

SAFETY ASSESSMENT IN HIGH RISE BUILDINGS USING JSA

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ABSTRACT:

The construction industry is a nowadays, a backbone of nation especially in developing countries. One of the most hazardous industry in the world is a construction industry as it is accounting for a high percentage of work related injuries and fatalities. Many countries have established the safety programs. In developing countries, where safety and health program are still at their infancy or lack of proper implementation and the situation is more critical. This paper aims at assessing to identify the health hazards, risks and causes of poor safety practices in high rise buildings. Mostly reported acute health hazards are “fall from height” and “electrocution”, while mostly reported chronic health hazard is “exposure to hazardous substances”. Lack of awareness about site safety and dislikes to wear PPE’s were identified as main cause of poor safety practices in construction sites. And this paper aims to give a complete study of all hazards in the sites and their corrective measures.

Keywords—High rise buildings, Safety assessment, Job safety analysis...

1. INTRODUCTION

1.1 PURPOSE OF THE STUDY

The purpose of this study is to analyse and determine why accidents and injuries are occurring and increasing within the construction sites. Among the various activities in construction site, the major accidents causing activities are chosen. Conducting job safety analysis within the selected activities in the site area, this study will analyse various job, tasks, and activities in relation to job safety, while considering the hazards and the risks involved in the activities. Furthermore, this study intends to determine the need for are commended actions for each hazard, as well as framing the safe operating procedure.

1.2 NEED FOR JOB SAFETY ANALYSIS

The department of Environment, Health and Safety (EHS) at the construction site is experiencing an increase of accidents in its construction activities. These accidents are affecting productivity, endangering staff, and increasing costs. Many workers are injured and killed at the workplace due to various construction related activities. One of the best ways to determine and establish proper work procedure is to conduct a job safety analysis. This

current study will investigate the critical component of major accident causing duties, tasks, and behaviours and identify the hazards associated with the activity, finally suggesting the recommended action necessary for the preparations of the operating procedure. Key to this analysis is the understanding of how employees can perform optimally while being aware of proper safety measures in order to reduce accidents and injuries.

1.3 OBJECTIVES OF THE PROJECT

The objectives of this project are:

- To investigate the factors affecting the safety in construction industries
- To identify the health hazards and risks in the sites
- To analyze the hazard assessment
- To prepare a safety precautions
- To provide a proper suggestion of safety measures to the industries

2. LITERATURE SURVEY

2.1 Marion Gillen and Davis Baltz, et al, (2002), published a paper on the title **“perceived safety climate, job demands, and co-worker support among union and non-union injured construction workers”**. The authors carried out the study which aimed to evaluate injured constructions workers. Injured severity was assessed using the Health Assessment Questionnaire (HAQ). Worker perceptions of workplace variables were determined by two instruments: a) safety climate measures for construction sites and b) the job content questionnaire (JCQ). [1]

2.2 Maria kozlovska and ZuzanaStrukova, et al, (2002). Published a paper on the title **“overview of safety Risk perception in construction”**. Construction industry is a generally risky business;

it remains one of the most dirty, difficult and dangerous with poor working conditions. According to the international labour organization, it accounts for 30-40% of the world’s fatal injuries. The paper analysed, described and systemized the principal groups of construction safety risks; Described the interdependencies among safety risks, affecting by spatial, technological and time parameters of the building process, as well as by the site conditions. [2]

2.3 Vicki Kaskutas and Ann Marie Dale, et al, (2003) “Fallprevention and safety communication training for foreman: report of a pilot project designed to improve residential construction safety”. Falls from heights account for 64% of residential construction worker fatalities and 20% of missed work days. We hypothesized that worker safety would improve with forementraining in fall prevention and safety communication. Results from worksite observational audits (n=29) and foremen/crewmember surveys (n=97) administered before and after training were compared. We observed increased compliance with fall protections and decreased unsafe behaviours during worksite audits. [3]

2.4 S.Chockalingam and T.Sornakumar, et al, (2011) “An Effective Total Construction Safety Management in India”. Construction safety management has always been a big issue in India. Construction safety is influenced by perception of risk, management, safety rules and procedures of the workers. A measure of safety management could be used to identify those areas of safety that need more attention and improvements. The dynamic nature of safety management, which has the ability to change on daily basis, means there is a great need for reliable tools that can measure safety climate.[4]

2.5 OphirRozenfeld and Rafael Sacks, et al, (2012) “construction job safety Analysis in support of Lean Project Management”. A method specialized for construction has been developed, called “Construction job safety Analysis” (CJSA). The method was applied to explore 14 primary construction activities. A survey was conducted through some 100 interviews with site managers and safety experts to reveal the likelihood of loss of control events that may be lead to accidents. [5]

2.6 M.O. Agwu, et al, (2012) “Impact of job Hazard Analysis on organisational performance in shell Bonny Terminal Integrated Project”. It defines job hazard analysis as a process of identifying potential hazards in construction activities and assessing its potential effects on people, assets and the environment while executing construction jobs. Safety performance as well as on company performance: enhancement of productivity, profitability and loss control through reduction of accident/Incident rate. The paper posits that: technology through better identification, assessment and control of job related hazards, there will be an improvement in management/employees obedience to safety rules and regulations.[6]

3. PROBLEM IDENTIFICATION

The visual inspection has been carried out in the construction site. The major problem of site hazards listed below:

- Materials fall from height
- Workers fall from height
- Fear of height
- Unsafe surroundings or environment
- Fall of scaffolding material
- Accident involving machinery

- Potential accident due to careless/unauthorized driving
- Unavailability of clear approach to the backfilling
- Fall of concrete slurry
- Collapsing of temporary structures
- Toppling of machines
- Sliding of sides in excavation
- Asphyxiation due to lack of oxygen in excavation
- Overloading at one particular edge on the near excavation
- Inhalation of dust
- Inhalation of toxic materials
- Electrocution
- Fire hazards
- Fall of material while shifting crane
- Mishandling of cutting and drilling machines
- Hand and eye get irritated/injured while anchoring
- Improper storage

4. METHODOLOGY

The systematic method is applied in a field of study. Its includes accident analysis, selection of job activities, hazard identification and finally suggesting corrective action and frame the operating procedures.

Steps involved in process of methodology



Flow chart 4.1.1 Methodology Process

4.1 MAJOR ACCIDENTS INVOLVING ACTIVITIES

The major accidents are identify by the past three year accident analysis which is given below. Based on major accident consideration, the job safety analysis is done.

NATURE OF INJURY

The following table illustrate the nature of accidents occurred in high rise buildings site.

Fig 4.1.1 Accident Analysis by Nature of Injury

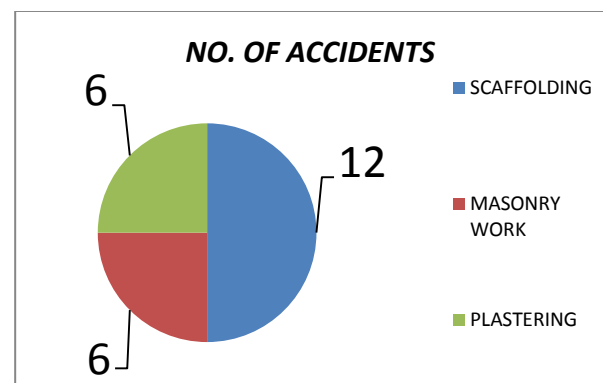
4.2 TYPE OF ACTIVITY INVOLVED

The below activities are involved in which the major accidents are occurred in high rise buildings. The following table shows that the number of accidents happened in each activities for the last one year in my visited sites. And these data gathered from oral discussion with labours.

Table 4.2.1 Number of Accidents by Jobwise

JOB SELECTION	NO. OF ACCIDENTS
SCAFFOLDING	12
MASONRY WORK	6
PLASTERING	6

Fig 4.2.1 Accident Analysis by Jobwise



SELECTION OF ACTIVITY

In this paper, the following activity jobs are selected for providing control measures of the identified hazards using JSA methodology.

- SCAFFOLDING
- EXCAVATION
- BACKFILLING
- FORMWORK
- REINFORCEMENT

4.3 CHECKLIST PREPARATION

A Checklist is a type of informational job aid used to reduce failure by compensating for potential

limits of human memory and attention. A basic example is the “to do list”.

Checklist for the Construction sites

Table 4.3.1 GENERAL SAFETY AND HEALTH PROVISIONS

Sl. No	SAFETY CHECKS	OSHA STAND -ARD	YES	NO
1	Safety and Training Education: All the employee are instructed in the recognition and avoidance of unsafe conditions?	1926.21 (b)(2)		
2	Are employees, who are required to handle or use poisons, caustics, and other harmful substances instructed in their safe handling and use?	1926.21 (b)(3)		
3	Are employees, who are required to enter confined spaces and in the use of protective and emergency equipment?	1926.21 (b)(6)		
4	Housekeeping: Is all the debris kept cleared from work areas, passageways, and stairs?	1926.25 (a)		
5	Personal protective equipment: Are employees required to wear appropriate personal protective equipment?	1926.28 (a)		

Table 4.3.2 OCCUPATIONAL HEALTH AND ENVIRONMENTAL CONTROLS

Sl. No	SAFETY CHECKS	OSHA STAND -ARD	YES	NO
6	Medical Services and First Aid: Is the facility for the treatment of injured employees located within three minutes of the jobsite?	1926.50 (c)		
7	Are telephone numbers of physicians, hospitals, or ambulances conspicuously posted?	1926.50 (f)		
8	Sanitation: Are drinking water and adequate toilet facilities available at the jobsite?	1926.51		
9	Occupational Noise Exposure: Are the employees is exposed are affected by noise exposure?	1926.52		
10	Gases, Vapors, Fumes, Dusts and Mists: Does the employer assure that no employees exposed to inhalation, ingestion, skin absorption, or contact with any substance?	1926.55 (a)		
11	Illumination: Are employees provided with light not less than the minimum illumination?	1926.56 (a)		
12	Are containers of hazardous chemicals, labeled, tagged, or marked?	1910.12 00(f)(1)		
13	Ventilation: Does the employer ensure that concentration of hazardous substances such as dusts, fumes, mists, vapors, or gases?	1926.57 (a)		
14	Hazard Communication: Does the employer have any hazardous material?	1910.12 00(e)(1)		

15	Does the employer have an SDS for each hazardous chemical on site?	1910.1200(g)(1)		
16	Are the employees trained in hazards of chemical in their work area?	1920.1200(h)		

5.RESULTS AND DISCUSSION

JOB SAFETY ANALYSIS:

A systematic method of identifying potential hazards and control measures to safely perform a specific task.

5.1 JSA-SCAFFOLDING

A temporary platform either supported from below or suspended from above, on which workers sit or stand when performing tasks at heights above the ground. A platform or frame work for raising workers and materials during the erection, repair, or maintenance of a building.

Table 5.1.1 JSA for Scaffolding

CRITICAL STEPS IN THIS JOB	POTENTIAL HAZARDS	CONTROL MEASURES
Erection of scaffolding for safe working at height, with cross bracing, planks, holding pins, split pin etc.	Man and material may fall from height. Fear of height. Unsafe surroundings or environment.	Wear safety helmet, belt and anchor the same with lifeline. Use fall arrest system. Ensure safety net is installed. Toe board should be provided. Ensure proper access and platforms to all working levels. The gap between

		railings and mid rail should be appropriate. Avoid working in rain and heavy wind.
Placement of the scaffolding	Scaffolding may collapse. Electrocution.	Check for quality of scaffold and ensure bracing in the each stage. Erect on hard soil/ firm ground. Lock/ anchor the structure with permanent structure/ column in the building. Check for any insulated electrical wires touches the scaffolding.
Dismantling the scaffold	Fall off scaffold material while dismantling.	People working in nearby area should use proper PPE. The area where dismantling takes place should be barricaded and appropriate communication in nearby areas to be made. Dismantling should be done by competent work men.
Use of	Falling	Carry tools in a bagor

tools and tackles .	of objects i.e. tools, bracing and other material.	tie the tools with rope. Use rope and pulley for lifting the material. Check that rope knot is properly tied. Check all the locking pins split pin etc.
Tie up of working platforms/ wooden planks/ landing mats.	Man and material may fall and lead to injury to workers.	Fix wooden planks/ landing mats properly with the scaffolding.
Up and down movement of workers working.	While moving up and down, persons may slip and fall or may hit against fixture. Material may fall.	Allow person up and down in stage with safety belts and helmets. The safety belt to anchored to lifeline. Fall arrestor be provided. Ladders to be used for climbing. Put safety net below the work place. Proper training to the specified workers.

5.2 JSA-EXCAVATION

Any Man-Made cut, depression/digging made on earth by removing its earth surface for basement to construct any building.

Table 5.2.1 JSA for Excavation

CRITICAL STEPS IN THIS JOB	POTENTIAL HAZARDS	CONTROL MEASURES
Operation of mechanical excavators.	Toppling of the machine/ tipper-injury/ death.	Ensuring licensed operator, fitness certificate of the machine/ tippers, and proper path way.
Manual excavation.	Injury.	Ensure proper PPE.
Slide slope.	Sliding of slides may cause injury/death.	Ensuring proper slopes/shoring based on the type of soils/as per the approved slope.
Barricade of excavated area.	Person/machine may fall cause injury/death.	Proper barricading to be done at a distance of 1 meter.
Bailing out water.	Sliding/cavity of earth/electrocution.	Ensure for safe working distance from the edges / shoring and elevated cables for the pumps.

5.3 JSA-FORMWORK

The term given to either temporary or permanent moulds into which concrete or similar materials are poured. In the context of concrete construction, the false-work supports the shuttering moulds.

Table 5.3.1 JSA for Formwork

CRITICAL STEPS IN THIS JOB	POTENTIAL HAZARDS	CONTROL MEASURES
Shuttering material shifting through crane.	Material may fall while shifting through crane.	Ensured that the material is tied with belt and signal man is available.
Stacking of materials/ handling of materials.	Person may fall if stacked on the path way.	Material should be stocked 1 meter away from the path way.
Life line rope at periphery of building.	If the life line are not provided to strong member, then it can lead to disasters.	Life line ropes to be provided in two levels at 0.5m and 1m respectively.
Wearing full body harness, helmet, shoes.	Workers may fall from height and cause injury.	Full body harness to be hooked properly and PPE's should be weared so will avoid accidents.
Handling of cutting machines by operators. All cutting machine should have protection guards.	May cause injury if it is operated by unauthorized persons.	Only skilled operators to operate the machine.
Stacking of runners and plywood.	May fall down if it stacked for more height.	Runner plywood should be stacked for an height of 1m.
Cleaning of cutting yard.	May cause fire if it is not cleaned.	On daily basis wood saw should be cleaned.

5.4 JSA-BACKFILLING

Backfilling is the re-filling the excavation or trench with earth after the tiles have been laid. It is also the material used for re-filling.

Table 5.4.1JSA for Back-filling

CRITICAL STEPS IN THIS JOB	POTENTIAL HAZARDS	SAFETY CONTROLS
Barricading of the	Accident involving	Safety plan in place to ensure control

backfilling location as per the traffic management for no human interface en route to the filling area.	machinery/human loss	points and measure with signage in place indicating vehicular movement.
Transportation of the soil	Potential accident due to careless / unauthorized driving.	Drivers with valid license and knowledge about the work have to be employed. Nature of backfilling location needs to brief to the Drivers.
	Unavailability of clear approach to the back filling location may lead to potential accidents.	Traffic management to be briefed to the drivers and confirmations on sufficiency of approach needs To be ensured.
	Absence of supervision during dumping of soil in the backfilling location.	Drivers to have clear rear view of the location of dump to avoid any potential accident.

Dozing of soil in the backfilling location	Absence of working space for the earth mover may lead to potential accident involving vehicle upturn in the backfilling location	Sufficient working space to be planned prior to transportation of soil to the dumping spot. Sufficient supervision with alerting device must be present for raising an alarm during a probable case of accident forecast.
Compaction of soil in the backfilling area using roller.	Mishandling of the roller might lead to equipment damage human injury.	Authorized operator with valid license has to be ensured for the machine operations.

5.5 JSA-REINFORCEMENT

The reinforced concrete is a composite material in which concretes relatively low tensile strength and ductility are counteracted by the inclusion of reinforcement having higher tensile strength and/or ductility. Reinforcing schemes are generally designed to resist tensile stresses in particular regions of the concrete that might cause unacceptable cracking and/or structural failure. Reinforced concrete may also be permanently stressed (in compression), so as to improve the behaviour of the final structure under working loads.

Table 5.5.1JSA for Reinforcement

CRITICAL STEPS IN THIS JOB	POTENTIAL HAZARDS	SAFETY CONTROLS
Stacking	Possibility of	Stock only upto

	toppling of the steel roads.	the height of 1 meter,1.5mts gap should be maintained in between the bundles
Loading and unloading	Possibility of getting hurt	Necessary PPEs should be used
cutting	Smallest particles can fly into the eyes, leading to eye damages.	PPE's to be taken; goggles and guards for machine are checked before.

6. CONCLUSION

To improve construction safety, the organization have started to seek effective job safety analysis system and procedures. The job safety analysis offers a good frame work for construction related activities. However, construction activities in these construction sites are found not vigorously seeking the certification programs. The study has analysed the frequent accidents in the construction site and examined the current status in the constructions site. Based on the accident categorization, the following activities are considered and performed job safety analyses. Excavation, scaffolding, formwork, backfilling, concrete work, tiles & granite fixing, reinforcement, block work, painting and anchoring. Based on the JSA report, various hazards and risks involved in each specific tasks are explored of the individual major accident causing activities. OHS measures of construction sites are given by framing the control measures for the individual activities. Checklist analyses were conducted in order to identify the various hazards in the construction site. It has been found that construction companies have not satisfactorily operating procedures. This reflected from a large

number of recorded accidents in the past three years. And finally prepared a JSA for the purpose of, to reduce the hazards in the construction sites.

REFERENCES

1. Marion Gillen and Davis Baltz, (2002) “perceived safety climate, job demands, and co-worker support among union and non-union injured construction workers”
2. Maria kozlovska and ZuzanaStrukova, (2002) “overview of safety Risk perception in construction”.
3. Vicki Kaskutas and Ann Marie Dale, (2003) “Fall prevention and safety communication training for foreman: report of a pilot project designed to improve residential construction safety”.
4. S.Chockalingam and T.Sornakumar, (2011) “An Effective Total Construction Safety Management in India”.
5. OphirRozenfeld and Rafael Sacks, (2012) “construction job safety Analysis in support of Lean Project Management”.
6. M.O. Agwu, (2012) “Impact of job Hazard Analysis on organisational performance in shell Bonny Terminal Integrated Project”.

www.delhimetrorail.com; 16 January 2004.