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A Systematic Review on Health Hazards, injuries, Accidents and Implementation of Risk reduction Strategies in Construction Industries

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Abstract:

In the construction site there can be various types of risks and hazards are involved in the operations, this operation includes disruption of work, escalation of time, delay in the work and increase in the estimated project amount. In many construction industries, employee safety is one of the major concerns of the employer once operating. In some countries, the injuries which happen in the workplace are higher when compared with other alternative industries. In construction site, there are lot of employees doing different works in the workplace using dangerous equipment's which are hazardous to health and can cause injury to the worker in the workplace. The injuries are caused because of numerous unsafe acts and unsafe condition in the construction site. This paper has reviewed about the construction site Health Hazard injuries, Risk, and safety problems in the Construction site. The major cause of health hazards in the workplace is also discussed in this paper. The hazards that are reported before are mainly caused by workers falling from height and electric shock. Proper work safety awareness has to be created among the workers when they are exposed to hazardous substance in the workplace and to use proper PPE during the work. In addition to that, the poor safety practice that is followed in the construction sites and the minor and major injuries caused because of not following the proper safety practices while they are working. The major cause for all of these is because the worker doesn't like to wear the right personal protective equipment that fits for the job he is doing, lack of knowledge about safety and overexertion. There is a need of conducting awareness program in the construction site as well as conducting on off-site awareness program for the workers will improve their knowledge and enhance active safety management so this can be applied or executed among the employees. Not only among the workers the awareness program should be conducted but also among the contractors who involved in the project, this awareness program should be conducted actively.

Keywords: *Construction Site, Personal Protective Equipment, Accidents, Risks.*

1. INTRODUCTION

Different working process is carried out in the construction site and it is a large place where many labours are involved in their work. They may be educated or non – educated but they are all under the risk of being injured and the risk may vary based on the work they are do. There are various hazards in the construction workplace; so there are many possibilities of getting injured in the construction industry. Comparing with other industries there are lot of tools and equipment which can easily hurt the worker and the percentage of risk is high.

In construction industry, there are many local workers and fresh workers who don't know anything about the working procedures. Apart from all these actions, weather plays an important role in the construction site. As we see the weather can delay the work on the workplace and it can also create a disaster if there is no proper safety procedure is being followed. Accidents in construction projects still continue to grow in the developing countries. This is due to different individuals from various places are working on a project, they may have a problem in communicating with the co-worker and change in culture tends to affect safety in the workplace. There are various types of employments in the construction sites, like technical, skilled and semi-skilled work force. All three workforces are at the risk of being injured; which may be minor injury or major injury and maybe even death. Apart from other industries construction site is different and unique from other work places; it consists of

materials used for construction, contractors, refurbishment services and operation. It makes the construction industry very dangerous and hazardous working environment. Safety is highly considered because it affects the image of the organization as well as the employees at the highest level. In construction industry large number of self-employed and migrant workers is employed, they are unaware of the job and they are not familiar with the working process. Further, employees are exposed to bad weather and working in this type of weather condition can cause health related problems to the workers. In India safety rules in construction sites are in their early stage, although government has implemented legislation like the labour Act of 1970, act for low wages and the Act for compensating workmen in 1923. These acts are passed for the well-being of the worker and to improve working condition. Even though In 2005 National Building Code of India has provided a set of instruction for construction activity, still many labours are pushed down by the construction builders and contractors. In growing countries like India execution of safety rules rarely exist, even though it is available it can't be implemented effectively. In construction, each activity is associated with a particular risk. The labour who does the job is highly exposed to the risk while the co-worker is exposed indirectly to the risk. Knowledge about the accident is needed, in order to redesign or to change direction to assess the level of safety. The intention of the research is to review earlier journals and literatures on the risk at construction sites, to point out the accident causes, to find out the reason for on-site injury and the on-site safety problems on construction sites.

2. Methodology

Literature papers are collected that are associated with the health hazards, risks, safety practices and safety problems in construction sites. The collected papers are published from conference, published in journals and from the corresponding online sites. From 160 papers about 25 papers were selected, analysed and reviewed, from that health hazards, risks and construction related injuries papers were chosen. Papers were identified and studied. Among the selected papers, Statistics and data regarding the injuries caused in the construction sites are collected and analysed, so in future similar accidents and injuries can be avoided.

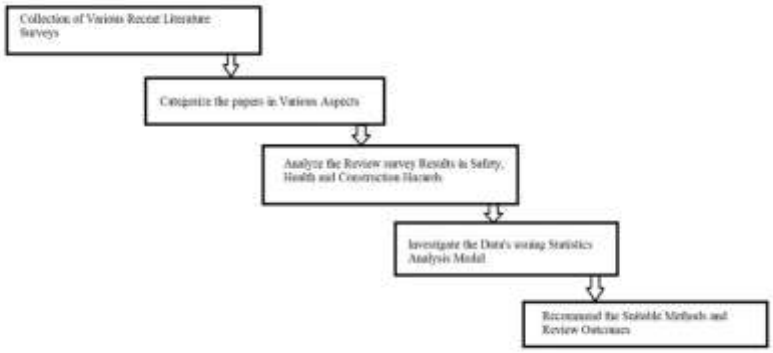

Figure 1. Methodology Flow Process

3. Health hazard and Risk in construction sites

In this section from previous studies and along with the collected literature, Health Hazards and Risk factors associated areas are analysed and presented. In addition to that, what are the possible ways to enhance safety practices were also identified. Physical hazard injury can be caused due to vibration, noise, radiation and temperature extremes. Noise is an inevitable because normally it is the nature of construction site. Hazards related to chemicals are used in construction sites, the chemicals involved are asbestos, solvents, hexavalent Chromium and welding fumes. In addition cement and adhesives or solvents are some of the other dust hazards, which can affect the health of the worker. These hazards affect the health either by chronic health effect or by acute health effect. The chronic and acute health hazards are given in (Table 1 & 2).

Further health hazard having chronic health effects are asbestos, corrosive materials, skin sanitizers, irritants, ionizing radiation, Improper housekeeping, Sewage, Compressed air environment, Limited lighting (Pendleburyet,[1]). It is reported that getting electrical shocks, lifting or carrying and moving heavy tools or materials, labours slip & fall from high places, wearing safeguarding clothing's, digging & working in deep trenches, fire and emergency, working with harmful chemicals, roof work and working with ladders were mostly considered as the cause of acute health hazard from the previous studies (Ismail and Ghani, [2]). Generally occurrence of injuries can be classified into three parts that is near miss, Incident and accident. Hazards can cause

injury to the worker directly or indirectly from the equipment that are used during the work. Human error is one of the major reason behind most of the accidents, the most common type of hazard's identified are due to scaffolding, power accessing equipment's, ladders and working in heights like roof work. This type of working condition can cause not only injuries, but it may also lead to death. Apart from this, there are many indirect ways of injuries can happen during the work. This type of injuries can be noise, vibration and the condition they are working (Hot or cold weather). From the previous studies and analysis, they found that in construction site noise is one of the major hazard because of using noisy equipment and noisy working condition.

Table 1. Chronic Health Hazard

	HEALTH HAZARD					
S.No	**Chronic Health Hazard**	**1**	**2**	**3**	**4**	**5**
1	Asbestos (insulation board, ceiling tiles)	✓	✓			
2	Corrosive materials (Concrete, brick)	✓	✓	✓		
3	Compressed air Surroundings (tunnels)	✓	✓			
4	Polluted ground and contaminated substances (Ancient buildings, gas work)	✓	✓			
5	Hazardous Materials	✓	✓	✓		
6	Harmful radiation (Welding)	✓	✓	✓		
7	Improper Housekeeping	✓	✓	✓	✓	
8	Physical hazard (Heat,Noise,radiation from nuclear power plant)	✓	✓			
9	Vibratory tools	✓	✓	✓		

Table 2. Acute Health Hazard

	HEALTH HAZARD					
S.No	**Acute Health Hazard**	**1**	**2**	**3**	**4**	**5**
1	Elecrtric shocks	✓	✓	✓	✓	
2	Worker fall from height (roof work)	✓	✓	✓	✓	✓
3	Excavating in deep trenches	✓	✓	✓		
4	Machinery and plant tool usage	✓	✓	✓		
5	Lifting, carrying and replacing large materials or equipment's	✓	✓	✓	✓	
6	Ladder	✓	✓	✓		
7	Dangerous Synthetic or chemicals	✓	✓	✓		

Chemical hazards were also present in construction site, which includes spray paints, smokes from welding, asbestos and other types of chemicals which can affect the human health. Construction work also involves chemical hazards like cement and solvents which can cause health related problems. These are commonly used materials in construction sites which can lead to major or minor health effects in the body (breathing problems). Vibration is another type of hazard that will cause internal body injury like back pain, hand arm vibration syndrome, upper limb disorder, later it may lead to serious injuries. When working under concrete and sand, the workers are highly affected by the dust so it may result in a disease called silicosis. Silicosis health effects are not shown in the human body immediately; it will take some time to show its effects, if the worker is continuously working in the dust for a long period then the silicosis can become severe and may lead to death. Normally in India most of the local construction workers are mostly affected by the silicosis because they are not well aware of the health hazards that are caused by the dust. As a matter of fact, the construction workers realise that they have silicosis during when they get older. From previous studies, falling from heights are occurring in construction sites, during storey building and when building bridges. Many near miss accidents will happen in construction

industry it's because of not wearing proper personal protective equipment (PPE) and as well as it also shows that no proper safety measures are being followed in the work place because this is the basic first level safety, i.e. wearing proper safeguarding protective equipment's. In the absence of these individual safeguarding protective equipment's accidents are more likely to happen more often. Workers have less knowledge about personal protective equipment (PPE), so creating awareness will help a lot and even organising a safety program will also be helpful for the workers.

3.1 Safety problems in construction site

Generally there are numerous amount of problems in construction site safety, these is because of unsafe acts and unsafe conditions which can be controlled and mitigated by the Management (Abdelhamid And Everett,[3]). The root causes of the accidents are divided into three types. During the start of the work or the operation, workers fail to Identify the unsafe condition due to this the workplace becomes unsafe and accidents and injuries happen (Ali,Kamaruzzaman and Sing[4]). Unsafe act and unsafe condition is the is the key reason for accident in the workplace (Tam and Zeng [5]).In Construction Sites accidents caused due to shortage of skilled labours, lack of training, lack of personal safeguarding equipment's, poor technical supervision, unsafe equipment, insufficient first aid facilities and lack of safety policy & regulations. In addition to that primary cause of unsafe condition is the lack of sufficient light, missing guardrails and hazardous conditions. Then the primary cause of unsafe behaviour is like working without safety appliances, smoking at workplace, and not using protective equipment's (PPE) (Stokdyk[6]).There are various concepts which explains the happening of unsafe acts and unsafe condition accidents this concepts will be Domino concept, Multiple Causation concept and Human Factor concept. Domino theory is a Sequence of Five Domino factor, if the first factor falls then the second, third and rest of the factors falls. These five Factors are related to accidents, removal of one factor can stop the falling of other factors thus preventing accidents (Ali, Kamaruzzaman and Sing[4]). If correct information is available then the accidents can be prevented and all the safety precautions are put into practice regularly (Stokdyk[6]).

3.2 Accidents Caused due to poor safety practices

Different kinds of working process exist in the construction site so there is a large possibility of getting hurt in the workplace. A statistics of Great Britain employees working in construction site was taken in the year 2013-2014 shown in table 3, in this Statistics most of the accidents are happened by handling and lifting of object followed by slip and trip [7]. To have a clear view about the accidents happened in the Great Britain, it is represented in figure 1. In the construction site workplace poor safety practice is another important factor in causing accidents. The possible sources of causing poor safety practice were identified in table 4; these activities were categorized under safety management, safety training, safety equipment, safety attitude of worker and other safety practices. Dislike in wearing Personal Protective Equipment (PPE) and lack of awareness using Personal Protective Equipment (PPE) during the work hours were found as the possible source of poor safety practices. Workers who are having less educational level were the accident victims who are injured (Rameezdeen, Pathirage and Weerasooriya[8]). Safety gloves, Safety boots, Safety goggles, Hi – Viz jackets, Ear muffs and Earplugs were hardly used and hardhats are often used in the construction site (Tam, Zeng, and Deng [5]). There is no willingness in worker to use the PPE and to obey the safety rules, were noted as the reason for cause for unsafe practices. To have a skilled workforce in the construction site, is by providing good training for the workers and hold them for a long term basis. (Gunawardana and Jayawardane[9]).

Table 3. Injuries, severity of injury and the kind of accident noted from Great Britain Employees (2013-2014).

S.No	Cause of accident	Fatal and over 7 days injuries in construction
1	Injured caused while lifting and carrying	1162
2	Skids, Slips or fall	1201
3	Fall from heights	965
4	Struck by moving, including flying/falling, objects	616
5	Contact while moving machinery	285
6	Trapped by something collapsing/overturning	44
7	Act of violence	22

8	Other kind of accident	585

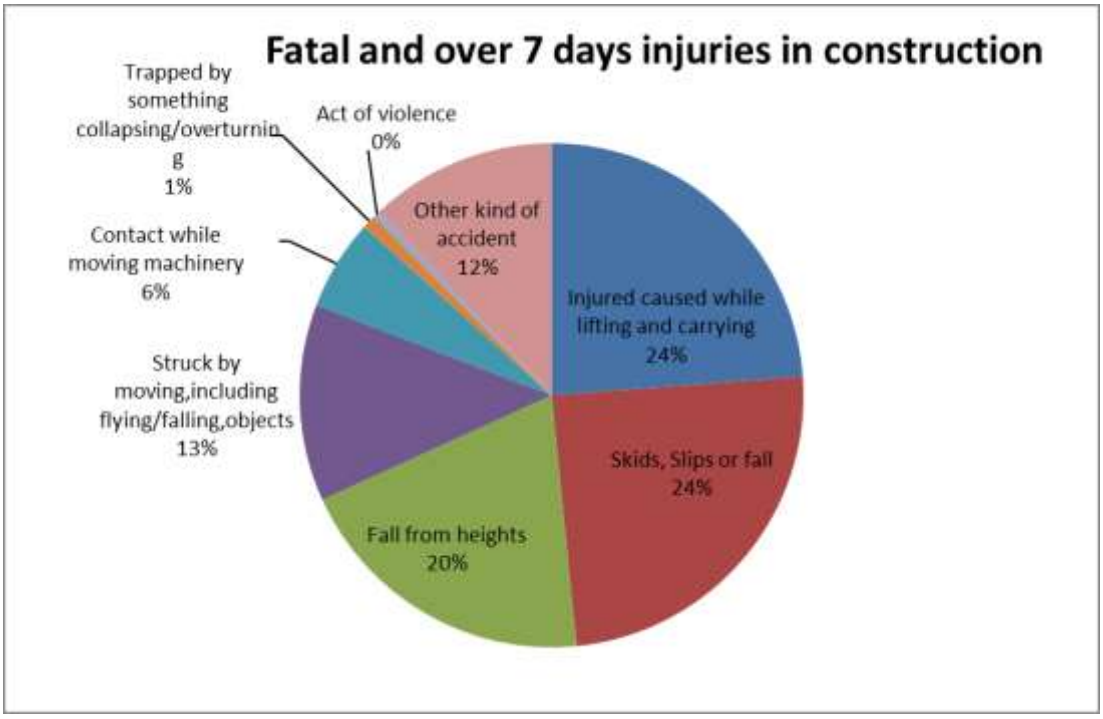

Figure 2. Fatal and over 7 days injuries in construction

Most of the contractors provide only basic training, 11% of the contractors doesn't provide training, 65% of contractors provide training once in a while and only 24% of contractors provide a proper training (Tam, Zeng, and Deng [5]).In a study, it is found that many labours consume alcohol and drugs when they come for work because alcohol and drugs are not tested for the labours before beginning of the work or during the work (Farooqui, Arif, and Rafeeqi[10]).

Table 4. Causes of poor safety practise range

S.No	Causes of poor safety practises	1	2	3	4	5
1	Unskilled labourers refuse to wear PPE					
2	Absence of PPE					
3	No proper awareness about PPE					
4	Safety officer not assigned					
5	Workers are not prepared to follow the safety procedures					
6	Inadequate training facilities					
7	Not having a proper knowledge about the job					
8	Worker showing unsafe attitude towards work (Wearing dangling clothes, Working with moving machinery)					
9	Workers consuming alcohol and drugs during the work hours					
10	No knowledge about the site safety and regulations					

4. Classification of Accident on construction site

1. Fall from high places

[11,12] Construction is normally related to heights, workers often have to work at heights using scaffolding and ladders. According to bureau of labour statistics, 34% of on job deaths occur to construction workers due to fall from heights. The main causes of the fall from height accident is due to unsafe portable ladders, imbalance in the tubular scaffold occurs when the worker stretch his body while he is standing in the scaffolding platform and falling down from leading edges, sharp end edges and unsafe roof corners. When a worker is standing on a tubular scaffold, there is a chance that the tubular scaffold will breakdown due to the imbalance caused by the steel plate that is present beneath the scaffolding and not properly installed fall arrestors will fail to prevent the worker from falling. If a worker is falling from a height it may cause skull fracture, pelvic fracture, intra thoracic injury and vertebral fracture. In order to prevent the fall from height accidents from tubular scaffolds when it is erected on a floor which is inclined preventive measures has to be followed like proper rugs should be used to make the structure immovable, awareness has to be created if the working height is over 3 meters, correct use of designed equipment's to prevent the fall and to emphasis safety training for workers before the work.

2 Skids, Slips and falls

[13,14] Considering from small equipment's to heavy tools and materials to trench's or unequal grounds, there are many hazards that could lead to serious injuries due to skid trip and fall. The cause for slip trip and fall can be because of various activities like any liquid spills (oil), differing walking surfaces, dusty and sandy surfaces, wind-driven rain, low illumination of light, Damaged or differing steps with no hand supports, Wet or greasy floors, floor tiles which are dissimilar and uneven bricks, and ramps without skid-resistant surfaces. Slip and fall causes non-fatal injuries like dislocations of bones, cuts, bruises and in some cases there is a chance of occurring fatal injury also. We can prevent this by maintaining a good housekeeping, Keep the floor dry and free from oil spills around the equipment which uses oil for the working process, keep the pathway free from obstacles along the aisles and walkways and always maintain a proper lighting.

3 Fire and explosion

[13, 15] Because of incomplete electrical systems, using the equipment when they are not properly plugged in the switch box and continues use of equipment for a long time without improper supply of current can be one of the reasons for fire and explosion. If sparks from the electrical equipment's comes in contact with the chemicals, flammable or combustible material then this can ignite the fire, later it can become a large open fire and explosion. The cause of the fire in construction sites can be gas leaks, chemical leaks, static electricity, combustible dust, welding in a place where it is not specially prepared for such works, use of flammable liquids and negligence in work. Fire can cause injuries like burns, deaths and respiratory problems due to smoke inhalation. Preventive measures for fire and explosion will be, fire alarm should be present in the construction site, keeping one fire extinguisher in every floor so it will be easily accessible for the users, for 24 hours water supply should be available and develop a fire protection program.

4 Overexertion

Working for a long duration of time under hot or humid climate can affect the worker health condition, so this can cause heat stroke. Overexertion can cause to dehydration, mental clarity reduction, dizziness and exhaustion. In a Construction site the major reason for accidents are the workers working on the open environment, so many workers are affected by heat and cold effect. Some signs will help us to recognize the overexertion like having dizziness, significant sweating, burning sensation, excessive thirst for water, nausea, weakness and sore muscles. Overexertion can also happen because of lifting overweight and improper positioning of body. Bending the knees while lifting heavy objects will reduce the strain on your back and it will prevent from, happening of torn muscles. The causes strain can be shovelling rocks and construction materials, working in small space, taking heavy load on workers head, during lifting and pushing if the work exceeds the limit of human joints, overexertion can happen. To avoid overexertion the preventive measures can be, ask for a help to lift heavy items, walk straight by keeping all body facing the same direction, have a clear way for walking and plan before you lift so there are no tripping on the way, store the objects in the shelf to your reach, keep the object close to the body so it will reduce stress on the muscles.

5 Trench collapses

Trench can cause serious damage if it collapses. Machinery kept near the trench can collapse the wall, causing damage to the worker working inside the trench. Improper shoring, flooding, inadequate safety equipment and

poor digging will be another cause for the accident. Non-fatal injuries like broken ankles, spinal injuries, broken back, neck injuries and nerve damage can cause trauma. The preventive measures for trench collapse will be, a safe work method statement has to be developed if the workers are working in the trench which is 1.5m in depth, and an emergency backup plan and a emergency response team has to be made ready when undertaking trench work, allow workers only who is authorized to do trench work, the edge of the trench must be kept free and work inside a trench shield.

6 Machinery accidents

Large number of vehicle are used in the construction sites, mostly heavy machinery's are used like bulldozers, cranes, welding and cutting machines etc. A small mistake can cause a large damage to the workers and to the property. Mistakes while operating construction machinery can lead to fatal injuries. To prevent this accidents, providing training to the worker using heavy machinery and providing proper personal protective equipment (PPE). Risk assessment has to be done before any machinery is used or installed; risk assessment helps to identify the hazards when doing the work and when using the equipment's. It also helps to eliminate the hazard. A guard has to be provided to prevent injury. Having a regular maintenance ensure that machine is free from fault and when working do not wear loose clothing, banning of the alcohol consumption for the staff operating machinery has to be made.

7 Falling debris material and Objects

[11,13,16] While working in heights, workers use tools, equipment's for the work. In Construction Sites it is common that people walk all over the places, so at that time the tools and equipment's from the high places fall on them causing major or minor injury, may be leading to death. Materials like bricks, pipes Falls when lifting, small tools like hammers and even the welding sparks are also dangerous when it is falling from a height. The main cause is placing the objects at the edge of the window or at the edge of the scaffolding; the bricks are not kept securely, keeping the material unfenced, not properly tied before lifting the pipes and lack of communication between the signaller and the operator of the crane. The injuries caused are major injuries like broken bones, neck fracture and back injuries, Paralysis and Permanent disabilities. The preventive measures will be keeping the material stored in a right way and closely strapped, make sure that the platform is securely fenced and enclosed, use effective means of communication, stay clear of the area where posted "Hazardous", don't walk under ladder or scaffolding and do not exceed the lifting capacity of the crane.

8 Personal Protective Equipment

The workers in the construction site must wear helmets, clothing and goggles etc. The workers exposure to hazards can be minimized and reduced by using personal safeguarding equipment's (PPT) is to. Managers can take several steps to reduce accidents by having a proper communication about safety during their visit on construction site, they have to allocate safety costs, each and every worker must know the safety records and managers must ensure that new workers receive their training about safe work methods. They must make effective use of safety department. Workers must be provided with awards, based on lowest injuries. Thus it helps to increase in the personal protection of workers in the construction sites.

9 Noise in the Construction

Site safety training regarding noise and Vibration in the workplace has to be given; because the people who are performing drilling are not well educated, so these people has no idea about the noise and Vibration hazard. Without ear plugs, noise hazard can affect the worker and continuous vibration can also lead to severe hand arm syndrome. Sudden health effects cannot be identified, the health effects will occur later like when the worker become older at 40s and 50s.In some places Not only the worker who is operating the machine gets affected by the noise hazard from the equipment but also the worker who is near by working on another process is also gets affected by the noise hazard. So to avoid this, all the workers has to wear the earplugs and ear muffs in the place where the noise is above the hearing level. In studies it has shown that hearing above 140db (decibel) can cause hearing damage.

10 Vibration in construction sites

Vibration in the construction sites can cause severe problems in the entire body or in a part of the body, where ever the vibration passes. Showing safety picture and safety chart on the notice board can create awareness among the workers. Direct survey has to be taken with the workers and also with the superior officers. There are various methods to improve the safety measures and to reduce the risks. Wearing gloves can act as a barrier to protect the worker from vibration. The worker has to take monthly test so that the effect can be rectified and thus it can be

cured. When we see in construction accidents, there is a common point that is many unskilled workers are exploited for low wages. Hard hat and safety boots has to be used during the work in construction sites. These are commonly used personal protective equipment's (PPE) but as we see safety goggles, safety gloves, safety jackets, ear muffs and ear plugs are not used regularly during the work. Many workers think that hardhat is not necessarily needed during the work, in some workplaces no proper personal protective equipment's (PPE) are given to the labours. To reduce the construction industry expenditure in some sites personal safeguarding equipment's are not given to the workers, so this can lead to accidents. However the workers attitude towards safety should be checked. The workers will never think of safety unless until an accident occurs. So educating workers, about safety is an important thing that can help the workers to follow a good safety practice during the work.

If there is any construction work is going on safety manual should be available at the construction site, but in real time most of the construction organisations don't have a safety manual. Some of the workers in construction sites work after consuming alcohol and drugs, if this isn't noticed then the chance of happening accidents will be more. This has to be checked before starting the work, every worker has to be tested for alcohol and drugs regularly. During the working hours, there should be a sudden inspection among workers.so this will reduce the consumption of alcohol and drugs during working hours. Comparing the hazards from the analysis, there are lot of hazards are still unidentified. Slip trip and fall is another hazard, which causes accidents in the workplace. These accidents happen due to misplacing of things in the workplace. Always remember to keep the equipment's and tools in the place where it belongs. Next, beware of trenches and uncovered holes because when walking from one place to another place during working, these may not be noticed. So place a safety sign near the holes and trenches so other workers will be notified about the danger. By keeping the work place clean and tidy the accidents like slip trip and fall can be prevented. Senior officers have to be strict with good housekeeping, so the workers can work safely without any type of illness and injury. Senior officers must also have to be strict with safety measures, wearing boots is an important safety measure thus it will prevent the workers from getting injured from nails that are lying around the construction area. Don't allow unauthorized people to enter inside the construction site, put a safety sign so that they will understand that the place is a hazardous area.

11 Supervisor

Supervisors get into accidents mostly by stepping on object, that is in the work area or in the pathway and they are also highly injured by hand held tools and equipment's in the construction sites.

12 Carper Installer

Carper installers have an important place in handling accidents and at the same time they have a high risk of overexertion. Some assume that their unnatural body postures lead to accidents and also sometimes their use of cutting tools and hand held machines.

13 Carpenter

High range of accidents happens to carpenters because of using handheld machines or tools and the risk of happening finger accidents are higher during the work.

14 Painter

Painters have the highest rate of accidents, like workers fall from heights, having contact with chemicals and it will also cause a major health issue.

15 Mason

Masons have high level risk because of overexertion, masons hand held tools and equipment's can also cause accident and they have a high rate of back injuries during buildings.

16 Glass installer

Glass installers have a high risk of happening accidents as they deal with glasses. Thus it may hurt their hand, wrist, head, toes, and even eyes. So when working using gloves, goggles and other necessary personal protective equipment can eliminate accidents.

17 External factors

The most common external factors used in the construction sites are ladders and sometime accidents may be caused due to sick workers also. The use of hand tools like hammer, knife, cutting machine, driller are dangerous to workers if they are not properly handled. The fall from height accidents are caused when workers are working on roofs using ladders and scaffolds. Falling from roof tops are becoming common accident in construction site. Buildings and towers with an unsafe design can cause a lot of accidents. The workers face a lot of accidents when climbing up and down the scaffolds and ladders. The roofing work in a construction site is a high risk task, which

has many dangers. The workers are mostly injured by the working with the materials like tar, asphalt etc. Accidents occur during lifting of heavy materials and there will be always a risk of stepping in the wrong or weak roof tops. Safety nets must be provided, so the falling of equipment's and workers can be prevented.

18 Accidents during excavations

There are more accidents happen during excavations especially during trenching. Among all other works in construction site trenching is one most threatening work for the excavation workers. It is important to protect the workers from accidents. This involves working in deep dig because this will result in death, when soil is accumulated too near at the edge of the trench and when the settled soil falls down it will drown the workers. Electrocution can occur when worker come in contact with the above power lines during the construction work so electricity is considered as a common hazard in the sites. It should be understood that Electrical accidents are caused not only because of electrical wires there are other reason perhaps. In the workplace there can be electrical wires lying on the ground without proper insulation so when it comes into contact with the materials and the tools can also cause electrical accident and even the misuse of equipment's that run by using electricity can also cause accident during the excavations. Struck-by accidents are also considered as a major accident in construction site. These accidents happen mostly when heavy equipment's are involved like cranes and trucks. When a worker is hit by a flying particle or by any flying substance in a construction site this comes under Struck-by accidents category, even the power tools can also cause Struck-by accidents.

19 Accidents with construction machines:

The majority of accidents are caused by Struck – by vehicles like cranes, trucks, loaders or other equipment's. The accidents are caused by mounting and dismounting the construction equipment's in the construction site. The people who are affected by the struck-by vehicle accidents are the ground workers who are working with the fastening of loads or loosening of loads with their hands thus their hands are mostly affected by injuries.

20 Back injuries caused in construction site

Back injuries are caused due to the lifting of heavy items or equipment's in the construction work site. The most affected workers are masons, carpet installers, painters, and concrete workers. Especially young construction workers will have more back injuries than the older workers because aged workers are less exposed to lifting heavy equipment's and thus hard construction works can cause high risk of back injuries than light construction works.

21 Hard tools

Mostly accidents in the construction sites are caused due to handheld tools. The most dangerous hand held tools are hammer and knife. Tool handling accidents include manual hand tools like manual saw, crowbar, axe and holding tools. Then electric machine tools are grinding machines, cutting machines and nail guns. Mostly welding equipment can cause burn injuries. Mostly sick people are harmed by hand held tools. Many injuries can be avoided by following safety measures when using the equipment's on the construction sites.

22 Ergonomic hazard in construction site

This hazard involved more in the construction workplace. This hazard can bring about back injury and sprain to labours. To resolve these issues, materials used in the construction are heavy so the material weight can be reduced, providing a good, healthy exercise to workers will make them flexible before work and the tools used should be designed ergonomically (Sang.D [43]). The injury can't be prevented just by changing the nature of the work, workers doesn't expose their pain that happen when continuously and repeatedly doing the work because of the fear that they will lose the job. In many sites, production is given more importance than the worker safety. To get a solution for the accidents the workers, unions and contractors has to work as a team (Laura Boatman [44]). Ergonomic risk elements in construction site are identified and musculoskeletal disorders are caused because of ergonomic hazards. Lumbar Spine, Eye Injury, Lacerations and Upper Extremities were found as the major injuries caused due to ergonomics (Pradeep Kumar[45]). Shoulder, neck, wrist and spine joints caused discomfort for masons and the helpers had pain mostly in their shoulders, spine and in elbows because repeatedly lifting sand and bricks. Carpenters work by standing and stretching their muscles for a long period so they suffer from neck, spine and shoulder pain and various types of repeated tasks are done like mixing the cement and sand, loading and unloading bricks, stretching, bending, uncomfortable work postures and walking from ground and top carrying heavy weights on head can make them tired. This continuous work can affect the worker physical body so resting and taking break can reduce the effect on workers. Handling tools may be difficult and cause accident due to continuously standing in the same posture for a long time (RatriParida[46]).

It is a risk factor when a job is done in an awkward or uncomfortable posture. The possibility of injury will increase if the worker doing the same job again and again in a very hot or cold condition. If continuous pressure is applied in the tendons and muscles (contact stress) when the worker holding equipment for a long time (drilling) and uses force to do the job can cause injury and it takes time for healing (Jaffar[47]). Working ergonomically than working in a traditional way differs very much there is lot of advantage if construction sites are working ergonomically. Working ergonomically can increase the productivity but from some contractors point of view increasing the work timing & hardworking will increase productivity. Planning ergonomically will have more benefits (Damaj[48]). Risk elements in ergonomics can be decreased by the workplace has to be designing ergonomically, proper communication between the lower worker, helper and the contractor and educating the worker by training them not just orally but also by writing (A.H. Abdul[49]). Ergonomic is a new idea in construction industry, in most of the construction industry ergonomics are given less importance and because of that the musculoskeletal problems are increasing. For many workers ergonomic training is not provided, in addition to that morning exercise can be provided to the workers to start the day actively. This ergonomic issue has to reach the top level managers in order to have an improvement regarding ergonomic hazard in the workplace (Timothy N [50]).

There is no permanent base for construction its temporary, once the work is finished it is moved. The equipment's and tools can be altered to avoid wrist injury and hand arm vibration (Scott[51]). The most used parts in the body during the work is lower back, hands and feet, this parts are highly exposed to ergonomic risk due to handling and storing materials in the workplace (John [52]).

4.1 To implement safety in construction site

It is not about managing a project just by finishing it in a correct time with the allocated amount of funds but in addition to that finishing the project with site safety and worker safety is also important (Belel [17])**.** Safety management is the mostly advised technique to upgrade the safety in construction site. The key to attain safety in an organisation and to improve organisational performance is through safety management. In addition to that in safety management hazard identification is the first step to control the accidents (Zolfagharian [18]). For a proper construction site safety, it has to have an organisational safety policy, provide safety training and conduct a daily conversation for about 5 to 10 minutes regarding basic safety procedures to be followed during the work. The worker who follows the safe practices and showing safety behaviour should be rewarded, at the construction site display the posters exhibiting safety signs, unsafe act and unsafe condition, safety inspection has to be conducted weekly, encourage the workers for using equipment safely and always provide PPE to the workers (El - Mashale, Al-Smadi Hyari and Rbabeh[19])**.**

Table 5. To develop the safety in construction site

S.No	To Develop the safety in construction site	I	II	III	IV	V
1	To Create safe regulations and policies					
2	Identifying Hazards					
3	Safety management must be applied in all construction industry at the organisational level					
4	Evaluating the risk and assessment					
5	Proper precaution must be decided before start the work					
6	Employee must recognize co-worker behaviours unsafe conditions.					
7	Increasing in workers awareness					
8	Conduct weekly safety inspection					
9	Training new employee					
10	Incentive programs					
11	Conducting weekly formal safety meetings					
12	Good housekeeping					
13	Charging fines for not following proper safety					

14	Mock drills					
15	Ensure that all the workers are given PPE during the work					

When conducting management level safety meeting all the safety improvement steps in construction site must be discussed along with the incentive program for worker must be discussed. When a worker is new to the job, ensure that training regarding safety has been given and identifying unsafe condition in construction site is also the responsibility of every worker (Belel and muhumud [17]). From table 5 workers attitude on safety, safety training, safety management and safety equipment are the 4 major points that has to be considered to improve construction site safety, under this category there are several other methods also available. Once in a while safety officer should conduct a mock drill.

5. Conclusion

Construction site consist of hazards and dangerous activities. Generally, construction site include complex, risky and long process. In every construction projects the project cost, time taken to complete a project and work safety are very important. Accidents can cause damage to the property and injury to the person but there will be a temporary and permanent loss to the construction industry. The review objective is to realize the construction site risk and health hazards involved during the work, reason for the accidents and source of injuries caused in the construction sites and accidents caused due to poor safety practices. In most of the construction sites the reason for the accidents are because of workers not following the work procedures in the workplace and working at elevated places without using proper personal protective equipment (PPE). In addition to that, operating the equipment's without having a basic safety knowledge and proper training should be avoided. Other causes will be like change in climatic condition, workers attitude towards safety and low skill level of the workers. All level employees from top level to the bottom level everyone must take safety seriously into consideration. Share some real time accidents that occurred before, this may help to build the safety practices among the workers. To avoid electric shocks, the construction site has to be kept free from water and the ground must be dry. Electronic equipment's should be used by keeping the floor dry, thus electrical shock can be avoided. For example when welding, the connection wires will be lying around in the ground so by keeping the ground dry and free from water, electrocution can be avoided. For all the workers at least once a year safety officer must conduct an awareness program and mock drill, so educate the workers through practical training. Training has to be given to the workers by showing the pictures and films this will help the non-educated workers to understand easily. Put the pictures in the notice board or put the picture in the place where all the workers can see (canteen). Ensure that all the workers are given the Proper personal protective equipment (PPE) according to the work, according to the workers need and according to the working condition not only hats and boots should be supplied to the workers but all kind of life personal protective equipment should be made available for the workers.

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