"SAFETY MANAGEMENT AND HAZARDS CONTROL MEASURES IN CONSTRUCTION"

A Thesis

Submitted in partial fulfilment of the requirements for the award of the degree of

MASTER OF TECHNOLOGY

IN

CIVIL ENGINEERING

With specialization in

CONSTRUCTION MANGEMENT

Under the supervision of

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CERTIFICATE

This is to certify that the work which is being presented in the thesis titled **"SAFETY MANAGEMENT AND HAZARDS CONTROL MEASURES IN CONSTRUCTION"** in partial fulfilment of the requirements for the award of the degree of Master of Technology in Civil Engineering with specialization in "**CONSTRUCTION MANAGEMENT** and submitted to the Department of Civil Engineering, Jaypee University of Information Technology, Waknaghat is an authentic record of work carried out By Rahul Sharma (Enrolment No. 152606) during a period from July 2016 to May 2017 under the supervision of **Dr. Ashok Kumar Gupta** Professor and head of Department of Civil Engineering, Jaypee University of Information Technology, Waknaghat.

The above statement made is correct to the best of our knowledge.

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ABSTRACT

With the rapid globalization there is a massive increase in construction activities all over the world specially in developing country like India. The present study deals with the hazards arising in these construction activities. This thesis will be useful to avoid potential hazards as the data used in the project was obtained after evaluating the questionnaires supplied to 25 active construction companies out of which 12 active companies corresponded with answered questionnaires. The thesis focuses on the use of RII (relative importance index) technique for evaluating different critical factors and proposing several mitigation techniques for avoiding hazards occurring during construction stages of project. The hazard analysis, accident analysis causes of accidents types of hazards were closely studied to achieve unsafe conditions.

CHAPTER 1

INTRODUCTION

1.1 GENERAL

Construction is the second largest economic activity in India, next to agriculture. Construction workers constitute 7 to 8% of the world labour force and this figure may be as high as 15 to 20% in some countries. Construction is one of the important economic activities in India. Construction industry offers employment opportunities to all people from highly skilled to totally unskilled labourer.at a construction site, several people work at the same time at the same at different levels. Workers, machines, over- head cranes, all should have to work in a congested area. The work should be carried out at a tremendous speed. Thus construction work is hazardous by its nature itself.

In the construction industry the possibility of a fatality is five times more likely than in manufacturing industry, where the risk of a major injury is two times higher. India has the world's highest accident rate among construction workers, according to a recent study by the international labour organization (ILO) that cited one survey by a local aid group showing that 165 out of every 1,000 workers are injured on the job. Thus it is necessary to promote the safety program to give the confidence and support of the employees. All available means like group meetings, posters, signs, and pictures should be brought into practice. The safety program must be provided from the time an employee is hired. Constant education and training is required in order to create safe environment in workers. An attitude of mind that will be as nearly automatic in its reactions as is humanly possible is to be included in every individual. This can be achieved by a process of continuous education training.

Safety can be defined as an individual's physical and mental readiness in doing a piece of job safely. Safety, like discipline, is a way of life, a state of mind, a force of habit.

Safety must be a part of each individual, in every activity, at all times and everywhere. The Murphy's law states that, "if there is a way to do a thing incorrectly, it is a sure thing that someone will do it that way.

Accidents is defined as an unexpected and desirable event resulting in damage or harm.

Hazards is an unsafe conditions or activity that if left uncontrolled can contribute to an accident.

Risk is assessment of probability of loss and "potential amount of loss".

1.2 IMPORTANCE OF SAFETY

1. Safety reduce the project cost as if any accident occurs the it will increase indirect cost of the project.
2. It is a moral and legal obligation of construction manager to provide a safe working place and of workers to work safely
3. Project runs on schedule as if any accident take place it affects the scheduling of the project, work site of the project, and project may be delayed, therefore safety also takes care of time.
4. Efficiency of project will also increase.
5. Unfavourable image for the client and adverse effect on a contractor's reputation when the project suffers high accident rates, therefore company's reputation will be better.

1.3 PDCA CYCLES

The safety management team of all construction company team follow's "PDCA" cycles to ensure the site safety.

PDCA stand for: -

P – PLAN

D – DO (communication and responsibility)

C - CHECK

A – ACT

The PDCA cycles cover both IS-14001 environmental management system (EMS) and IS-18001 occupational health safety assessment series (OHSAS). For ensuring safety and health at construction site we have study the types of hazards and identification of unsafe act and unsafe condition that may cause risk.

1.4 NEED OF STUDY

Project is to know the importance of safety in construction projects. There are several accidents happen in the construction projects which may delay the project and also may

increase the cost of the project. throughout the world the construction is one of the most hazardous industries. there are so many projects in India which are being delayed or stopped due to inadequate safety measures and lack of knowledge about proper safety techniques to be used on site.

Different type of accident happens in the construction project. So there is need to study and identify root causes of accidents and try to minimize them. So accidents should be managed in a proper way to avoid such type of delay and failure of project in future.

1.5 OBJECTIVE

1. The thesis deals evaluation of various parameters like hazard analysis, accident analysis, causes of accidents and types of hazards to obtained unsafe act and unsafe condition arising in a construction working environment.
2. To obtain real response from company staff of various construction companies using the above evaluated unsafe act and unsafe condition. This was achieved by supplying a self-prepared questionnaire to the companies and receiving their response.
3. The application of RII method for calculating of five critical factors based on which different mitigation techniques are also parped. The input database for RII analysis was provided by the answered companies questionnaire.

1.6 SCOPE OF THE PROJECT

Scope of the project to explore safety and control measures in building construction projects in India by questionnaires survey of different building projects in different part of the country mainly focusing on building of northern region.

From the questionnaires critical factors shall be identified using the RII method and the suggested preventive measures shall be found and analysed to conclude their efficiency.

CHAPTER 2
LITERATURE REVIEW

2.1 GENERAL

Literature review is a critical summary of published research literature relevant to a topic under consideration for research. In this project, literature under-mentioned presents an objective and critical summary of work being carried out on safety management and hazard control measures in construction and how to ensure the required safety on construction sites. This literature also presents the measures to eliminate the safety hazards while construction. The purpose of literature review is to know the research already done and its future significance on this topic. Following literature review is presented in chronological order starting from recent work.

2.2 WORKSITE HAZARD ANALYSIS

Worksite analysis is the method of identifying hazards related to a project's construction events and the construction site. Identify the workplace hazards before determining how to keep employees. In performing worksite studies, consider not only hazards that presently exit in the workplace, but also those hazards that could occur because of change in events or procedures or because of other factors, such as parallel work activities. First, perform hazard analyses of all construction projects previous to the start work, determine the hazards involved with each phase of the project and perform steady safety and health site inspections.

Second, require managers and employees to inspect their workplace previous to the start of each work shift or new activity, study accidents and near misses, and analyse trends in accident and injury data.

A project hazard analysis should be achieved for each project prior to the start of work and should provide the basis for the project-exact safety and health plan. The project hazard investigation should identify the following:

1. The expected phase of the project.
2. The types of hazards likely to be related with each anticipated phase.
3. The control measures required to project site workers from the identified hazards.

4. Those phase and specific processes of the project for which activities or related protective measures must be designed, overseen, approved, or inspected by a listed professional engineer or competent person.

Those phase and specific operations of the project that will require additional analyses are those that have a difficulty of hazards or unusual activities involved, there is uncertainty regarding the site conditions that will be present at the time of construction, or there is anxiety for construction methods that will be used to complete the phase or operation.

A phase hazards analysis may be achieved for those phase of the project for which the project hazards analysis has recognized the need for further analysis, and for those phase of the project for which construction methods or site situations have changed since the project hazards analysis was completed. As suitable, the phase hazard analysis should include the following:

Identification of the specific work processes or procedures. An evaluation of the hazards associated with the exact chemicals, equipment, materials, and procedures used or present during the presentation of that phase of work.

1. An evaluation of the safety and health impacts of any change in the calendar, work procedures, or site disorder that have occurred since the performance of the project hazard analysis. Identification of specific control measures necessary to defend workers from the identified hazards.
2. Identification of specific operations for which protective measures or procedures must be designed, overseen, approved, or examined by a registered professional engineer or capable person
3. Identification of the specific work processes or procedures.
4. An evaluation of the hazards associated with the exact chemicals, equipment, materials, and procedures used or present during the presentation of that phase of work.
5. An evaluation of the safety and health impacts of any change in the calendar, work procedures, or site disorder that have occurred since the performance of the project hazard analysis.
6. Identification of the specific work processes or procedures Identification of the specific work processes or procedures.

7. An evaluation of the hazards associated with the exact chemicals, equipment, materials, and procedures used or present during the presentation of that phase of work.
8. An evaluation of the safety and health impacts of any change in the calendar, work procedures, or site disorder that have occurred since the performance of the project hazard analysis.
9. Identification of specific control measures necessary to defend workers from the identified hazards.
10. Identification of specific operations for which protective measures or procedures must be designed, overseen, approved, or examined by a registered professional engineer or capable person.

2.3 ACCIDENT ANALYSIS

Accident investigation is a technique which has been used by the national mine safety and health academy in Beckley, west Virginia, to examine mining-related accidents and events. There are many comparisons between the mining and construction industries; therefore, it makes this analysis technique also related to the construction industry.

The following are working definitions of accident and instance:

Accident is any undesired event causing in personal injury and/or property damage and/or equipment failure.

Accidents and incidents are usually intricate. They may result from ten or more individual or unexpected events. Elimination of one or more of those events may result in to accident at all. Analysis of an accident agents may want to know

1. Time of day
2. Location
3. Casualty
4. Accident type
5. Unconfined energy
6. Nature of injury

7. Equipment being used
8. Unsafe act
9. Hazardous materials
10. Policies and decisions
11. Unsafe conditions
12. Environmental factors
13. Personal factors
14. Influence of other on the incident.

All of those may have donated to the accident. The resolved of this section is to systematically guide an accident investigator through a three-level method to accident cause, identically and analysis. Once accident reasons have been identified, references and specific preventive measures for each casual factors may be developed.

2.3.1 CAUSUES OF ACCIDENTS

In order for work to progress in the workplace, certain components must cooperate. These components are people, equipment, and provisions. These three interacting components use recognized procedure to accomplish the job. When these components cooperate according to planned methods, the effect will most likely be efficient or safe production. However, at some point, something accidental may happen.

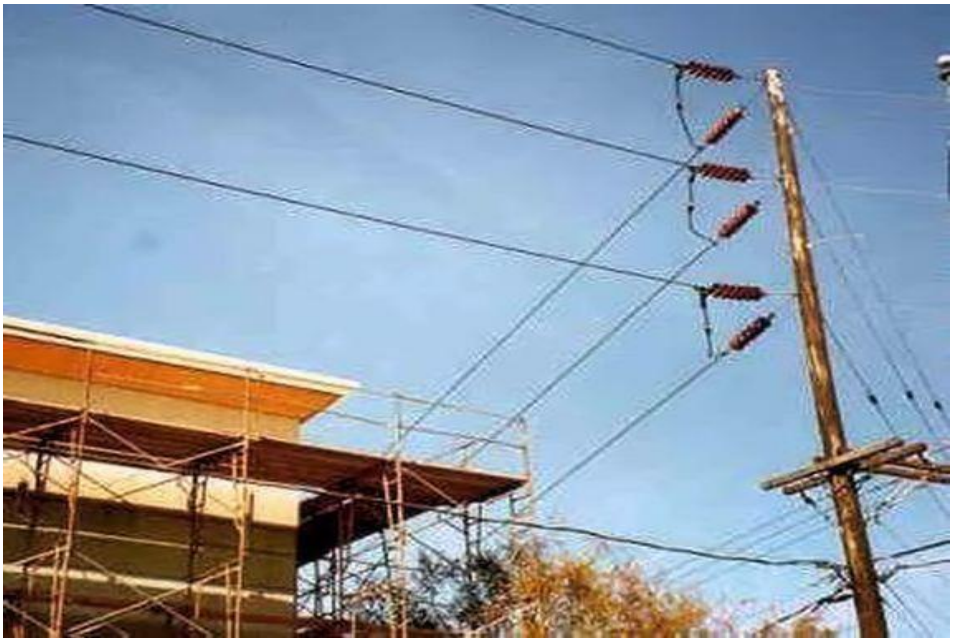

FIGURE 2.1 Electrical energy sources at construction worksites are power lines

FIGURE 2.2 An unsafe/congested work area

Development worksites manage every one of these segments which might be calculates the vast quantities of mischances/occurrences happening on development ventures.

Undertakings are not performed in disengagement. The physical condition continually impacts the cooperation of specialists, machines, and materials. These impacts might be either useful or destructive. Different elements additionally influence undertaking execution. These variables are a piece of the social condition (e.g., government offices, unions, families and companions, organization administration). Social condition variables may, in like manner, be useful or destructive. In this mischance/occurrence examination idea, the impacts of the considerable number of connections may bring about either a fruitful employment finish or a mishap. The accompanying are cases of the outcomes of these sorts of impacts.

2.3.2 ANALYZING ACCIDENTS

To investigate a mischance or episode it is important to know, at the very least, the sort of mishap, kind/nature of any individual harm, property harm, or gear disappointment. Some examples of accident types include the following:

1. Struck against.
2. Caught in, under, or between.
3. Rubbed or scraped.
4. Physical reaction.
5. Struck by.
6. Overexertion.
7. Contact with electricity.
8. Contact with temperature extremes.
9. Contact with radiation, caustics, toxic, or noxious substances.
10. Fall from height.
11. Fall to same level.
12. Public transport.
13. Motor vehicle

Personal injuries include broken bones, scratches, etc. Property is damaged by fire, water, accidents, etc. Equipment failures include hydraulic leaks, metal tiredness, etc. All these have occurred at construction worksites.

2.3.3 DIRECT CAUSUS

When making a point by point examination of a mischance or occurrence, consider the arrival of vitality as well as perilous material as an immediate cause. Vitality or risky material is thought to be the constrain which brings about harm or other harm at the season of get in touch with It is critical to distinguish the direct cause(s). Keeping in mind the end goal to counteract harm, it is frequently conceivable to update gear or offices and give individual security against vitality discharge, or discharge/contact with dangerous materials. A few cases of direct causes as vitality or dangerous materials sources are found in Table 2.1.

Energy Sources	Hazardous Materials
1.Mechanical:	1.Compressed or liquid gas:
Machinery	Flammable
Tools	Non-flammable
Noise	2. Corrosive material
Explosives	3. Flammable material:
Moving objects	Solid
Strain	4. Poison
Liquid	5. Rusting material
2. Electrical: Gas	6. dust
Uninsulated electrodes	
High voltage sources	
3.Thermal:	
Flames	
Hot surfaces Molten metals	
4. Chemical:	
Acids	
Bases	
Oils Explosives	
5. Radiation:	
Lasers	
X-rays	
Microwave	
Energy Sources	
Welding	

TABLE 2.1 Sources of Direct Connecting Agents

2.3.4 INDIRECT CAUSES

Unsafe acts and/or unsafe conditions include indirect causes of accidents and/or incidents. These indirect causes can impose injury, property damage, or equipment failure. They allow the energy and/or hazardous material to be released. Unsafe acts can lead to unsafe conditions and vice-versa. Examples of unsafe acts and unsafe conditions are found in Table 2.2.

Unsafe Acts: - 1.Failure to wear PPE 2. Failure to warn co-workers or to secure equipment 3. Disregarding equipment/tool defects 4. Improper lifting 5. Improper working location 6. Improper use of equipment: At extreme speeds Using faulty equipment Servicing moving equipment 7. Operating equipment without expert 8. Exuberance 9. Making safety devices inoperable 10.Drug misuse 11.Alcohol use Unsafe Conditions: - 1. Overfilled work areas 2. Defective machinery/tools 3. Improperly stored explosive or hazardous materials 4. Poor lighting 5. Poor ventilation 6. Scarce supports/guards 7. Poor housekeeping 8. Radiation revelation 9. Extreme noise 10. Hazardous atmospheric conditions

TABLE 2.2 Unsafe Acts and Condition

2.3.5 BASIC CAUSES

Some mischance examinations result just in the ID and remedy of backhanded causes, however aberrant reasons for mishap are manifestations that some hidden causes exist which are regularly named fundamental causes. By going above and beyond, mischances

can best be forestalled by recognizing and rectifying the fundamental causes. Fundamental causes are assembled in Table 2.3.

At the point when fundamental causes are dispensed with, risky acts/hazardous conditions may not happen (e.g., Charlie South utilized a broken mallet in light of the fact that no substitution pound existed in the apparatus container). For Charlie's situation, the essential cause, absence of stock control techniques, set up his consequent risky act.

Mischances, in this way, have many causes. Fundamental makes lead perilous acts and risky conditions (backhanded causes). Aberrant causes may bring about an arrival of vitality as well as perilous material (direct causes). The immediate cause may take into consideration contact, bringing about individual harm or potentially property harm as well as hardware disappointment (mishap).

Basic Causes: -

Policies and Decisions

1. Safety policy is not
   - in writing
   - employed by top management
   - distributed to each employee
   - reviewed occasionally
2. Safety procedures do not provide for
   - written manuals
   - safety meetings
   - job safety analysis
   - housekeeping
   - safety reviews/inspections
3. Safety is not considered in the procurement of
   - provisions

- equipment
- services

4. Safety is not considered in the personnel performs of
   - selection
   - hiring
   - training
   - placement
   - medical investigation
   - authority
   - responsibility
   - liability

Personal Factors: -

1. Physical
   - inadequate size
   - inadequate strength
   - inadequate energy
2. Experiential
   - insufficient knowledge
   - inadequate skills
   - accident records
   - unsafe work practices
3. Motivational
   - needs
   - abilities
4. Attitudinal
   - toward others — people company job
   - toward self — alcoholism drug uses sensitive upset

5. Performance
   - risk taking
   - lack of hazard alertness

Environmental Factors: -

1. Unsafe facility design
   - poor mechanical layout
   - insufficient electrical system
   - inadequate hydraulic system
   - crowded incomplete access ways
   - insufficient illumination
   - inadequate ventilation
   - lack of noise control
2. Unsafe operating procedures
   - normal
   - backup
3. Weather
4. Geographical area

TABLE 2.3 Basic Causes

When an accident investigation is received, the statement should contain listed information about the accident. As a minimum, the accident statement should include the following:

1. date
2. time
3. name(s) of incapacitated
4. accident/incident type
5. description of accident/incident
6. list of property damage
7. list of apparatus involved

8. direct causes
9. indirect causes
10. basic causes
11. references for prevention of direct causes
12. references for prevention of indirect causes
13. references for prevention of basic causes.

2.4 TYPES OF HAZARDS

Building construction hazards may be summarized under the following headings:

1. Design hazards.
2. Hazards due to the use of definite persons.
3. Hazards due to use of construction materials.
4. Hazards due to Falls.
5. Hazards due to Equipment.
6. Hazards due to construction methods.
7. Electrical hazards.

2.4.1 DESIGN HAZARDS

In practice, it is hard to suspect the deadly perils which development specialists experience regularly, some of these, if known can be limited by configuration measure. In the event that one knows about any ecological issue in a range where formative move is to be made place, one should consider these issues in the outline to deflect conceivable danger (Orji 2014).

The motivation behind any building structure is to full fill some human needs. The plan of any such structure must full fill the utilitarian targets of wellbeing, serviceability, and economy. The structure must be protected under the most exceedingly terrible arrangement of burdens. Under outrageous loadings, harm to the structure can be confined and conceivable loss of lives decreased, yet dynamic and calamitous breakdown must not happen. Under the working burden, the miss happening of the structure must not debilitate the appearance toughness and execution of the structure (Ede 2011).

As indicated by Davison and Owens (2003) as referred to in Ede (2011), the outline stage is the arranging and plausibility examines organize in which experts may help the proprietors to assess the specialized and efficient alternatives accessible and after that understand the plan. The outline comprises of the making of the compositional shape, distinguishing proof of the heaps for basic plan, mechanical and electrical outlines, determination of materials and proportioning of the segment. They additionally expressed that amid this stage, the fundamental necessity of security, tasteful, economy, and constructability must be viewed as regardless of the customer's brief.

2.4.2 HAZARDS DUE TO THE USE OF DEFINITE PERSON

Jambool (2012), deplored that the recurrence of crumple of structures in Nigeria in the current past has turned out to be vexatious, threatening and humiliating. The frequencies have turned into an issue of worry to all partners in the development business and for sure, the fabricated condition as the maintainability of the constructed condition is progressively and enormously debilitated. The effect of building breakdown has influenced the whole texture of human attempt, running from mental injury on those influenced to the economy of the country. Lives and properties are lost, income to government in apartment rates and charges are lost, ventures and in this manner occupations are lost, casualties endure lasting handicaps, vagrancy, among others, including fatalities.

Salah (1996) referred to in Ede (2011), highlighted the prior instances of building breakdown checked in Nigeria and their conceivable causes and recommended in addition to other things the association of qualified experts in the diverse periods of building development prepare and the survey of scholarly program to improve the limit of specialists and technologist in the building business. The engagement of unfit people in building development prepare has been one of the primary reasons for building breakdown in Nigeria and the conceivable causes can be followed to the exercises that happen in the origination – plan arrange, development supervision stage and post development benefit organize. For an acknowledgment of value employments in any of these phases of building procedure, an abnormal state of expertise and polished skill is required.

Ede (2011) additionally expressed that the development stage is the execution organize where each exertion is made to guarantee consistence with the outline and particulars. The exercises that happens inside this stage are so gigantic and frequently clashing that lone a prepared proficient can deal with them. Guaranteed Architects, Builders, Engineers and

gifted craftsman's have their individual parts in this stage in order to authorize the quality confirmation specification. Therefore, the expert bodies ought to venture up their reconnaissance of the building area in order to launch the shams.

2.4.3 HAZARDS DUE TO CONSTRUCTION MATERIALS

Construction work includes the utilization of various materials to understand a structure; these materials are produced using the blend of substance mixes which posture peril to wellbeing. The majority of the essential development materials like concrete, glass, metals, paints, asbestos, black-top and so on stance extremely serious wellbeing danger amid site application than amid assembling. For example, silica, concrete, timber, quarry and asbestos clean are known to bring about lung contamination, impedance, endless obstructive lung sicknesses, prohibitive lung illnesses, pneumoconiosis, genuine bacterial disease, skin tumour and carcinoma of the lungs, stomach and colon (Olatunjietal 2007).

To additionally intensify the circumstance, the Nigerian development market is overflowed with materials of obscure respectability that are feeble to bolster the planned load and along these lines causes mischance because of disappointment of built parts (Development Storm 2002).

Perils due development materials can originate from the capacity arrange intended for the materials in the site. In a perfect world, materials ought to be put away as per the recommended technique; dangerous materials ought to secure by a fleeting spread. Access to those storage rooms ought to be limited to particular individuals.

Development Storm (2002) additionally presented that a decent site format plan is essential for a mishap free site and endeavour's ought to be put on legitimate development materials squander transfer. Dangerous squanders must be put away in fixed compartments built of reasonable material with a name that unmistakably demonstrates the substance and collection dates.

2.4.4 HAZARDS DUE TO FALLS

Tumbles from stature is the main source of damage in the development business. In the Sheltered Work Australia (2013), eight-year time frame overview from 2003 to 2011, uncovered 232 passing's which represented 11% passing's coming about because of tumbles from tallness. In another accommodation by Oladiran and Sodano, mishaps coming about because of stature got the most astounding positioning.

Inadvertent falls are regular in development ventures since labourer's are presented to unsafe circumstances like working from a tallness with the guide of platforms and stepping stools. Tumbles from platform or steps regularly result from the utilization of inadmissible stepping stool and flawed or ineffectively built frameworks. Also, development labourer's barely get any preparation to set them up for such work, and platforms development is not legitimately administered. Seeker (2011), in this way advices that businesses must give a full security program that will propel the general wellbeing of the work environment. Such program ought to incorporate giving fall security frameworks, for example, watch rails, wellbeing nets, individual fall capture framework, situating gadget framework and cautioning line framework.

Different types of fall considered in this writing are fall of hard questions from a stature and aimless transfer of hard protests by labourer's from a tallness. For this situation, hard cap ought to be worn in addition to giving wellbeing meshes around the borders of the building. Platform ought to be checked to be sound, unbending and sufficiently adequate to take care of its fair share in addition to four times the most extreme proposed stack without settling or influencing. It must be raised by a prepared faculty. Step ought to be legitimately built to have the capacity to convey any expected load.

2.4.5 HAZARDS DUE TO EQUIPMENT

In elevated structure structures, development makes more utilization of hardware extending from the hand controlled instruments to refined sorts like crane and lift. The utilization of these gear can posture hazard to specialists. Fischer (1998) distinguished the primary driver of mechanical dangers as human mistake and inward mechanical breakdown including the directing instrument and slowing mechanism. Referring to a case with the crash of a loader with the mass of building, which came about to the passing of a specialist, he built up that mechanical disappointment of machine parts can happen at whatever time regardless of being in great condition at the onset. For this reasons, it is basic that parts of machines be checked before working them; in a perfect world, routine administration looks at ought to be conveyed at interims as indicated by the medicines of the machines' makers.

In a comparative circumstance, Seeker (2011) presented that hardware risks can introduce themselves in ground labourer's being struck by a vehicle altering course, moving over of

gear, running over of vehicles when brakes are not appropriately set, falling of gear from back scrapers, pails and moving development vehicles.

Gear dangers can be dispensed with and controlled by strict adherence to all development wellbeing rules, for example,

1. Using and working vehicles under an arranged preventive upkeep plot.
2. Providing all vehicles with driving and gadgets fit for giving cautioning of forward and in reverse methodologies.
3. Keeping turning around to without a doubt the base.
4. Designating stopping zones for vehicles on level ground that has great surface and satisfactory get to.
5. Providing a motivating force for drivers to take pride in their vehicle.
6. Providing great and very much characterized get to routes for vehicle acquiring development materials, hardware and evacuating surplus soil or harmed materials from site.

2.4.6 MANGMENT OF CONSTRUCTION HAZARDS

Administration of development danger is not getting the required consideration that it merits in Nigerian development industry; this might be because of the way that it doesn't deliver an immediate profit that is effectively seen, not at all like the real creation handle. Shockingly for the business, assets are squandered each year, the industry is truly confronting the shortage of its workforce, which is apparent in the shortage of gifted craftsman’s and an overwhelming dependence on transient labourer’s.

Various security safety measures to be gone up against development site have been recommended by Michele et al. (2011) as takes after:

1. Perform a careful stroll through of the site to distinguish and survey any work environment danger and record anything that might be viewed as dangerous.
2. Train all staff in work-site wellbeing and working method either on location or at preparing office: preparing ought to incorporate legitimate lifting procedures to help decrease regular back wounds.
3. Identify and stamp any risky material and decide any hazard required to faculty: name and store any material regarded unsafe in appropriate holder and secure them in a sheltered area. Ensure there is a MSDS (material security information sheet) for all possibly perilous chemicals/materials.

4. Inspect gear to make certain it is working legitimately: be watchful for unordinary commotion and jerky development. Report any issue instantly and don't work the apparatus until repairs have been made.
5. Use saddles and other security hardware when performing rooftop work or chipping away at the platform.
6. Provide individual defensive hardware to all representatives, including hard caps, security goggles and boots, hand gloves, ear plugs (or another type of defensive) and face veils.
7. Be beyond any doubt OSHA (word related security and wellbeing organization) benchmarks are met. Draw in a wellbeing and security assessor.
8. Prepare for crises, administrators and site specialists ought to realize what to do if there should arise an occurrence of electrical, mechanical and power disappointment or wounds.
9. Protect the general population by blockading the development site amid work hours. In the wake of working hours bolt all purpose of section.

2.4.7 ELECTRICAL HAZARDS

Electrical danger is viewed as one of the significant perils in development adding to around 350 passing's every year (OSHA).

So also the Agency of Measurements referred to in OSHA (2002) recorded that 278 specialists passed on from electric shock at work in 1999, representing just about 5% of all at work fatalities that year. Another accommodation by McCann and Paine (2002) uncovered that electrical and electric shock mishaps on location in the vicinity of 1992 and 1998 represented 1002 passing's because of electric shock and 17 because of electrical flashes nearby. Tragically, insights are not accessible in Nigeria to demonstrate the quantity of passing's or wounds emerging from electrical perils, yet McCann and Paine's accommodation demonstrated that the primary casualties of electrical wounds are electrical labourer's all things considered their discoveries might be connected to Nigeria since development, regardless of the geological area has similar components.

The reasons for electrical passing or damage nearby as indicated by Brenner and Cayley (2009) in their diminishing request of significance are: contact with overhead electrical cables, contact with wiring or other electrical parts, contact with electrical current from machines, instruments and apparatuses and contact with underground electrical cables.

Electrical dangers can be stayed away from by watching the important security measures, for example, arrangement of individual defensive hardware (PPE). Lockout and labelling of flawed and sit out of gear electrical gadget, guaranteeing that all links are in legitimate condition before any electrical gadget is exchanged on, guarantee that no one might associate, keep up or change electrical hardware or establishments unless the individual is a circuit tester affirmed under the exchanges capability and apprenticeship.

2.5 UNSAFE ACT AND UNSAFE CONDITIONS

Following unsafe acts and unsafe condition where identified from above study:

2.5.1 UNSAFE ACTS:

1. Opening and closing of switches without authority or warning.
2. failure to place warning signs or signals they are needed.
3. working unsafety such as throwing materials or tools at another worker.
4. using unsafe equipment, wrong tools for the job or using hands instead of right tools.
5. Operating hoists and tracks without proper communication.
6. Over confidence like working or live electrical equipment that could be conveniently energized.
7. Taking unsafe position or posture too close to openings and lifting in an unstable position.
8. Distracting, teasing, joking, quarrelling, annoying.
9. Failure to use recommended safety protection equipment.

2.5.2 Unsafe conditions:

1. Working at elevated place.
2. Improper earthing.
3. Working on lines without taking proper safety precautions.
4. Unguarded floor openings, and excavations.
5. Exposed live wires.
6. Improper illumination.
7. Constrained location.
8. Unsafe design and construction such as poor scaffolding, structure, platforms.
9. Working on transmission lines.
10. Emergency work, leading to hurried working.

2.6 CONSTRUCTION WORKER'S PERCEPTIONS OS SAFETY PRACTICES: A CASE STUDY IN MEXICO, CARCANO AND FRANCO POOT [1]

Categorized qualities and specialist recognitions were among the primary variables influencing the security atmosphere in development locales. Albeit a few view of laborers may appear to be ridiculous to others, these segments were a piece of their existence. Laborer conduct was a critical calculate working environment wellbeing the same number of mishaps were regularly created by shaky activities, in which blends of human conduct were the result of such discernments. The point of this review was to investigate laborers' view of security practices in their chronic workplace, a building site in Mexico. Specialist view of wellbeing practices were caught utilizing an instrument in which the accompanying measurements were thought about: Education and preparing, Work inspiration, Family and social incorporation, Work put mix, Safety mindfulness coordination, and Accidents. The creators inferred that laborers have gotten next to no instruction and have a constrained culture of security mindfulness, which drove them to see that their absence of safeguard was the primary driver of mischances.

2.7 IDENTIFING THE CRITICAL FACTORS AFFECTING SAFETY PROGRAM PERFORMANCE FOR CONSTRUCTION PROJECTS WITH IN PAKISTAN CONSTRUCTION INDUSTRY, ZUBAIR AHMED MEMON, KANYA LAL KHATRI AND ALLAH BUX MEMON [2]

A survey review was led to highlight the impact of the Development Security Components. The poll review was dissected utilizing Point (Normal Record Strategy) and rank connection test was directed between various gatherings of respondents to gauge the relationship between various gatherings of respondent. The creator finding that administration support is the basic element for actualizing the security program on ventures. From factual test, the creator additionally presumed that every respondent gathering was firmly for administration bolster figure as CSF (Basic Achievement Consider).

2.8 RESEARCH NEEDS FOR BUILDING INFORMATION MODULING FOR CONSTRUCTION SAFETY, DR. KIHANG LU AND THOMAS MILLS RA [3]

Lettering shows that there is an absence of responsive devices and assets to help creators with tending to development security. Current apparatuses are basically message based independent registration sort instruments which are either gotten to through paper or programming interface. All the while, the present and developing development of BIM in the development business is putting forth new means and ways to deal with enhance the wasteful aspects of paper-based procedures. While trying to exploit the capability of BIM for security in plan and to encourage its coordination, this paper diagrams the essential attributes of existing outline for-wellbeing (DFS) devices and expounds on the capability of BIM for security. The paper arranges BIM by functionalities and maps appropriate DFS ideas to depict the imperatives. The paper recognizes future research requirements for key parameters of BIM instruments to better address security contemplations and recommends that a BIM for Wellbeing approach which consolidates comprehension of peril acknowledgment and outline improvement could prompt be making a manufactured domain that effectively coordinates more secure development forms.

2.9 STRUCTURAL EQUATION MODEL OF CONSTRUCTION SAFETY CULTURE, THARWADER CHINDA AND SHERIF MOHAMED [4]

Goal – This paper embarks to depict the advancement and observational testing of an auxiliary condition model of development wellbeing society. A key commitment of the model is giving experiences into the connections among wellbeing society empowering influences, and the connection between those empowering influences (what the association is doing) and security culture objectives (what the association means to accomplish) with regards to the Thai development industry.

Plan/system/approach – In light of the universally perceived EFQM Fabulousness show, this paper exactly inspects the connections and causal connections between five empowering influences (i.e. Administration, Arrangement and system, Individuals, Organizations and assets and Procedures) and wellbeing result (i.e. Objectives). The paper uses the auxiliary condition displaying system to test the theorized positive between connections between the empowering agents and objectives. A poll review was directed to a specimen of development contracting associations working in Thailand to evoke conclusions on the diverse qualities with regards to their present wellbeing practices and execution.

Discoveries – Bolstered by exact confirmation, this review built up that right off the bat, the Initiative empowering influence specifically impacts the usage of Approach and Procedure, in

any case, its impact on Associations and Assets seems, by all accounts, to be a roundabout one; also, Organizations and Assets was found to in a roundabout way influence Procedures through Arrangement and System, which in like manner gives off an impression of being in a roundabout way affected by the General population empowering agent.

Innovation/esteem – This review gives a more noteworthy comprehension of the communications between the key components of wellbeing society (empowering agents and objectives), and among the empowering influences themselves.

2.10 WHY OPERATIVE ENGAGE IN UNSAFE WORK BEHAVIOR: INVESTIGATING FACTORS ON CONSTRUCTION SITES, RAFIQ M. CHOUDHRY, DONGPING FANG [5]

Choudhry and Fang did an examination on the conduct center and found that laborers are included in perilous conduct due to absence of security mindfulness, putting on an extreme picture, work weight, colleagues' dispositions, hierarchical, monetary and mental components. The creator proposed suggestions for enhancing site wellbeing by tuning in to the perspectives of the subcontractor's specialists. The purpose for this was the subcontractors manage distinctive circumstances that judge their activity on how best to function securely on a development extend. The goal was separated into three sections: laborers perspective, perilous practices and security conduct. The creator's objective was to comprehend the specialist's perspective in the matter of why mischances happen and this was refined by performing top to bottom meetings with laborers. Increasing comprehension of why development laborers participate in dangerous work conduct and distinguishing components that impact their wellbeing conduct was a piece of their review.

2.11 SAFETY PERFORMANCE IN TH EGYPTIAN CONSTRUCTION INDUSTRY, AMN A.G HASSANEIN AND RAGAA S. HANNA [6]

This review introduces the after effects of a poll overview that was directed among a chosen test of huge size contractual workers working in Egypt, and also an examination of the wellbeing approaches in both the Assembled States and Egypt. The outcomes uncovered that security programs connected by substantial size contractual workers in Egypt were less formal than those connected by their American partners. Just a couple organizations out of the reviewed test had mischance records separated by ventures and gave laborers formal security introduction. The creator suggested that changes in the method for the business' commitment

to social protection were vital; accordingly connecting mishap protection expenses to the temporary worker's security execution. This is intended to fill in as a solid impetus for security administration.

2.12 EXPLORING THE INTEGRATION OF HEALTH AND SAFETY WITH PRE- CONSTRUCTION PLANNING, BILLY- HARE, IAIN CAMERON AND A. ROY DUFF [7]

Purpose – The motivation behind this paper is to provide details regarding discoveries from an exploration extend, dispatched by the UK Wellbeing and Security Official (HSE), to examine the reconciliation of wellbeing and security with pre-development arranging.

Outline/system/approach – Four guiding gatherings and three master boards were talked with, utilizing center gathering strategies, to characterize basic achievement figures through subjective, grounded hypothesis, examination.

Discoveries – The principle results from the examination are: basic achievement elements depend on receiving incorporated groups; and successful two-route stream of data is fundamental. Likewise, existing outline and administration apparatuses can be adjusted to fulfill the variables distinguished rather than endorsed necessities for a standard wellbeing and security arrange.

Creativity/esteem – This review has educated further research including the advancement of a passage procedure model and supporting incorporated administration devices. It has additionally educated HSE with arrangement choices for their survey of CDM.

2.13 A REVIEW OF THE LITERATURE ON PREVENTIVE OCCUPATIONAL HEALTH AND SAFETY ACTIVITIES IN SMALL ENTERPRISES, PETER HASLE AND HANS JORGEN LIMBORG [8]

This paper talks about exact research went for looking at the connection between the safety atmosphere and safe work conduct in development site situations. A writing survey has distinguished various autonomous develops with the possibility to influence the wellbeing atmosphere. An examination model was produced in view of the speculation that sheltered work practices are outcomes of the current security atmosphere, which, thusly, is dictated by the recognized free develops. A poll overview was utilized as a part of request to encourage the accumulation of data from development locales. The model was tried utilizing basic

condition displaying. The paper exhibits the consequences of testing the exploration display. The outcomes verify the significance of the part of administration duty, correspondence, specialists' inclusion, demeanors, ability, and additionally strong and supervisory situations, in accomplishing a positive safety atmosphere.

2.14 CONSTRUCTON SITE SAFETY ROLES, T. MICHAEL TOOLE, P.E, MASCE [9]

A study of configuration specialists, general temporary workers, and subcontractors demonstrates there is not uniform concurrence on the site wellbeing duties that ought to be expected by each of these gatherings. Conceivable clarifications for this absence of shared assumptions with respect to site security parts are talked about. It is recommended that particular site security duties be appointed on future undertakings in light of each gathering's capacity to control the variables expected to avoid eight main drivers of development mishaps.

2.15 CONSTRUCTION INDUSTRY ACCIDENT IN SPAIN, MIGUEL A CAMINOLEZ, DALA O RITZEL, IGNACIO FORTANEDA, OSCAR J GANZALIZ ALCANTARA [10]

They investigated mechanical mishaps that occur on development locales and their seriousness. Eighteen factors were contemplated. They broke down the impact of each of these regarding seriousness and casualty of the mischance. The clear examination was grounded in 1,630,452 mischances, speaking to the aggregate number of mishaps endured by specialists in the development segment in Spain over the period 1990-2000. The creators presumed that age, kind of agreement, time of mischance, length of administration in the organization, organization measure, day of the week, and impacted the earnestness of the mishap. The examination gave a knowledge into the imaginable reasons for development wounds in Spain. Therefore, of the investigation, businesses and administrative offices in Spain began to give proper techniques and preparing to the development specialists.

2.16 BENCHMARKING STUDIES ON CONSTRUCTION SAFETY MANGEMENT IN CHINA, D.P FANG, X Y HUANG AND JIMMIE HINZE, M. ASCE [11]

This paper presents data to gauge security administration execution on development locales. In China, the traditional development wellbeing benchmarking methodology was to survey

security execution by assessing the physical security conditions nearby and in addition the mischance records, while no consideration has been paid to the administration calculates that impact site security. The creators recognized key components that impact security administration and built up a strategy for measuring wellbeing administration execution on development destinations. In view of the overview and meeting, information gathered on wellbeing administration figures 82 development extends in China, the security administration record as a way to assess constant wellbeing administration execution by measuring key administration components was produced. The measured elements were contrasted and the generally acknowledged physical wellbeing execution list, which was gotten from review records of physical security conditions, mishap rates, and the fulfillment of the venture administration group. Multifaceted straight relapse was led and the outcomes show that the security administration execution on location was firmly identified with authoritative elements, monetary elements, and components identified with the connection amongst administration and work nearby. In light of this benchmarking study, a down to earth security appraisal strategy was produced and after that actualized on six development ventures. The creator presumed that this technique can be a successful device to assess security administration on development ventures.

2.17 DEVELOPMENT OF CAUSAL MODEL OF CONSTRUCTION ACCIDENT CAUSATION, AKHMAD SUNAJI, A ROY DUFF AND STEPHEN J PECKITT [12]

Accidents happen in a wide range of development exercises. The mishap causation process is mind boggling. Mishap anticipation requires a far reaching comprehension of this perplexing procedure. This paper proposes a reasonable, yet functional, model of mischance causation for the development business, highlighting the hidden and complex association of components in the causation procedure. The model depicts the limitations and reactions experienced by the gatherings required in venture origination, outline, and development, which may influence mischance causation. This paper points of interest hypothetical discoveries of research presently being directed at UMIST. Both proximal and distal elements are considered (for instance, agent elements, site condition and frameworks of work, and venture administration and hierarchical issues). An investigation of 500 mischance records gave by the U.K. Wellbeing and Security Official demonstrates that mischances in development ventures include wrong development arranging (28.8%), improper development control (16.6%), unseemly development operation (88.0%), wrong site condition (6.0%), and wrong agent activity

(29.9%). Information at present accessible are, in a few regards, deficient and should be supplemented, later on, by augmented mishap examinations.

2.18 MEASURING THE OCCUPATIONAL HEALTH AND SAFETY PERFORMANCE OF CONSTRUCTION COMPAINES IN AUSTRALIA, JOHAN LIN AND ANTHONY MILLS [13]

Various office administrators are presently required to bargain specifically with little firms occupied with the support, change and cleaning of physical framework. Progressively the execution of little firms thinks about the director of the office, thus a comprehension of their operation is required. It is compulsory for all organizations to give a sheltered workplace to their specialists and subcontractors. Thusly, word related wellbeing and security (OHS) is a noteworthy issue for organizations essentially because of the dread of arraignment. The presentation of Zero Tolerance by the Victorian Government Work Cover Authority in 1999 gave much higher OHS wellbeing measures for the development business. This has put an expanded weight on development and support organizations particularly little firms that are not in a place of money related quality. The extent of the organization has been observed to be a noteworthy contributing component to the OHS execution of development temporary workers. This exploration depends on a benchmarking investigation of 44 development organizations in Victoria, Australia. The outcomes demonstrate that the central point affecting security execution were; organization size, and administration and representative duty to OHS.

2.19 EMPIRICAL INVESTIGATION OF CONSTRUCTION SAFETY MANAGEMENT ACTIVITIES AND PERFORMANCE IN AUSTRAILA, S. MOHAMED [14]

He observed the viability of security administration exercises at present received by Australian contracting associations. A security administration study has been directed in the contracting associations working in the State of Queensland, Australia. In view of an exploration show delineating measurable examination methods, a security administration record mirroring the force of level of wellbeing administration exercises has been produced to give a methods whereby singular associations can be evaluated and reviewed on their security administration duty and dispositions. The creator revealed a nitty gritty observational investigation completed to inspect the connection between the power of wellbeing administration duty and the general security execution, expert liveliness and record.

2.20 BEHAVIOR BASED SAFETY MANAGEMENT IN HONG KONG'S CONSTRUCTION INDUSTRY, HELEN LINGARD AND STEVE ROW LINSON [15]

A behavior based way to deal with mechanical wellbeing administration has been upheld by many creators and has been found to successfully enhance security execution in various modern settings and on various landmasses. This paper covers the execution of a conduct based security administration program in the Hong Kong development industry. The conduct based security administration strategies of execution estimation, participative objective setting, and the arrangement of execution criticism were presented in a carefully controlled field investigate seven open lodging development locales in Hong Kong. The paper depicts this test and clarifies how the program was actualized. The consequences of the investigation were blended. Conduct based security procedures were very powerful in achieving enhanced execution in site housekeeping, however huge upgrades in access to statures were just seen on two of the seven locales, and there was observed to be no noteworthy change in the utilization of bamboo framework amid the trial intercession. The paper introduces these outcomes and talks about variables that may have added to the restricted adequacy of the methods in the last two execution classifications.

2.21 INTEGRATION SAFETY AND HEALTH PERFORMANCE IN TO CONSTRUCTION CPM, NABIL A. KARTAM [16]

Risk identification is essential to development wellbeing administration; unidentified dangers introduce the most unmanageable dangers. This paper displays an examination demonstrating the present levels of danger distinguishing proof on three U.K. development ventures. A most extreme of just 6.7% of the technique articulations broke down on these ventures figured out how to recognize the majority of the dangers that ought to have been distinguished, in view of current learning. Most extreme danger distinguishing proof levels were observed to be 0.899 (89.9%) for a development extend inside the atomic business, 0.728 (72.8%) for a venture inside the railroad business, and 0.665 (66.5%) for a venture inside both the railroad and general development industry segment. The outcomes show that peril distinguishing proof levels are a long way from perfect. An examination on the purposes behind low risk distinguishing proof levels demonstrates key hindrances. This prompts the introduction of an Information

Technology (IT) device for development extend wellbeing administration (Total-Safety) and, specifically, a module inside Total-Safety intended to help development faculty create technique explanations with enhanced levels of danger.

2.22 STRATEGIES FOR ACHIEVING EXCELLENCE IN CONSTRUCTION SAFETY PERFORMANCE, EDWARD J JASELSKIS, STURAT D. ANDERSON, JEFFREY S. RUSSELL [17]

A personal study of managers' and representatives' implications of word related wellbeing and security (OHS) chance control was directed among an example of private companies occupied with the Australian development industry. Two OHS dangers applicable to the development business were chosen for study. One hazard (tumbles from tallness) spoke to a prompt outcome, while the other (word related skin ailment) spoke to a long haul wellbeing impact. Implications of the sources and control for these dangers were investigated amid top to bottom meetings. Members saw the quick impact, tumbles from stature OHS chance, as being more imperative in their work environments than the postponed impact, skin malady OHS chance. The danger of tumbles from stature was seen to be controllable yet requiring a lot of push to forestall, while there was a fatalistic acquiescence to the danger of word related skin infection. Implications of hazard control for both word related skin malady and tumbles from tallness concentrated on individual as opposed to innovative hazard controls. Authoritative boundaries to the selection of innovative OHS chance controls in the development business were recognized.

2.23 A SURVEY OF CONSTRUCTION SITE SAFETY IN HONDURAS, EDWARAD J JASELSKIS AND GUILLERMO ARTURO RECARTE SUAZO [18]

A survey was utilized to gather wellbeing related data from development laborers, field administration and upper administration in the Home Office on private, business and substantial common development extends in San Pedro Sula, Honduras. Information were gathered utilizing vis-à-vis interviews - 108 development laborers, 10 field administrators and 8 senior directors took an interest. Information were breaking down utilizing connection, relapse and investigation of fluctuation methods. Comes about exhibited a considerable absence of mindfulness or significance for security at all levels of the development association. Laborers once in a while wore individual defensive gear, utilized ineffectively developed frameworks, dishonorably utilized devices and stepping stools and ignored great housekeeping

hones. Just about seventy-five percent of the skilled workers endured no less than one lost-time mishap; huge numbers of their wounds were in expected areas on their bodies given the way of their work and the site conditions. Large portions of the field extend directors expressed that they didn't give laborers individual defensive gear or wellbeing preparing and did not utilize a committed security individual on location. Best level administration does not seem persuaded that it is to their greatest advantage to enhance wellbeing execution since just around 25% gave a vast security preparing program, kept up mischance records and gave security motivating forces. Extra outcomes, proposals for enhancing development wellbeing in Honduras, examine constraints and future research regions were additionally distinguished.

2.24 ROLE OF DESIGNERS IN CONSTRUCTION WORKER SAFETY, JIMMIE HINZE, FRANC'S WIEGARD [19]

Development is a standout amongst the most unsafe businesses because of its special nature. Measured by universal norms, development site wellbeing records in China are poor. This paper plans to look at the status of wellbeing administration in the Chinese development industry, investigate the hazard inclined exercises on development locales, and recognize elements influencing development site security. The discoveries uncover that the conduct of temporary workers on wellbeing administration are of grave concern, including the absence of arrangement of individual assurance hardware, standard security gatherings, and security preparing. The fundamental components influencing wellbeing execution incorporate 'poor security consciousness of top administration', 'absence of preparing', 'poor wellbeing attention to venture chiefs', 'hesitance to info assets to wellbeing' and 'careless operations'. The review additionally suggests that the legislature ought to assume a more basic part in stricter legitimate requirement and arranging security preparing programs.

2.25 A SAFETY CLIMATE MEASURE FOR CONSTRUCTION SITES, NICOLE DEDOBBELEER AND FRANCOIS BELAND [20]

This review tests Brown and Holmes' (1986) three-calculate wellbeing atmosphere demonstrate on development laborers. In this model, atmosphere was seen as molar perceptions individuals have of their work settings. Information were gathered by a self-administered poll in a cross-sectional study led among 384 specialists utilized in nine nonresidential development locales in Baltimore, MD. The reaction rate was 7170. Comes about utilizing two straight basic

relations (LISREL) strategies (most extreme probability utilized by Brown and Holmes and weighted minimum squares) showed a decent model fit. The weighted slightest squares method, which is more suitable for our information, uncovered that a two-consider display gave a general better fit. The two elements were (an) administration's dedication to security and (b) specialists' contribution in wellbeing. This model underscores administration and specialists' inclusion in security matters. Comes about likewise recommend the need of tending to worries of these two bunches in security approaches.

CHAPTER 3

DATA COLLECTION AND QUESTIONNAIRE SURVEY

3.1 DATA COLLECTION

Safety in construction is to be ensured by careful planning of the location, design and layout of the project. Numerous accidents are reported as no suitable measures are taken initially at planning stage.

Construction of industrial structure requires adherence to statutes and codes prescribed for safe job practices. For this, the Company and the contractors must be in harmony to establish interrelationship between statutory requirement and practical approach. The company must insist upon compliance with the provisions of safety and health regulations that pertain to the related construction work.

Along with codes and standards, thorough supervision by a competent person is a must to work without incidents. Hence, with conception of any project, it is of a paramount importance that due care is taken in construction safety.

Based on the study of various accidents and various literature 19 unsafe act and unsafe conditions are identified which effect the projects in India. The various factors and their explanation are presented below.

S.NO	UNSAFE ACT UNSAFE CONDITION	EXPLANATION
1	Working at elevated place.	The main hazards associated with working at height are people falling and objects falling onto people below. These may occur as a result of inadequate edge protection, or from objects in storage being poorly secured.
2	Improper earthing.	In an electrical installation or an electricity supply 1. System an earthing 2. system or grounding 3. system connects specific parts of that installation with the Earth's conductive surface for safety and functional purposes.

3	Working on lines without taking proper safety precautions.	Work on new and existing energized (hot) electrical circuits is prohibited until all power is shut off and grounds are attached.
4	Unguarded floor openings, and excavations.	An excavation means any man-made cut, cavity, trench, or depression in an earth surface, formed by earth removal. Excavation and unguarded openings are one of the most dangerous hazards during construction. Often excavations and trenching may temporarily remain unguarded or un-barricaded, causing additional hazards.
5	Exposed live wires.	An electrical shock is received when electrical current passes through the body. You will get an electrical shock if a part of your body completes an electrical circuit by touching a live wire and an electrical ground, or Touching a live wire and another wire at a different voltage.
6	Improper illumination	Employers, the self-employed and people in control of nondomestic premises have a duty to ensure that lighting is safe and does not pose a health risk to employees and others who may use their premises.
7	Constrained location.	There are constraints in every working environment. However, there can be situations that we are unaware of the existence of the constraints, or, we tend to put more emphasis on the project goals.
8	Unsafe design and construction such as poor scaffolding, structure, platforms.	Falls of persons from height represent the most serious safety risk in the construction industry. Many of these falls are from unsafe working places, or from unsafe means of access to working place.
9	Working on transmission lines.	Some activities may cause interference with power lines

		1. Overhead power lines 2. Operation of a crane, forklift, and other construction equipment 3. Changing street lights 4. Tree trimming 5. Underground power lines 6. Excavation
10	Emergency work, leading to hurried working.	Working hours are prescribed in the working hours' legislation. Local adjustments may also be made.
11	Opening and closing of switches without authority or warning	An electric shock hazard arises when a person touches an unprotected live electric wire or other live device. With high voltages it is not even necessary to touch; merely entering the danger area is enough to receive an electric shock.
12	working unsafety such as throwing materials or tools at another worker.	Tools shall not be thrown from one worker to another, or to another working location .
13	using unsafe equipment, wrong tools for the job or using hands instead of right tools.	Hand tools are tools that are powered manually. Hand tools include anything from axes to wrenches. The greatest hazards posed by hand tools result from misuse and improper maintenance.
14	Operating hoists and tracks without proper communication	The operator must not leave the controls while the load is suspended, except where to be held suspended for a period of time exceeding normal lifting operations. implements measure necessary to restrain the boom hoist and telescoping
15	Over confidence like working or live electrical	Electrical accidents are caused by a combination of three factors:

	equipment that could be conveniently re-energized	1. Unsafe equipment and/or installation, 2. Workplaces made unsafe by the environment, and 3. Unsafe work practices.
16	Taking unsafe position or posture too close to openings and lifting in an unstable position	Taking unsafe position or posture too close to openings and lifting in an unstable position also converted in hazard
17	Distracting, teasing, joking, quarrelling, annoying	Practical joking and horseplay while on the job is strictly prohibited as it may lead to distraction of mind and may lead to accident or may compromise the safety of employees or the public.
18	Failure to use recommended safety protection equipment	All personal protective equipment should be safely designed and constructed, and should be maintained in a clean and reliable fashion. It should fit comfortably, encouraging worker use
19	Avoiding the use of guard rails and safety nets while working on higher stories.	Generally, fall protection can be provided through the use of guardrail systems, safety net systems, or personal fall arrest systems. OSHA refers to these systems as conventional fall protection.

FIGURE 3.1 Unsafe act and unsafe condition

3.2 QUESTIONNAIRE

QUESTIONNAIRE REGARDING UNSAFE ACT AND UNSAFE CONDITION IN CONSTRUCTION PROJECTS

(Please fill the appropriate boxes with yellow colour)

Section -I COMPANY PROFILE

1 **Company Name**

2 **Phone No:**

3 **Nature Of Company :**

Client		E.g:	Client
Contractor			contractor
Designer			
Consultant			
Other			
(please specify)			

4 **Age Of the Company**

1-5 years	
5-10 years	
10-15 years	
15-20 years	
Above 15	

Section -II RESPONDENT PROFILE

1 **NAME**

2 **Position in the Company**

Engineer	
Construction Manager	
Project Manager	

Contract/Bussiness	
Development Officer	
Business/Cluster Head	
Site Co-ordinator	
Any other	
(Please specify)	

3 **Experience in the Construction Industry**

1-2 years	
3-4 years	
4-5 years	
5-6 years	

(Where VL = Very low, L=loo, M=medium, H=high, VH=very high)											
S.NO	**Unsafe act and unsafe condition**	**Occurrence**					**Severity**				
		VL	**L**	**M**	**H**	**VH**	**VL**	**L**	**M**	**H**	**VH**
1	Working at elevated place	1	2	3	4	5	1	2	3	4	5
2	Improper earthing	1	2	3	4	5	1	2	3	4	5
3	Working on lines without taking proper safety precautions	1	2	3	4	5	1	2	3	4	5
4	Unguarded floor openings, and excavations	1	2	3	4	5	1	2	3	4	5
5	Exposed live wires.	1	2	3	4	5	1	2	3	4	5
6	Improper illumination	1	2	3	4	5	1	2	3	4	5
7	Constrained location	1	2	3	4	5	1	2	3	4	5
8	Unsafe design and construction such as poor scaffolding, structure, platforms.	1	2	3	4	5	1	2	3	4	5
9	Working on transmission lines.	1	2	3	4	5	1	2	3	4	5
10	Emergency work, leading to hurried working	1	2	3	4	5	1	2	3	4	5
11	Opening and closing of switches without authority or warning	1	2	3	4	5	1	2	3	4	5
12	working unsafety such as throwing materials or tools at another worker.	1	2	3	4	5	1	2	3	4	5
13	using unsafe equipment, wrong tools for the job or using hands instead of right tools	1	2	3	4	5	1	2	3	4	5

14	Operating hoists and tracks without proper communication	1	2	3	4	5	1	2	3	4	5
15	Over confidence like working or live electrical equipment that could be conveniently re-energized	1	2	3	4	5	1	2	3	4	5
16	Taking unsafe position or posture too close to openings and lifting in an unstable position	1	2	3	4	5	1	2	3	4	5
17	Distracting, teasing, joking, quarrelling, annoying	1	2	3	4	5	1	2	3	4	5
18	Failure to use recommended safety protection equipment	1	2	3	4	5	1	2	3	4	5
19	Avoiding the use of guard rails and safety nets while working on higher stories	1	2	3	4	5	1	2	3	4	5

TABLE 3.2 Questionnaire

CHAPTER 4

RESULT ANALYSIS

4.1 RELATIVE IMPORTANCE INDEX TECHNIQUE

It is used determine the relative importance of the various causes and effects of delays. The same method is going to adopted in this study within various groups (i.e. contractors, project safety, owner and site supervisor). The four-point scale ranged from 1 (very Low affect) to 5 (very high affect) is adopted and transformed to relative importance indices (RII) for each factor as follows:

$$\mathbf{RII = \Sigma W / (A*N)}$$

Where, W is the weighting given to each factor by the respondents (ranging from 1 to 5), A is the highest weight (i.e. 5 in this case), and N is the total number of respondents. Higher the value of RII, more important was the cause of delays.

4.2 RANKING INDEX

S.NO	UNSAFE ACT AND UNSAFE CONDITION	OI	SI	RII	RANK
1	Working at elevated place.	0.73	0.78	0.57	1
2	Improper earthing.	0.55	0.65	0.35	16
3	Working on lines without taking proper safety precautions.	0.58	0.75	0.43	8
4	Unguarded floor openings, and excavations.	0.55	0.83	0.45	5
5	Exposed live wires.	0.46	0.78	0.36	14
6	Improper illumination	0.53	0.75	0.4	11
7	Constrained location.	0.65	0.71	0.46	4
8	Unsafe design and construction such as poor	0.53	0.83	0.44	7

	scaffolding, structure, platforms				
9	Working on transmission lines.	0.48	0.76	0.37	13
10	Emergency work, leading to hurried working.	0.63	0.71	0.45	6
11	Opening and closing of switches without authority or warning	0.51	0.68	0.35	17
12	working unsafety such as throwing materials or tools at another worker.	0.46	0.63	0.29	19
13	using unsafe equipment, wrong tools for the job or using hands instead of right tools.	0.53	0.78	0.41	10
14	Operating hoists and tracks without proper communication.	0.53	0.7	0.37	12
15	Over confidence like working or live electrical equipment that could be conveniently de-energized	0.63	0.68	0.43	9
16	Taking unsafe position or posture too close to openings and lifting in an unstable position	0.61	0.78	0.48	3
17	Distracting, teasing, joking, quarrelling, annoying	0.61	0.58	0.35	15

18	Failure to use recommended safety protection	0.5	0.7	0.35	18
19	Avoiding the use of guard rails and safety nets while working on higher stories.	0.63	0.76	0.48	2

TABLE 4.1 Ranking index

4.3 CRITICAL FACTOR

S.NO	Unsafe act and unsafe condition	OI	SI	RII	RANK
1	Working at elevated place.	0.73	0.78	0.57	1
2	Avoiding the use of guard rails and safety nets while working on higher stories.	0.63	0.77	0.49	2
3	Taking unsafe position or posture too close to openings and lifting in an unstable position	0.62	0.78	0.48	3
4	Constrained location.	0.65	0.72	0.47	4
5	Unguarded floor openings, and excavations.	0.55	0.83	0.46	5

TABLE 4.2 Critical factor

4.4 MITIGATION TECHNIQUES

Several mitigation techniques have to be proposed for the above mentioned critical factors, in order to ensure a safe working environment by avoiding hazardous situations. Following methods have been proposed to minimise or avoid these hazards by certain mitigation techniques.

4.4.1 WORKING AT ELEVATED PLACE

For working at elevated place the following mitigation techniques are used.

4.4.1.1 GOOD DESIGN

Good design is important in working at elevated place. Not only of the existing structure or materials to be worked on but design and strength/stability of the access equipment used, and the design of the task itself.

FIGER 4.1 working at elevated place

4.4.1.2 SUPERVISON AND PLANNING OF WORK

Initial plans should be made when the work has to be done at heights, with careful consideration and use of good working equipment's. A safe mechanism of work should be set up or initiated which takes in to consideration the following.

1. Supervision of equipment is required e.g. fall arrest equipment.
2. Weather condition, example maintenance on an icy roof and working in rainy condition on a slippery surface.
3. Emergency or rescue arrangements are important.

4.4.1.3 EVASION OF WORK IN EXTREME WEATHER CONDITIONS

If opposing condition such as icy, rainy or windy weather increase the risk of working at height.

4.4.1.4 MAIN PRECAUTIONS

1. Avoid work at height.
2. Carry out work from an existing of work.
3. Safe working platform is provided with guardrails, that are strong enough to prevent a fall.
4. Where safe work platform is not possible, provide properly installed personnel equipment such as rope access or boatswain's chairs.
5. Depression plans should be in place to cover reasonably for escapable condition.

4.4.2 CONSTRAINED LOCATION

For constrained location the following mitigation techniques are used.

4.4.2.1 MANAGEMENT SURVEY

Construction mangers should be identifying all confined spaces. Since many workers not work in unsafe places that are obvious to the trained safety professional.

4.4.2.2 INSPECTION

Inspection should be done before the work start and also determine whether the entry of worker in to a confined space is absolutely necessary.

4.4.2.3 IDENTIFICATION OF ALL HAZARDS

Identify the all hazards accessory with the confined space.

4.4.2.4 JOB HAZARD ANALYSIS

Inside confined area a job hazard analysis for every task has to be performed which will explain every step to be taken and what procedure are needed before entering the confined space.

FIGER 4.2 Job hazard analysis

4.4.2.5 PREPARATION OF CONFINED SPACES

Preparation of confined space should be done for all circumstances for example preparation for ventilation, purging, and procurement of special equipment tools or any necessary safety devices.

4.4.2.6 COMMUNICATION TO THE WORKER

Communication between the worker in the confined space and the outer side person.

4.4.2.7 APPROPRIATE RESCUE SYSTEM

Trained rescue system should be present in site.

4.4.3 EMERGENCY WORK LEADING TO HURRIED WORKING

The hazards in construction are also lead by one such reason i.e. hasty working methods under emergency conditions. Hasty working conditions are caused in an emergency situation due to the following reasons.

1. Initial safety measures have not been provided initially which led to the emergency.
2. Use of emergency equipment to deal with the situation which causes pave and hurried working amongst the workers for e.g. lac of sand buckets in a fire affected area can lead to pains.

FIGURE 4.3 Emergency work

4.4.4 UNGURDED FLOOR OPENINGS AND EXCAVATIONS

Excavation, cavity or trench is a manmade cut in the ground made by removing earth. construction of trench is the most common form of excavation.

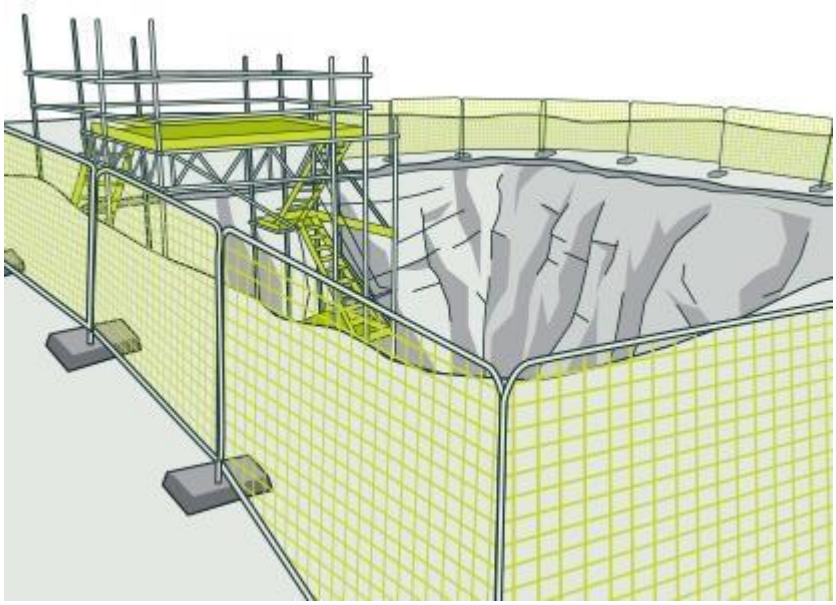

FIGURE 4.4 Covered excavation

For house foundation or basement excavation following condition are follow: -

1. Excavation of house foundation is less than 7.5 feet deep.
2. Excavation is benched for every 5 feet of depth and at least 2 feet horizontally.
3. At the bottom minimum horizontal width of the excavation is no less than 2 feet.
4. At the excavation site no water surface no cracks or other conditions that might reduce the stability of the excavation.

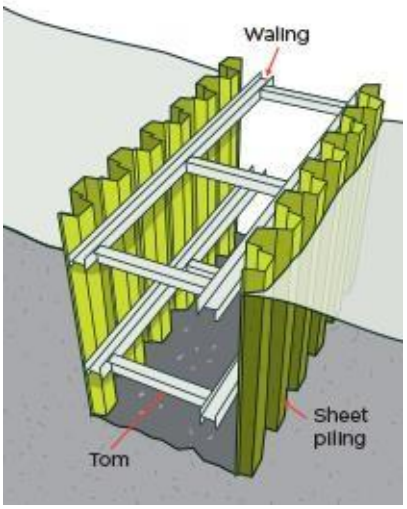

FIGURE 4.5 Excavation of house foundation

5. Not use the heavy equipment and vibrating equipment by the excavation site.
6. All equipment, use in excavation and material or loose soil is kept back from the edge of the excavation for a distance at least equal to the depth of the excavation.
7. Minimum workers needed to perform the work in the excavation.

4.4.5 AVOIDING THE USE OF THE GUARD RAILS AND SAFETY NETS WHILE WORKING ON HIGHER STORES

Use of rued rails and safety net while working on higher stories. Because it is important safety equipment. To prevent falls look for the following points.

FIGURE 4.6 Use of safety nets

1. Dust, small roller bearing like pellets, or loose gravel, spills, water, grease spots.
2. Discarded tools, projecting part or trash.

FIGURE 4.7 Use of guard rails

3. Tracked in a rainy or snow days or liquids from leaking piper.
4. Dusts or other materials from manufacturing process that have lubrication properties that can be tracked to other location.

Avoiding slips these following steps can help avoid slips: -

1. Build facilities and design with slip resistant floors.
2. Dry and keep floor clean
3. Repair of leaking pipes are important.
4. For tracking of liquids use mats.
5. When you analyse tasks consider slips and falls.
6. Proper lighting is providing.
7. Slip resistant shoes is not provided.

CHAPTER 5

CONCLUSION AND FUTURE SCOPE

5.1 CONCLUSION

1. Analysis of the collected data and a comparative study of the literatures available helped in obtaining 9 unsafe acts and 10 unsafe conditions.
2. The results from the thesis conclude the five critical factors in the field of building construction i.e. working at elevated place, avoiding the use of guard rails and safety nets while working on higher stories, confined space, unguarded floor openings and excavations and emergency work leading to hurried working, unsafe design in construction such as poor scaffolding, platform
3. Mitigation techniques were proposed for the above found 5 critical factors to minimize the hazards caused by them in the near future in the building construction field.

5.2 FUTURE SCOPE

Further factors can be identified through literature review and data collection through on-going projects. Case studies of on-going projects can be reviewed to identify different other factors. Other analysis methods can be employed like sensitivity analysis, scenario analysis and other related techniques. Also our focus of the thesis was on the hazards caused due to unsafe conditions on a building construction side. Using the thesis pattern point of observation and inspection can be changed like we in future dam construction sites bridges etc. can be used to calculate other mitigation techniq

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ANNEXURE 1

S.NO	FACTORS	OCCURANCE												OI
		R 1	R 2	R 3	R 4	R 5	R 6	R 7	R 8	R 9	R 10	R 11	R 12	
1	Working at elevated place.	3	4	4	3	3	4	3	4	5	3	4	4	0.73
2	Improper earthing.	3	2	3	1	5	5	2	1	2	2	4	3	0.55
3	Working on lines without taking proper safety precautions.	3	4	4	1	3	4	1	2	2	3	4	4	0.58
4	Unguarded floor openings, and excavations.	3	2	2	2	3	3	4	4	2	2	3	3	0.55
5	Exposed live wires.	2	3	2	1	3	5	2	2	1	1	4	2	0.46
6	Improper illumination.	3	2	2	1	4	4	3	3	2	2	4	2	0.53
7	Constrained location.	3	3	2	5	3	4	4	1	5	3	3	3	0.65
8	Unsafe design and construction such as poor scaffolding, structure, platforms.	2	3	2	4	4	4	2	2	1	2	4	2	0.53
9	Working on transmission lines.	4	1	2	1	4	3	3	2	1	2	4	2	0.48

10	Emergency work, leading to hurried working.	4	3	2	5	4	4	2	3	3	2	3	3	0.63
11	Opening and closing of switches without authority or warning.	3	3	2	1	3	4	1	2	2	3	3	4	0.51
12	working unsafety such as throwing materials or tools at another worker.	3	2	4	1	3	3	1	1	2	3	3	2	0.46
13	using unsafe equipment, wrong tools for the job or using hands instead of right tools.	2	3	3	3	2	4	3	2	2	2	3	3	0.53
14	Operating hoists and tracks without proper communication.	2	2	4	3	2	3	3	3	2	2	4	2	0.53
15	Over confidence like working or live electrical equipment that could be conveniently re-energized.	3	3	3	2	2	4	5	4	1	4	3	4	0.63

16	Taking unsafe position or posture too close to openings and lifting in an unstable position.	2	4	4	3	3	4	3	3	2	2	4	3	0.61
17	Distracting, teasing, joking, quarrelling, annoying.	2	4	4	3	3	2	5	5	2	1	3	3	0.61
18	Failure to use recommended safety protection equipment.	2	1	3	3	4	3	2	3	2	2	4	1	0.5
19	Avoiding the use of guard rails and safety nets while working on higher stories.	2	4	4	1	4	5	4	2	2	4	4	2	0.63

ANNEXURE 2

S.NO	FACTORS	SEVERITY												SI
		R 1	R 2	R 3	R 4	R 5	R 6	R 7	R 8	R 9	R 10	R 11	R 12	
1	Working at elevated place.	2	4	3	2	3	5	4	5	4	5	5	5	0.78
2	Improper earthing.	4	1	2	4	3	4	4	2	2	4	5	4	0.65
3	Working on lines without taking proper safety precautions.	4	5	3	4	3	3	3	3	3	5	4	5	0.75
4	Unguarded floor openings, and excavations.	4	5	4	4	3	3	5	5	4	4	4	5	0.83
5	Exposed live wires.	4	2	4	4	4	4	4	3	5	4	4	5	0.78
6	Improper illumination.	4	4	4	5	3	3	4	4	3	4	3	4	0.75
7	Constrained location.	4	4	4	2	2	4	3	3	4	4	4	5	0.71
8	Unsafe design and construction such as poor scaffolding, structure, platforms.	5	4	4	4	4	2	4	3	5	5	5	5	0.83
9	Working on transmission lines.	4	3	3	3	4	2	5	4	4	5	5	4	0.76
10	Emergency work, leading to hurried working.	3	5	3	5	2	3	3	4	3	4	4	4	0.71
11	Opening and closing of switches without authority or warning.	4	3	4	3	2	2	3	3	4	4	4	5	0.68

12	working unsafety such as throwing materials or tools at another worker.	4	2	2	4	4	2	2	4	3	4	3	4	0.63
13	using unsafe equipment, wrong tools for the job or using hands instead of right tools.	5	4	2	5	3	3	5	4	4	4	4	4	0.78
14	Operating hoists and tracks without proper communication.	2	3	3	4	2	3	4	4	4	4	5	4	0.7
15	Over confidence like working or live electrical equipment that could be conveniently de-energized	5	5	2	2	2	2	4	5	4	3	4	3	0.68
16	Taking unsafe position or posture too close to openings and lifting in an unstable position.	4	5	3	5	3	3	4	5	4	3	4	4	0.78
17	Distracting, teasing, joking, quarrelling, annoying.	4	5	2	4	3	3	1	1	4	2	4	2	0.58
18	Failure to use recommended safety protection equipment.	5	3	2	5	3	2	3	4	4	4	4	3	0.7

19	Avoiding the use of guard rails and safety nets while working on higher stories.	5	5	2	3	3	3	5	4	4	3	5	4	0.76