and equipment, and chemical or physical disturbance. We can exhibit the cause of accident according to the above statement in fishbone model.

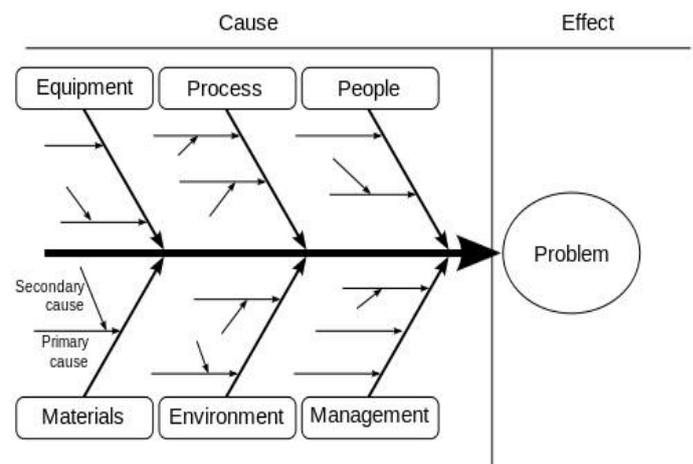


Figure.3.1 Root Causes of Accident

3.2 MAJOR FACTOR FOR ACCIDENT

There are three major factors which affect project EHS performance:

- i) human factor
- ii) physical condition
- iii) Management factors and analysis of the incident happened at multiple construction industries.

3.3 CAUSES OF ACCIDENT BY HUMAN FACTORS

According to accidents are caused due to poor safety awareness, lack of training, lack of organizational commitment, poor technical supervision, uncontrolled operation, unwillingness to input resources for safety, shortage of skilled labour, unsafe equipment, lack of first aid facilities, lack of safety regulations, lack of personal protective

equipment, lack of innovative technology, and poor information system. Physical hazards are present in every construction project. These hazards include noise, heat and cold, radiation, vibration and barometric pressure. Construction work often must be done in extreme heat or cold, in windy, rainy, or foggy weather or at night. Ionizing and non-ionizing radiation is encountered, as are extremes of barometric pressure. The machines that have transformed construction into an increasingly mechanized activity have also made it increasingly noisy. The sources of noise are engines of all kinds (e.g., on vehicles, air compressors and cranes), winches, rivet guns, nail guns, paint guns, pneumatic hammers, power saws, sanders, routers, planers, explosives and many more. Noise is present on demolition projects by the very activity of demolition. It affects not only the person operating a noisemaking machine, but all those close-by and not only causes noise-induced hearing loss, but also masks other sounds that are important for communication and for safety. Pneumatic hammers, many hand tools and earth-moving and other large mobile machines also subject workers to segmental and whole-body vibration. Heat and cold hazards arise primarily because a large portion of construction work is conducted while exposed to the weather, the principal source of heat and cold hazards. Roofers are exposed to the sun, often with no protection, and often must heat pots of tar, thus receiving both heavy radiant and convective heat loads in addition to metabolic heat from physical labour. Heavy equipment operators may sit beside a hot engine and work in an enclosed cab with windows and without ventilation. Those that work in an open cab with no roof have no protection from the sun. Workers in protective gear, such as that needed for removal of hazardous waste, may generate metabolic heat from hard physical labour and get little relief since they may be in an air-tight suit. A shortage of potable water or shade contributes to heat stress as well. Construction workers also work in especially cold conditions during the winter. The principal sources of non-ionizing ultraviolet (UV) radiation are the sun and electric arc welding. Exposure to ionizing radiation is less common, but can occur with x-ray inspection of welds, for example, or it may occur with instruments such as flow meters that use radioactive isotopes. Lasers are becoming more common and may cause injury, especially to the eyes, if the beam is intercepted. Strains and sprains are among the most common injuries among construction workers.

These, and many chronically disabling musculoskeletal disorders (such as tendinitis, carpal tunnel syndrome and low-back pain) occur as a result of either traumatic injury, repetitive forceful movements, awkward postures or overexertion. Falls due to unstable footing, unguarded holes and slips off scaffolding and ladders are very common.

3.3.1 Carelessness of the Workers

In this case, both the workers and the supervisor might be convinced that the risk is low. Its human nature to assess risk based on experience, so each time you take a risk and don't get injured, it reinforces the idea that the task was safe or the risk was too low to matter. Young workers, such as apprentices, may be prone to take more risks to prove they are good workers or they may be less likely to speak up about hazards. Because of these factors, young workers tend to have higher injury rates. The challenge for safety professionals is convincing people to take precautions for risks they may never encounter, but are nonetheless very real dangers.



Figure 3.2 Carelessness of the Workers

Labeling a worker's injury as mere carelessness oversimplifies a complex issue. Workers are often constrained by their environment or employer just as supervisors are often asked to balance safety with productivity. Rather than blame the worker or blame the employer, we should be examining the root causes on both sides that led to the incident. The next step is examining the incentives that promote unsafe behavior and finding ways to stop positively reinforcing unsafe actions. Changing behavior is never easy. It's not as straightforward as setting strict rules and enforcing them, since this can lead to people obeying the rules when management is watching and ignoring them when they are not. Rules have to make sense for workers to buy in and follow them. As much as possible, rules also should not interfere with the job or productivity. If so, people will be pressured to cut corners. Understanding the human aspects of safety takes time, but in the long run, may prove more effective than the top-down command and control model so prevalent in construction today. Workplaces are getting safer, but we are never going to reach our goal of zero injuries and fatalities until we understand why people do what they do. Only then can we address the root causes of unsafe decisions.

3.3.2 Persons Fall Due To Poor Concentration

The poor concentration in construction site is very impact for human. The Centers for Disease Control and Prevention states that falls can happen in all occupational settings, and "circumstances associated with fall incidents in the work environment frequently involve slippery, cluttered or unstable walking/working surfaces; unprotected edges; floor holes and wall openings; unsafely positioned ladders; and misused fall protection.



Figure 3.3 Persons Fall Due To Poor Concentration

"To reduce the risk of falling at work, CCOHS recommends paying attention to your surroundings and walking at a pace that's suitable for the surface you're on and the task you're performing. Additionally, walk with your feet pointed slightly

outward, make wide turns when walking around corners and use the handrails on stairs.

3.3.3 Ignorance of PPE

In the safety world hazard recognition plays a vital role in keeping your people safe from unsafe behaviors and/or conditions. Some hazards are easily recognized, for example an employee climbing up a 20 foot ladder with tools held in both hands. At a minimum, each employee is required to wear a hard hat and safety glasses. High visibility safety vests with reflective striping are required when employees are exposed to vehicular traffic.



Figure 3.4 Ignorance of PPE

In the absence of vehicular traffic, high visibility shirts should be worn at all times. All workers must wear shirts with sleeves, long work pants, and sturdy work shoes or boots when working on a construction or renovation site. Sleeveless or tank top shirts, short pants, sweatpants, sneakers, sandals, and high-heeled or open-toed shoes are not permitted.

3.3.4 Failure to Follow Safety Rules

Failures by employers or contractors to follow state and federal safety regulations too often result in death or injury to workers, or even to worksite visitors or passersby.

3.3.5 Falls from High Heights or Scaffolding

Fall hazards are present at most worksites and many workers are exposed to these hazards on a daily basis. A fall hazard is anything at your worksite that could cause you to lose your balance or lose bodily support and result in a fall. Any walking or working surface can be a potential fall hazard. Any time you are working at a height of four feet or more, you are at risk. OSHA generally requires that fall protection be provided at four feet in general industry, five feet in maritime and six feet in construction. However, regardless of the fall distance, fall protection must be provided when working over dangerous equipment and machinery. The importance of fall protection cannot be stressed enough. Fall hazard incidents are injuries produced by impact between the injured person and the source of injury when the motion producing contact was generated by gravity. Fall hazards in construction cause accidents such as the following: A makeshift scaffold collapsed under the weight of four workers and their equipment, seriously injuring all four. A worker carrying a sheet of plywood on a flat roof stepped into a skylight opening and fell to the level below. A roofer, while attempting to remove a roof opening cover, fell approximately 21 feet to the concrete floor below and was killed. A construction worker was working from a carpenters' wall bracket scaffold without fall protection. The worker fell 19 feet to the ground, sustained

blunt trauma to the head and later died. Construction workers are often required to work at very high heights, on scaffolding and ladders, in windows and on roofs. A fall is categorized when a person is injured after falling or jumping from a ladder, scaffold, building, roof, or other elevated place or working area landing, with impact, on the ground or surface below. According to the Bureau of Labor Statistics, these accidents account for 34 percent of all on-the-job deaths of construction workers.

Causes

- Unprotected roof edges, roof and floor openings, structural steel and leading edges, etc.
- Improper scaffold construction
- Unsafe portable ladders
- A safe system of work for scaffold dismantling was not provided
- The tubular scaffold was not horizontally and securely erected on the inclined floor
- The worker overstretched his body from the working platform resulting in the imbalance of the tubular scaffold
- The steel plate underneath the tubular scaffold failed to balance and secure the scaffold
- The overall structure of the boatswain's chair was unsafe. The whole structure was not inspected by a competent examiner before use
- The fall arrestor and independent lifeline were not properly installed, thus failing to prevent the worker from falling

3.3.6 Slips, Trip and falls

From stray tools and materials to uneven ground or holes, there are many hazards on a construction site that could lead to a dangerous slip, trip, or fall. Slips happen when there isn't enough friction or traction between your feet and the surface you're walking on. Common causes of slips include wet or oily floors, spills, loose or unanchored mats, and flooring that lacks the same degree of traction in all areas, CCOHS states. Trips happen when your foot strikes an object, causing you to lose your balance. Workers trip due to a variety of reasons, including clutter in walkways, poor lighting, uncovered cables, drawers being left open and wrinkled carpeting or rugs. To help prevent slips and trips, CCOHS recommends the following:

- Clean up spills immediately. If a spill can't be cleaned up right away, place "wet floor" warning signs for workers.
- Keep walkways and hallways free of debris, clutter and obstacles.
- Keep filing cabinets and desk drawers shut when not in use.
- Cover cables or cords in walkways.
- Replace burnt-out light bulbs promptly.
- Consider installing abrasive floor mats or replacing worn flooring.
- Encourage workers to wear comfortable, properly fitted shoes.

Falls

The Centers for Disease Control and Prevention states that falls can happen in all occupational settings, and "circumstances associated with fall incidents in the work environment frequently involve slippery, cluttered or unstable walking/working surfaces; unprotected edges; floor holes and wall openings; unsafely positioned ladders; and misused fall

protection. “To reduce the risk of falling at work, CCOHS recommends paying attention to your surroundings and walking at a pace that’s suitable for the surface you’re on and the task you’re performing. Additionally, walk with your feet pointed slightly outward, make wide turns when walking around corners and use the handrails on stairs.

Causes

- spills of liquid or solid material
- wind-driven rain or snow through doorways
- change from wet to dry surface
- dusty and sandy surfaces
- the incline of a ramp low light levels
- use of unsuitable footwear , with wet, muddy, greasy or oily soles
- Wet or greasy floors, Loose flooring, carpeting or mats
- Uneven walking surfaces
- Missing or uneven floor tiles and bricks
- Damaged or irregular steps; no handrails
- Electrical cords or cables
- Ramps and gang planks without skid-resistant surfaces
- Metal surfaces – dock plates, construction plates

3.3.7 Electrocutions

Due to the fact that construction sites are a work in progress, there is often exposed wiring, power lines, and unfinished electrical systems around. Coming in contact with these could lead to electrocution or shock. In many of the electrocutions, electrical workers and other construction workers touched metal objects that had become energized through contact with live electrical equipment and wiring or with overhead power lines. Thus, 42 (12%) of the electrocutions of electrical workers and 88 (32%) of those of other construction workers that involved electrical wiring and equipment involved these contacts. The most common contacts were with metal ladders, metal pipes, metal wires that were deliberately cut or stripped or were accidentally cut by electric drills or other tools, wires that were energized by contact with live wires, and energized trucks and other vehicles. Electrocutions as a result of metal objects contacting overhead power lines involved 26 electrical workers and 167 of other construction workers. The most common examples involved metal ladders, cranes, aerial lifts, trucks or heavy equipment (such as water well drillers, backhoes, concrete pumpers and dump trucks), wires, metal poles, and metal scaffolds or scaffold parts. Working in cramped areas was a contributing factor in 97 electrocutions (6%), about 8 deaths per year. For electricians, working in attics or above drop ceilings was a risk and for other construction workers, working under houses, in basement crawlspaces, or in attics. Standing in water or having equipment such as trouble lights and extension cords touching water was a contributing factor in at least 51 electrocutions. Low voltage (600 volts and under) was involved in the electrocutions of at least one-third of electrical workers and one-quarter of non-electrical workers. At least 14% of all electrocutions involved 120/220 volts (household current). (The voltage was not known in more than one-quarter of electrocutions.)

- Electrocutation when Using Hand Tool
- Electrocutation when Carrying Out Electrical Works

Causes

- The workplace was damp and with water pools
- The electric saw was not properly earthed

- The power socket was not fitted with any residual current device (commonly known as earth leakage circuit breaker)
- There was leakage current from the electric saw
- The power supply had not been disconnected before the works were carried out
- The insulations of some of the wires had been damaged Injuries type Shock, Burns, Falls due to contact with electricity, Electrocution (death)

3.3.8 Struck By Object

Struck-by injuries are produced by forcible contact or impact between the injured person and an object or piece of equipment. Having said that, it is important to point out that in construction, struck-by hazards can resemble caught-in or – between hazards.

- Struck-by flying object
- Struck-by falling object
- Struck-by swinging object
- Stuck-by rolling object

Causes

- The catastrophic failure of equipment on the oil rig
- Objects falling off the rig’s superstructure, the tops of tanks, building roofs, scaffolding, aerial lifts, cranes and forklifts can strike employees working nearby
- tripping pipe in and out, the derrick man or the floor hands
- Semi-tractor trailers, crew trucks, service vehicles, end loaders, excavators and forklifts can pose

3.3.9 Falling Debris, Materials or Objects

A construction worker injured by falling debris, materials, or objects at a construction site should call an experienced personal injury lawyer for a free consultation. When mandatory construction site safety rules are followed such “accidents” do not generally happen. On construction sites, objects do not fall from the sky absent negligence. On projects with multiple levels, it is common for falling tools, building materials, or beams to strike workers below.

- A metal bar falling from height
- Bricks falling from height
- Metal pipes falling during lifting operation
- Formwork panels being knocked over
- Toppling over of precast concrete building unit

Causes

- The metal bar was liable to fall as it was placed at the window edge on an upper floor
- The falling of the metal bar might be inadvertently caused by someone at work
- No secure fenders/bracings had been installed at the external wall of the building near the podium
- The concrete bricks were neither properly stacked nor securely tied
- The platform of the hoist was not installed with any enclosures to prevent loose materials from falling during lifting
- The frame of the hoist was unfenced
- The metal pipes were not properly tied before lifting
- The materials were lifted past an area where workers were working
- The lifting operation was carried out despite insufficient communication between the crane operator and signaler

- The vertically placed panels lacked sufficient support and proper storage to prevent them from toppling over by accident.

3.3.10 Getting Caught In-Between Objects or Materials

According to OSHA, caught-in hazards collectively are one of the four deadliest dangers found on a construction site. Although it seems like common sense to never place yourself between a piece of heavy equipment and an immovable object, when you're concentrating on the job at hand sometimes you find yourself in unexpected danger. Here are some tips to prevent becoming a victim of caught-in/between accidents. Construction sites are filled with heavy machinery, tools, and materials. Often, workers find themselves stuck in between immovable objects, machinery, or fallen debris.

- Trapped During Lift Maintenance
- Caught between a vehicle and another object,
- Pinched between equipment and the rig's substructure, and
- Crushed between a load of pipe that fell off a trailer and forklift.

Causes

- The stopping switch in the machine room as well as the emergency stop switch and the maintenance switch on the maintenance work
- No warning sign was posted to warn other people not to use the lift
- work involving moving equipment
- inadequate training or preparation
- completing a task under physical or mental pressure
- being absent-minded
- working with unreliable machinery

3.3.11 Fires and Explosions

Because of unfinished piping, leaking gases, and incomplete electrical systems, fires and explosions are a common occurrence on construction sites.

Data from the Occupational Health & Safety Administration (OSHA) indicate that there are on average 36 fire and explosion deaths per year in the construction industry. From underground gas lines to temporary heating devices to electrical systems, construction sites in South Carolina are full of hazards that can turn a day's work from routine to explosive in an instant.

Causes

- The use of flammable liquids
- Welding or abrasive cutting techniques used in places not specially prepared for such works
- Liquid gases used with an open flame;
- Flammable and combustible materials (e.g. petroleum, timber and packaging).
- Gas leaks;
- Chemical leaks;
- Electric sparks/malfunction;
- Welding;
- Static electricity;
- Combustible dust;
- Lack of training/negligence;

3.3.12 Overexertion

Hours of hard labor, often in extremely hot or humid conditions, can cause workers to overexert themselves and

even fall victim to heat stroke accidents. The condition can lead to dehydration, exhaustion and reduced mental clarity. Simple mistakes can lead to devastating accidents that can quickly end the lives of one or more individuals. Overexertion is a major cause of construction accidents, and is possibly involved in far more accidents than has been reported. Recognizing and handling overexertion when it occurs is extremely important to avoiding serious accidents. Some of the signs of overexertion include fatigue, dizziness, significant sweating, chest pain, weakness, and sore muscles, tightening of muscles, a burning sensation, nausea and excessive thirst. Overexertion is the No. 1 cause of non-fatal injuries according to a study carried out by The Center for Construction Research and Training overexertion creates stress on the joints and muscles in the body. Other ways overexertion injuries happen is because of repeated bending at the time to position your body correctly before you lift or move anything. It only takes a few seconds to position yourself correctly in order to prevent an overexertion injury from occurring.

Bend at the knees when lifting. These will reduce the strain that is put on your back when lifting heavy objects. The waist and poor posture. These strains happen and can result in stretched or torn muscles. Construction workers are very susceptible to this type of overexertion, especially when they work outside on days that are hot and humid. Overexertion can be avoided, by taking breaks, staying hydrated, and using proper lifting and other techniques to reduce body stress.

Causes

- Reaching over the worker's head;
- Working in small spaces;
- Reaching and leaning to pick up objects;
- Shoveling dirt, rocks, or other materials; and
- Bending over to grasp objects.
- Overexertion occurs when the load, whether lifted, carried, pushed, pulled or otherwise handled, exceeds the limits of the human joint system doing the work

3.3.13 Machinery accidents

Construction workers use a lot of heavy machinery in their work. From cranes and bulldozers to jackhammers and nail guns, an error or accident with these tools can be very dangerous. Making a single mistake while operating construction machinery can result in a very serious injury or even death. Some of the worst construction accidents are caused by heavy machinery malfunctions. The most catastrophic construction accidents involving machinery often result in life changing injuries such as amputations, traumatic brain injuries and even death. Surviving family members who've lost a loved one due to a machinery accident at a construction site may be able to file a wrongful death lawsuit against whoever was responsible for making sure this type of accident does not occur. Construction equipment and machinery is often to blame for construction worker accidents. Actually, not the equipment itself, but those who designed it, maintained it, or used it improperly. Forklifts accidents, backhoe accidents, scissor lift accidents, masonry machinery accidents, hydraulic jack accidents, crane accidents, front-end loader accidents, boom accidents --- all these and many more construction machines and equipment cause innumerable accidents and injuries every year in New York and elsewhere. But almost all circumstances, these accidents are not just "accidental". They are caused by someone's negligence or carelessness. Construction machinery and equipment is safe only when (1) it is designed and manufactured safely; (2) the workers who use the construction equipment and machinery

are properly trained and supervised; (3) the workers who use the construction equipment and machinery do so safely and properly; (4) the construction equipment and machinery is properly maintained; and (5) the construction equipment and machinery is equipped with proper warnings.

Causes

- Accidents and injuries caused by faulty or unsafe work equipment.
- falls from height due to defective or unsuitable ladders, working platforms or scaffolding
- Injuries caused by sharp edges or broken parts on work equipment
- Injuries sustained whilst using work equipment without proper protection
- work accidents and injuries caused by lack of proper training to use work equipment
- Injuries caused by the unsafe use of work equipment
- Workplace injuries caused as a result of unsuitable work equipment Injuries type Amputations, traumatic brain injuries, hand and bone fracture

3.3.14 Trench Collapses

Trenches are often a necessity on construction sites. If a trench collapses while a worker is inside, it could cause them to be hit with tools, machinery, or materials or bury them in the surrounding dirt. Trenches have been used and formed by people for hundreds of years for many different purposes including, agricultural uses, and installing utilities and pipelines. The construction of trenches is not simply digging in the soil, as it comes with risks and hazards. Some of the feared dangers associated with Trench construction are the trench collapses, cave-ins and side wall collapses. There are also some invisible dangers of trench contractions are asphyxiation inhalation of toxic fumes and suffocation. Out of these risks, trench collapse is the frequently happened incident on construction sites. If a Trench collapse happens unfortunately it does cause a lot of injuries to the workers digging the trench. Such injuries include broken leg or arm, death due to lack of oxygen when weight of collapses trench is on the buried worker leaving very little or no space for the proper supply of oxygen. Construction workers working on trenches face high risk of Trench collapse dangers and there are many reasons contribution in Trench collapses. Some of the commonly recognised reasons are that trench walls are not supported by shoring or trench boxes, trenches dig on previously disturbed soil, vibration of the land around the trench area due to the vehicles running too close to the trench, unsafe distance between spoil pile and the lip of the trench, dried trench walls that make trenches weak and heavy rain falls. Occupational Safety and Health Administration (OSHA) has many rules to minimize the Trench collapses and risks associated with it. For example as per OSHA regulations trenches deeper than five feet must be shored for support; this is because of the fact that most of the Trench collapses happen in trenches less than 12 feet deep. While most employers hesitate to use supportive trench boxes due to the added cost and put the lives of labors at higher trench collapse risks. Trench collapse incidents should not be taken lightly but there should be effective trench collapse preventive measures. Trench collapse risks can be minimized by shifting the soil weight away from the trench opening. Trench collapses can also be minimized by placing trench sheets on both sides of the trench. The party responsible for carrying out construction work for trenches should carefully examine the soil conditions should employ a person qualified in trench safety to carry out tests to ensure there are no poisonous gases inside the soil

prepared for trenches. The responsibility to reduce risks associated with trench collapses lies on the shoulders of both employer and workers. It is wise if both undertake necessary training on trenches collapse before executing work for the construction of trenches.

Causes

- Moving machinery near the edge of a job site excavation can cause a collapse of a wall within the excavation.
- A rainstorm or flooding from a broken water main could increase the risk for injury.
- Improper shoring or bracing can cause catastrophic injury to workers.
- Contact or sever underground utility lines.
- Flooding;
- Improper shoring;
- Equipment defects;
- Machinery resting dangerously close to the trench;
- Inadequate safety equipment; and
- Poor digging.

3.4 CAUSES OF ACCIDENT BY PHYSICAL CONDITION

3.4.1 Light (LHT)

Light linked to visibility related accident in workplace. In some occasion, insufficient lighting and blind spots can cause accidents. Sometimes glare reflected from equipment and tool can disrupt visibility in a person field of vision causing run over accidents.

3.4.2 Weather (WTH)

Working environment and variety of natural phenomenon can cause fatalities on site, as most of these are unpredictable. This includes rain, wind, earthquake, flooding and landslides.

3.4.3 Sunlight (SUN)

Working under direct sunlight for a long period of time may cause heat rashes, heat exhaustion, and heat stroke. This could lead to a more serious health-related issues, and accident.

3.4.4 Ventilation (VEN)

Working in an enclosed space with no ventilation making it hard to breathe.

3.4.5 Dust (DUS)

Dust that builds up when cutting, drilling or grinding material on the construction site can cause serious effects inside the body if exposed to for a long period of time.

3.4.6 Noise (NOS)

Frequent exposure to high level of noises either from the environment or from equipment can cause hearing damage.

3.4.7 Layout (LAY)

Inadequate space or difficult entry to perform a certain tasks was recognized as 15% of the accident studied therefore leading this to one of the major case whereby the delivery vehicle partially overturned due to the lack of sufficient room to extend the stabilizers.

3.4.8 Electrical hazard (ELC)

Electrical hazard causes 44% of all fatal electrical accidents from all industry. Mismanagement and poor protection of electrical system leads to fatalities.

3.4.9 Vibration (VIB)

Working with operating machine or equipment that vibrates at a high frequency could cause workers to become exhausted and stagnant.

3.5 CAUSES OF ACCIDENT BY MANAGEMENT FACTORS

3.5.1 Equipment design (DSG)

Appropriate tools design can eliminate common safety hazard.

3.5.1 Design of PPE (PPE)

Inappropriate PPE design may lead the workers not too wear PPE during their work. This, in turn, decreases work performance and creates health and safety hazard.

3.5.2 Quality of material (QLT)

Collapsing of building can be caused by poor material quality. Ransom et al., stated that poor quality of material causes accidents in construction industry.

3.5.3 Innovative technology (TEC)

Outdate equipment could cause ineffective work and injuries, as it cannot provide a suitable function for some specific.

3.5.4 Sub-contractor's equipment (SUB)

Subcontractor provides equipment machine and their employees to the construction company under the agreement to help them finish the project on time. Improper use of subcontractor's equipment could lead to construction accident.

3.5.5 Safety related budget (BUD)

Construction Company should provide enough budgets to support necessary safety-related activities.

3.5.6 Project duration (DUR)

In limited project time available, workers are force to work under pressure. This in turn, causes accidents.

3.5.7 Customer satisfaction (PSR)

When Construction Company tries to meet the expectations of customer so as to satisfy them, pressure builds up leading to unexpected accidents, which should not happen.

3.5.8 Maintenance program (MTN)

According Ransom et al., tools and equipment in the construction site are not properly maintained. This could lead to serious accidents.

3.5.9 Safety training program (TRN)

The training program that does not match the nature of work, is meaningless.

3.5.10 Adequate provision of safety equipment (ADQ)

Many construction companies in Thailand do not have enough PPE to provide to all of their employees when they come to work, therefore some worker needs to buy the PPE for themselves. PPE are also expensive and this leads to worker not buying it as they could not afford the safety equipment.

3.5.11 Work hours (SHF)

Accidents in the accidents in the construction site occur when workers work more than eight hours per day or 60 hours per week.

3.6 RANKING AND MEAN VALUE OF CAUSES OF ACCIDENTS

Table 3.1 Ranking and Mean Value of Causes of Accidents

Causes of Accidents	Mean Value	Ranking
Failure to follow safety rules	4.3213	1
Ignorance of PPE	4.0365	2
Space congestion	3.6277	3
Improper use of safety items	3.5182	4
Improper equipment	3.2993	5
Lack of proper training	3.2701	6
Inadequate Construction Planning	3.2628	7
Inexperience	3.2117	8
Faulty Ladders/ Scaffoldings	3.1095	9
Poor line of communication among safety officer and employees	2.9635	10
Due to substance Abuse	2.7737	11
Lack of Coordination	2.6715	12
Persons fall due to poor concentration	2.4015	13
Dropping/ throwing objects from	2.3723	14

high rise projects		
Improper stacking	2.1022	15
Mental illness	2.0657	16
During unloading of goods	2.0365	17
Improper housekeeping	2.0146	18
Carelessness	1.9781	19
Harsh Deadlines	1.9635	20
Due to structural failure	1.9562	21
Improper signaling	1.9562	21
Less concentration of workers or drivers	1.9343	22
Rash driving	1.8175	23
Improper positioning and posture during working	1.8102	24
Unclear of the information	1.7883	25
Language barrier (speaking, writing and reading)	1.7518	26
Material component failure	1.7518	26
Welding accidents	1.7445	27
Poor understanding of signage (safety information and warning signs)	1.7374	28
Due to landslides	1.6161	29
Incompetence	1.6058	30
Problems occur during grounding	1.5912	31
Struck by moving vehicles	1.5839	32
Struck by sharp things	1.5766	33
Improper walkway/ roadway	1.5766	33
Due to compressed gas explosion	1.5766	33
Inflammable materials unsecured	1.5766	33
Poor judgment	1.5693	34
Forms of message transferred cause confusion	1.5693	34
No proper traffic control	1.5474	35
Fall of building or a part of it	1.4380	36
Accident due to elevator shaft falls	1.2920	37
Due to crane falls	1.2117	38

4. EFFECTS OF ACCIDENTS IN CONSTRUCTION SITE

As the construction industry is carried out in hazardous environments, it experiences accidents in different levels of severity, some causing minor and major Injuries with even some resulting in fatality.

Table 4.1 Ranking and Mean Value of Effects of Accident

Effects of Accident	Mean Value	Ranking
Cost of Medical Expenses	4.3577	1
Time loss of project execution	3.7299	2
Productivity Loss	3.4453	3
Distrust of Firm	3.1898	4
Cost of training given to new worker	3.1460	5
Cost of Recruiting new worker	3.0219	6
Mental illness of workers	2.8832	7
Cost of Accident investigation time	2.5401	8
Additional supervision cost	2.1314	9
Compensation Cost	1.9343	10
Repairs	1.9124	11

5. CONSTRUCTION SAFETY RULES

1. Keep your mind on your work at all times. No horseplay on the job. Injury or termination or both can be the result.
2. Personal safety equipment must be worn as prescribed for each job, such as: safety glasses for eye protection, hard hats at all times within the confines of the construction area where there is a potential for falling materials or tools, gloves when handling materials, and safety shoes are necessary for protection against foot injuries.
3. Precautions are necessary to prevent sunburn and to protect against burns from hot materials.
4. If any part of your body should come in contact with an acid or caustic substance, rush to the nearest water available and flush the affected part. Secure medical aid immediately.
5. Watch where you are walking. Don't run.
6. The use of illegal drugs or alcohol or being under the influence of the same on the project shall be cause for termination. Inform your supervisor if taking strong prescription drugs that warn against driving or using machinery.
7. Do not distract the attention of fellow workers. Do not engage in any act which would endanger another employee.
8. Sanitation facilities have been or will be provided for your use. Defacing or damaging these facilities is forbidden.
9. A good job is a clean job, and a clean job is the start of a safe job. So keep your working area free from rubbish and debris.
10. Do not use a compressor to blow dust or dirt from your clothes, hair, or hands.
11. Never work aloft if you are afraid to do so, if you are subject to dizzy spells, or if you are apt to be nervous or sick.
12. Never move an injured person unless it is absolutely necessary. Further injury may result. Keep the injured as comfortable as possible and utilize job site first-aid equipment until an ambulance arrives.
13. Know where firefighting equipment is located and be trained on how to use it.
14. Lift correctly - with legs, not the back. If the load is too heavy GET HELP. Stay fit. Control your weight. Do stretching exercises. Approximately twenty percent of all construction related injuries result from lifting materials.
15. Nobody but operator shall be allowed to ride on equipment unless proper seating is provided.
16. Do not use power tools and equipment until you have been properly instructed in the safe work methods and become authorized to use them.
17. Be sure that all guards are in place. Do not remove, displace, damage, or destroy any safety device or safeguard furnished or provided for use on the job, nor interfere with the use thereof.
18. Do not enter an area which has been barricaded.
19. If you must work around power shovels, trucks, and dozers, make sure operators can always see you. Barricades are required for cranes.
20. Never oil, lubricate, or fuel equipment while it is running or in motion.
21. Before servicing, repairing, or adjusting any powered tool or piece of equipment, disconnect it, lock out the source of power, and tag it out.
22. Barricade danger areas. Guard rails or perimeter cables may be required.
23. Trenches over five feet deep must be shored or sloped as required. Keep out of trenches or cuts that have not been properly shored or sloped. Excavated or other material shall not be stored nearer than two feet from the edge of the

excavation. Excavations less than 5 ft may also require cave in protection in some instances.

24. Use the "four and one" rule when using a ladder. One foot of base for every four feet of height.
25. Portable ladders in use shall be equipped with safety feet unless ladder is tied, blocked or otherwise secured. Step ladders shall not be used as a straight ladder.
26. Ladders must extend three feet above landing on roof for proper use.
27. Defective ladders must be properly tagged and removed from service.
28. Keep ladder bases free of debris, hoses, wires, materials, etc.
29. Build scaffolds according to manufacturers' recommendations and MIOSHA Construction Safety Standard Part 12 - Scaffolding.
30. Scaffold planks shall be properly lapped, cleated or otherwise secured to prevent shifting.
31. Use only extension cords of the three-prong type. Use ground fault circuit interrupters at all times and when using tools in wet atmosphere (e.g. outdoors) or with any temporary power supply. Check the electrical grounding system daily.
32. The use of harnesses with safety lines when working from unprotected high places is mandatory. Always keep your line as tight as possible.
33. Never throw anything "overboard." Someone passing below may be seriously injured.
34. Open fires are prohibited.
35. Know what emergency procedures have been established for your job site. (Location of emergency phone, first aid kit, stretcher location, fire extinguisher locations, evacuation plan, etc.)
36. Never enter a manhole, well, shaft, tunnel or other confined space which could possibly have a non respirable atmosphere because of lack of oxygen, or presence of toxic or flammable gas, or has a possibility of engulfment by solids or liquids. Make certain a qualified person tests the confined area with an appropriate detector before entry, that the necessary safety equipment is worn. Standby person may be required to be stationed at the entrance.

6. CONCLUSION

In my project is the Risk management system using software's like C++, JAVA. To improve the EHS performance, project performance to lead factor. The EHS performances lag indicator shall be converted to leading factor my implementing following risk management system. All incident / accidents are preventable unless good safety culture follows at project.

1. All near miss / First aid case report shall be reporting and investigate in time.
2. All near miss / first aid case shall be circulated to all staff.
3. Near miss campaign shall be conducted once in a month.
4. Rewards shall be given to staff and workmen for reporting near miss.
5. Reporting system shall be simple and easy to all.
6. All NM and FA case shall be discussed in EHS committee meeting.
7. Effective EHS committee meeting shall be conducted once in a month.
8. Workmen rewards shall be issuing for safety conscious.

Engineer In charge and Project EHS In charge shall conduct periodic inspections to verify the implementation of controls

stipulated in the Safe Work method statement. The EHS risk management system shall be reviewed periodically taking into consideration of field audit findings, incident reports and feedback from projects. This shall be carried out at all levels (cluster/project) during the EHS committee meetings. The EHS Risk Assessment shall be maintained up to date.

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