HIRA in Excavation in High Rise Buildings

K. Srinivas [1]

Abstract

Hazard Identification and Risk Assessment (HIRA) is carried out for identification of hazard, the analysis of hazard, estimation of the likely effects of the risk and the mitigation measures/controls that are to be taken to minimize the risk. A good hazard identification process is the key to good risk management. It may not be possible to identify all hazards before commencement of work. Hence, the risk management process is dynamic which means control methods are to be applied even for risks which are identified even at a later stage of the project. Risk assessment gives an idea regarding the severity of hazards and safety measures to be taken. The present study focuses on hazards in excavation and the measures to be taken to minimize the same. The study was conducted on high rise buildings.

Keywords : **High rise buildings, risk analysis, risk assessment, risk priority number**

I. INTRODUCTION

Construction site safety is an aspect of construction related activities that is concerned with protecting construction site workers and others from death, injury, disease, or other health-related risks. Construction is a hazardous activity where site workers are exposed to various risks. Site risks can include working at height, colliding with moving machinery (vehicles, cranes, etc.), materials, power tools, and electrical equipment, handling of hazardous substances, and effects of excessive noise, dust, and vibration. The leading causes of construction site fatalities are falls, electrocutions, crush injuries, and caught-between injuries.

Safety at workplace is paramount to boost productivity. Safe working conditions are as important as production and productivity. The commitment for adherence to safety practices will not only create a safe environment, but also boost up the moral and confidence of employees. Safety is an integral part of industrial excellence and organisational culture. Therefore, it is essential for organisations to accord at most importance to safety for excellence in business .Organisations that have good safety culture in true spirit are the most productive ones.

The construction industry is a labour intensive industry. It creates demand for skilled and semi-skilled labour force. In India, the employment in construction sector was about 54 million in the year 2021, out of which, 84% were unskilled.

The workforce in construction sector in India has inherent risk to life and limb due to lack of safety culture. Construction labor forms 7.5% of the world labour force and contributes to 16.4% of fatal global occupational accidents.

In the construction industry, hazards keep cropping up every day as the job process is set in motion. Despite the safety rules which apply to construction site, workers in building trades are often at high risk of serious injury. According to a survey by the Indian government, number of construction workers who died in accidents at workplace is more

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than 6,000 per annum and 165 out of every 1000 workers are injured.

The causesof accidents are poor management, safety policies and decision, personal factors and environmental factors. The direct causes of accidents are:

- Stuck by or against hard surface
- Falling from height
- Cut or caught in between two moving objects
- Exertion contact
- Hitting with impact

II. LITERATURE REVIEW

The following is the brief summary of the project carried out by different researchers in the field of construction for risk assessment.

III. RISK ASSESSMENT METHODOLOGY

Hazard Identification and Risk Assessment (HIRA) is carried for identification of hazards/undesirable events that can lead to risk. It is widely accepted that various techniques of risk assessmentcontribute greatly towards improvements in the safety of complex operations and equipment.

To manage risk, hazards must first be identified, and then the risk should be evaluated and determined, whether it is to be tolerated or not. The risk understanding developed from these studies forms the basis of establishing safety management activities at a site. An incorrect perception of risk at any point could lead to either inefficient use of limited resources or unknowing acceptance of risks which may result in exceeding the project cost.

TABLE I.
STUDIES CONDUCTED

Title of Study	Reference	Summary
Assessment of risk in construction industry using HIRA	[1]	Priorities need to be established so that the most dangerous situations are addressed first and those least likely to occur and least likely to cause major problems can be considered later. Hazard identification and risk assessment need to be done. The study also revealed that systematic methods were used and risk was assessed by brainstorming, check list, and health and safety regulations.
Hazard identification and evaluation in construction industry	[2]	The knowledge of construction job safety analysis is structured in a form that can be used by a software called CHASTE. It enables forecasting of safety approach to compute the predicted levels of risk for the activities of specific projects, by using a three-dimensional building model and a construction schedule.
Hazard identification and risk assessment in construction industry	[3]	The study concluded that the issue will improve as the level of risk assessment of hazard identification gets higher.
HIRA in construction site	[4]	The study concluded that there should be an initial step for crisis readiness and keeping a protected working environment by recognizing the dangers and danger appraisal done by HIRA can be utilized to attend to most risky circumstances first and other risks can be attended to later.
End-Users' opinions to enhance the process of Hazard Identification and Risk Assessment (HIRA) in construction projects	[5]	The study shows that safety knowledge was not available to carry out HIRA when and where it was needed. From the end-users' view, this study suggested that firms should adapt to new strategies to capture, store, and disseminate safety knowledge in organizations to make HIRA effective.

A. HIRA Process

(1) ***Hazard Identification :*** The methods of hazard identification and the process of risk assessment is depicted in Fig. 1 and 2.

(2) ***Risk Assessment :*** Risk can be presented in a variety of ways to communicate the results of analysis to make decision on risk control. For risk analysis that uses likelihood and severity in qualitative method, presenting result in a risk matrix is a very effective way of communicating the distribution of the risk throughout a plant and area in a workplace. Risk can be calculated using the following formula:

$$RPN = P \times S \qquad (1)$$

Where,

RPN Risk Priority Number;

P Probability of occurrence;

S Severity.

Likelihood is given a rating on a scale of 1 (Remote Possibility) to 5 (Extremely likely) depending on probability of occurrence of an event. Similarly, severity is given a rating on a scale of 1 (Insignificant) to 5 (catastrophic) depending on it consequence.

(3) ***Risk Analysis :*** Depending upon the risk priority number, the risk ranking matrix is prepared and rating is done as shown in Table II.

(4) ***Controlling and Reviewing*** : Depending upon the rating of the risk, controls are applied (Fig. 3.).

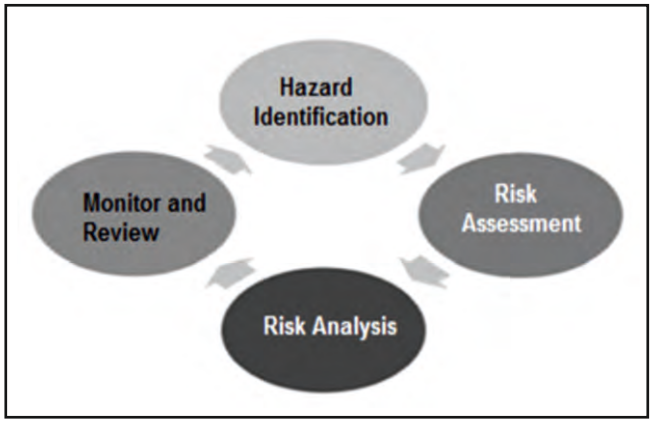

Fig. 1. HIRA Process

IV. CASE STUDY

As a part of project work, various construction sites were

Fig. 2. Methods of Hazard Identification

TABLE II.
RATING OF RISK PRIORITY NUMBER

RPN	Rating
1 – 5	Low
6 – 15	Medium
16 – 35	High

visited in Hyderabad which are of high rise buildings(G+27),(G+3), and (G+5).Various hazards at these site were identified for which risk assessment was done and the control measures were followed.

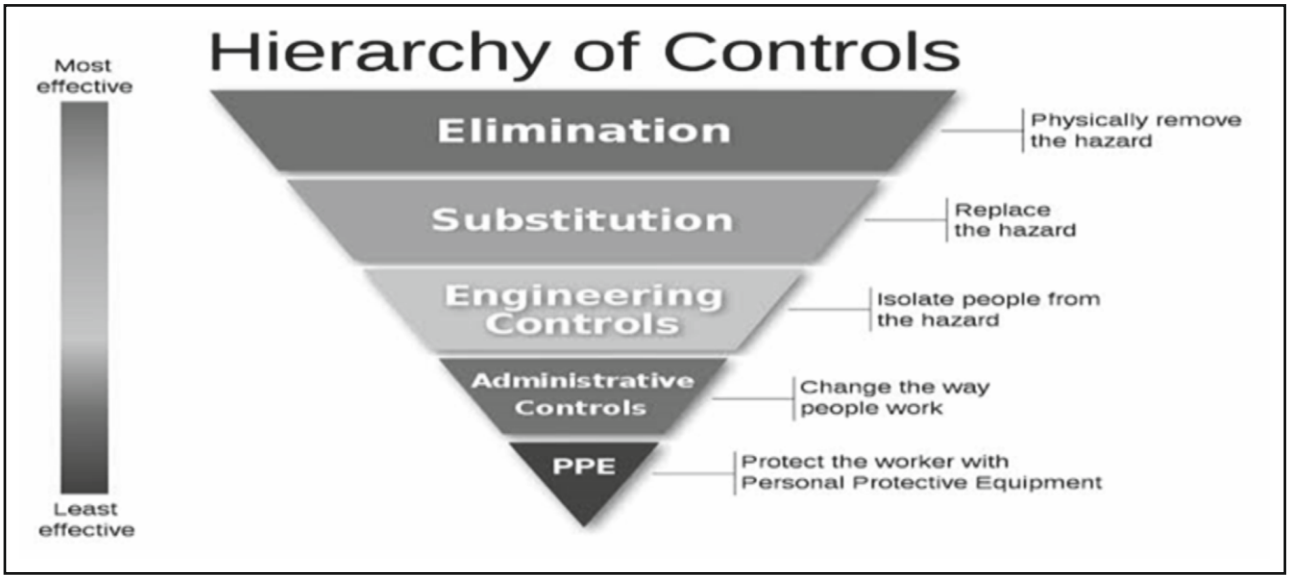

Fig. 3. Hierarchy of controls for minimizing risk

Fig. 4. (a) A typical view of excavation

Fig. 4. (b) Barrication is not provided on construction site

(c) Machines are at the edge of excavation

(d) A typical view of excavation work at construction site

(e) Improper stacking of soil

(f) Machine work at the edge of excavation

(g) Improper barrication

(h) Seepage of water

Fig. 4. Construction Sites

TABLE III.

CALCULATION OF RISK PRIORITY NUMBER AND CONTROL MEASURES TO BE TAKEN

RISK ASSESSMENT ON EXCAVATION							
S. No.	**Activity**	**Hazard Involved**	**Persons at risk**	**P**	**S**	**RPN**	**Control measures**
1.	Excavation	• Improper Barrication • Collapse of soil • PPE is not worn at site • Loose soil	4 persons have been working at site without proper PPE kit.	4	5	20 ☆	•Proper barrication has to provided. • Provide shoring. • Provide proper lighting. **To be attended to urgently**
2.	Excavation	Seepage of water Loose soil		3	3	9 △	Shotcreting has to be done for loose soil.
3.	Excavation	Machine at edge of the excavation		3	4	12 △	• Hard barrication has to be installed around the excavation. • Top block has to provided. • Shoring has to be provided.
4.	Excavation	Improper means of access and egress	2 workers are standing near the machines	3	4	12 △	Install proper ladder for access and egress. **Medium Risk**
5. •	Excavation	• Improper stacking of soil • No use of PPE at site • Improper barrication	3 workers are doing work without PPE.	4	4	16 ☆	• Provide shoring • Provide stop blocks. • Provide barrication. • Dewatering has to be done. **High Risk**
6.	Excavation	• Machine work at the edge of excavation • Improper barrication	1 worker is near the excavation.	3	4	12 △	• Provide barrication. • Provide stop blocks.
7.	Excavation	• Improper stacking of soil • No barrication at site		3	3	12 △	• Provide barrication. • Provide shoring.
8.	Excavation	• Seepage of water • Poor house keeping • Improper barrication • Poor access and egress		3	3	12 △	• Provide grouting. • Dewatering has to be done. • Provide barrication.

Legend ☆ Red

△ Yellow

V. CONCLUSION

The norms for emergency preparedness and maintaining a safe workplace are to be defined and analyzed. Although all hazards are to be addressed, resource limitations usually do not allow this to happen at a time. Hazard identification and risk assessment can be used to establish priorities so that the most dangerous situations are addressed first and those least likely to occur and least likely to cause major problems can be considered later.

The study also revealed that systematic methods were not adhered to and risk was assessed by judgement and experience rather than through brainstorming and providing checklists.Health and safety regulations were followed to a reasonable extent. Working at height, and manual handling were observed to be the most critical hazards in construction site.

On the basis of methods used to communicate risk at construction sites, it can be concluded that toolbox meetings, site meetings, posters, and informal verbal communication are used for communicating the risk and safety measures to be adhered to. It was also revealed that safety committees and gang supervisors play a major role in communicating health and safety issues at construction sites. However, the conflicts was observed when there is a clear separation between health and safety communication and quality and productivity and this causes relations to get strained among the executives and also between the executives and workers. The study also reveals that PPE is the main item used for risk control. There was enough PPE on the sites. On the basis of factors influencing risk management, the study shows that the legal system plays a major role in risk assessment, communication, and control. The study also provides factors that hinder health and safety risk management in construction sites. The factors include low level of public awareness of regulations, lack of resources such as personnel and funds, having little or no knowledge of safety regulations, complexity of design, the procurement system, and low level of education, site configuration, and location. Thus, the main 'mantra' is that every job on the construction site must be carried out with at-most activity.

VI. LIMITATIONS OF THE STUDY

This study was confined to only excavation activity in high rise buildings.

AUTHOR'S CONTRIBUTION

The author conceived the idea of carrying out Hazard Identification and Risk Assessment in high rise buildings pertaining to excavation activity and accordingly scored for papers of high repute based on key words and carried out a practical study on the topic and compiled the manuscript accordingly.

CONFLICT OF INTEREST

The author certifies that he has no affiliation or involvement in any organization of financial/non-financial interest or for the subject written in the manuscript.

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Dr. K. Srinivas has 15 years of industry experience and more than 16 years of teaching experience primarily in the areas relating to construction management. He is presently working as Assistant Professor with Jawaharlal Nehru Architecture and Fine Arts University, Hyderabad.