

Analysis of Health Hazards, Risk and Safety Practices in Construction Sites

D. Sivaramarathinam¹, R.B. Karthick², C. Jabez Deva³

Department of Industrial Safety Engineering

^{1,2,3}P.G Scholar, Bannari Amman Institute of Technology, Tamilnadu, India Assistance Professor,

Abstract-*This review attempts to identify the health hazards, risks and causes of poor safety practices in construction sites. In addition, the differences in safety practices in both developed and developing countries and methods to improve construction site safety are discussed. Construction is project-based where different parties work together to achieve a common goal. The means of achieving this goal is fraught with hazards, which pose danger to human life. Hazard is therefore a phenomenon or a process that can endanger construction workers and their work environment. Hazard associated with building construction can be from work materials, equipment, work method, and practices among others. This paper explores the different types of hazard that exist in building construction sites and their rate of occurrence in order to create the needed awareness that will induce careful actions as well as advance some safety precautions for their mitigation. The literature reviewed the different types of hazard that can be found in building construction sites and the corresponding safety precautions for abating them, while the field survey used questionnaire to elicit the frequency of hazards on site; this was administered through convenience sampling techniques within Enugu metropolis in Enugu state. The descriptive analysis tools were used for analysis. The findings revealed that hazard due to the use of equipment are often encountered on site while electrical hazard is rarely encountered. Conclusion was reached and recommendations based on the findings were made in the paper.*

Keywords-Personal Protective Equipment (PPE), Site management, Workers.

I. INTRODUCTION

The Construction site is a very important place, as a considerable number of workers are involved in construction activities. Employments in construction site can be categorized into three groups; “Management and technical” work force, “Skilled” work force and “Semi-skilled and Unskilled” work force. Personnel with high educational qualifications, usually graduates, trained to design, manage and instruct the construction processes can generally be identified as “Management and technical” work force. Persons who possess extensive knowledge and experience in their construction activities or profession are identified as “Skilled”

work force. “Semi-skilled and Unskilled” work forces are the site labors with little or no construction knowledge. Generally, all skilled, semi-skilled and unskilled workers are at risk of being injured, death or various illnesses in a construction site, although the level of risk varies with activities they are engaged in.

A hazard is a potential source of harm or an adverse health effect on a person or persons. “Hazard” and “Risk” are often used interchangeably. Workers of construction sites are, generally, exposed to an excessive risk of being injured at work construction industry is unique and complex compared with other industries and it contains a wide range of construction materials and products, building services, manufactures, contractors, sub-contractors, design, operation, and refurbishment services.

These complexities make the construction industry as one of the most hazardous industries that causes high rate of accidents. Safety in construction sites is needed to be highly considered in order to reduce the risk of being injured at work. Safety is also identified as one of the major factors affecting the image of the project manager and the organization. The high rate of accidents occurs in the construction industry than in the other manufacturing sector possibly because the construction industry consists of high self-employed workers, and large number of seasonal and migrant workers; many of them are unfamiliar with construction processes.

In addition, those workers are exposed to bad weather and involved in many different trades and occupations. The concerned work should be safe and conditions on the construction site should not cause damage to life, health and professional skills”. explains that employer needs to have safety norms and health standards; there should be safety practices in construction sites to be followed by the employer. Effective safety management is to make the environment safe, to make the job safe and to make workers safety conscious. In recent years, many developed countries have considered safety as one of the important management issues of construction projects, especially, personal safety. Objective of this study is to review previous research studies on investigation of health hazards and risks in construction sites to identify causes of

poor safety practices and methods for improving construction site safety.

II. TYPES OF HAZARDS

Building construction hazards may be summarized under the following headings:

- Design hazards
- Hazards due to the use of unqualified persons.
- Hazards due to use of construction materials
- Hazards due to Falls • Hazards due to Equipment
- Hazards due to construction methods
- Electrical hazards

A. Design hazards

In practice, it is difficult to anticipate the fatal hazards which construction workers encounter on a daily basis, some of these, if known can be minimized by design measure. If one is aware of any environmental problem in an area where developmental action is to be taken place, one will have to consider these problems in the design to avert possible hazard. The purpose of any building structure is to satisfy some human needs. The design of any such structure must satisfy the functional objectives of safety, serviceability, and economy. The structure must be safe under the worst system of loads. Under extreme loadings, damage to the structure can be localized and possible loss of lives reduced, but progressive and catastrophic collapses must not occur. Under the working load, the deformation of the structure must not impair the appearance durability and performance of the structure. The design stage is the planning and feasibility studies stage in which professionals may assist the owners to evaluate the technical and economical options available and then realize the design. The design consist of the creation of the architectural form, identification of the loads for structural design, mechanical and electrical designs, selection of materials and proportioning of the section. They further stated that during this stage, the basic requirement of safety, aesthetic, economy, and constructability must be considered irrespective of the client's brief.

B. Hazards due to the use of unqualified Persons

Lamented that the frequency of collapse of buildings in Nigeria in the recent past has become vexatious, menacing and embarrassing. The incidences have become an issue of concern to all stakeholders in the construction industry and indeed, the built environment as the sustainability of the built environment is increasingly and greatly threatened. The impact of building collapse has affected the entire fabric of human endeavor, ranging from psychological trauma on those affected

to the economy of the nation. Lives and properties are lost, revenue to government in tenement rates and taxes are lost, investments and subsequently jobs are lost, victims suffer permanent disabilities, homelessness, among others, including fatalities. highlighted the earlier cases of building collapse verified in Nigeria and their possible causes and suggested among other things the involvement of qualified professionals in the different phases of building construction process and the review of academic program to enhance the capacity of craftsmen and technologist in the building industry. The engagement of unqualified persons in building construction process has been one of the principal causes of building collapse in Nigeria and the possible causes can be traced to the activities that take place in the conception – design stage, construction-supervision stage and post construction-service stage. For a realization of quality jobs in any of these stages of building process, a high level of skill and professionalism is needed. further stated that the construction stage is the implementation stage where every effort is made to ensure compliance with the design and specifications. The activities that takes place within this stage are so enormous and often conflicting that only a trained professional can handle them. Certified Architects, Builders, Engineers and skilled artisans have their respective roles in this stage so as to enforce the quality assurance specification. Therefore, the professional bodies should step up their surveillance of the building sector so as to eject the imposters.

C. Hazards due to construction materials

Construction work involves the use of different materials to realize a structure; these materials are made from the combination of chemical compounds which pose danger to health. Most of the primary construction materials like cement, glass, metals, paints, asbestos, asphalt etc pose very severe health hazard during site application than during manufacturing. For instance, silica, cement, timber, quarry and asbestos dust are known to cause lung infection, impairment, chronic obstructive lung diseases, restrictive lung diseases, pneumoconiosis, serious bacterial infection, skin cancer and carcinoma of the lungs, stomach and colon. To further worsen the situation, the Nigerian construction market is flooded with materials of unknown integrity that are weak to support the intended load and subsequently causes accident due to failure of constructed parts. Hazards due construction materials can come from the storage plan designed for the materials in the site. Ideally, materials should be stored according to the prescribed method; hazardous materials should equally be stored in watertight containers or protected by a temporal cover. Access to those storage spaces should be restricted to specific people. Construction Storm further submitted that a good site layout plan is important for an accident free site and

efforts should be placed on proper construction materials waste disposal. Hazardous wastes must be stored in sealed containers constructed of suitable material with a label that clearly shows the contents and accumulation dates.

D. Hazards due to falls

Falls from height is the leading cause of injury in the construction industry. In the, eight year period survey from 2003 to 2011, revealed 232 deaths which accounted for 11% deaths resulting from falls from height. In another submission by, accidents resulting from height received the highest ranking. Accidental falls are common in construction projects because workers are exposed to risky situations like working from a height with the aid of scaffolds and ladders. Falls from scaffold or ladders often result from the use of unsuitable ladder and faulty or poorly constructed scaffolds. Moreover, construction workers hardly receive any training to prepare them for such work, and scaffolds construction is not properly supervised. therefore advices that employers must provide a full protection program that will advance the overall safety of the workplace. Such program should include providing fall protection systems such as guard rails, safety nets, personal fall arrest system, positioning device system and warning line system Other forms of fall considered in this literature are fall of hard objects from a height and indiscriminate disposal of hard objects by workers from a height. In this case, hard hat should be worn plus providing safety nettings around the perimeters of the building. Scaffold should be checked to be sound, rigid and sufficient enough to carry its own weight plus four times the maximum intended load without settling or swaying. It must be erected by a trained personnel. Ladder should be properly constructed to be able to carry any intended load.

E. Hazards due to Equipment

In high rise structures, construction makes more use of equipment ranging from the hand powered tools to sophisticated types like crane and hoist. The use of these equipment can pose risk to workers. Identified the main causes of mechanical hazards as human error and internal mechanical breakdown involving the steering mechanism and brake system. Citing an example with the collision of a loader with the wall of building, which resulted to the death of a worker, he established that mechanical failure of machine parts can happen anytime in-spite of being in good condition at the onset. For this reasons, it is imperative that parts of machines be checked before operating them; ideally, routine service checks should be carried out at intervals according to the prescriptions of the machines' manufacturers. In a similar situation, Hunter submitted that equipment hazards can present themselves in ground workers being struck by a vehicle

changing direction, rolling over of equipment, running over of vehicles when brakes are not properly set, falling of equipment from back hoes, buckets and moving construction vehicles. Equipment hazards can be eliminated and controlled by strict adherence to all construction safety guidelines such as:

- Using and operating vehicles under a planned preventive maintenance scheme.
- Providing all vehicles with driving and devices capable of giving warning of forward and backward approaches.
- Keeping reversing to the absolute minimum
- Designating parking areas for vehicles on level ground that has good surface and adequate access.
- Providing an incentive for drivers to take pride in their vehicle. Providing good and well defined access ways for vehicle bringing in construction materials, equipment and removing surplus soil or damaged materials from site.

F. Hazards due to construction methods

Construction method in this literature embraces actions taken in manipulating and converting raw materials to realize a building structure. Realizing a stable structure requires the engagement of construction professional to carry out the construction work with the aid of skilled artisans. Poor construction methods and workmanship arising from the use of quacks are responsible for the failure of most buildings, however such disaster do not relate only to finished buildings, infact buildings that are still under construction collapse causing the death of workers. Poor construction methods are caused by negligence and inadequate quality control on site leading to:

- Incorrect placement of steel, which could lead to collapse
- Poor construction of formworks for wet concrete
- Incorrectly made construction joints and
- Inadequate cover to reinforcement.

G. Electrical hazards

Electrical hazard is considered one of the major hazards in construction contributing to approximately 350 deaths each year. Similarly, the Bureau of Statistics cited in OSHA (2002) recorded that 278 workers died from electrocution at work in 1999, accounting for almost 5% of all on-the-job fatalities that year. The electrical and electrocution accidents on site between 1992 and 1998 accounted for 1002 deaths due to electrocution and 17 due to electrical flashes on site. Unfortunately, statistics are not available in Nigeria to

show the number of deaths or injuries arising from electrical hazards, but McCann and Paine's submission showed that the main victims of electrical injuries are electrical workers as such their findings may be applied to Nigeria since construction, irrespective of the geographical location has the same features. The causes of electrical death or injury on site in their decreasing order of importance are: contact with overhead power lines, contact with wiring or other electrical components, contact with electrical current from machines, tools and appliances and contact with underground power lines. Electrical hazards can be avoided by observing the relevant safety measures such as provision of personal protective equipment (PPE). Lockout and tagging of faulty and idle electrical device, ensuring that all cables are in proper condition before any electrical device is switched on, ensure that nobody shall connect, maintain or modify electrical equipment or installations unless the person is an electrician certified under the trades qualification and apprenticeship.

H. Management of Construction Hazards

Management of construction hazard is not getting the required attention that it deserves in Nigerian construction industry; this may be due to the fact that it does not produce a direct dividend that is easily perceived, unlike the actual production process. Unfortunately for the industry, resources are wasted every year, the industry is seriously facing the dearth of its workforce, which is evident in the scarcity of skilled artisans and a heavy reliance on migrant workers. A number of safety precautions to be taken on construction site as follows:

- Perform a thorough walk through of the site to identify and assess any workplace hazard and write down anything that may be considered unsafe.
- Train all personnel in work-site safety and operating procedure either on-site or at training facility: training should include proper lifting techniques to help reduce common back injuries. Identify and mark any hazardous material and determine any risk involved to personnel: label and store any material deemed hazardous in proper container and secure them in a safe location. Make sure there is an MSDS (material safety data sheet) for all potentially hazardous chemicals/materials.
- Inspect equipment to be sure it is working properly: be on the lookout for unusual noise and jerky movement. Report any problem immediately and do not operate the machinery until repairs have been made.
- Use harnesses and other safety equipment when performing roof work or working on the scaffold.

- Provide personal protective equipment to all employees, including hard hats, safety goggles and boots, hand gloves, ear plugs (or another form of protective) and face masks.
- Be sure OSHA (occupational safety and health administration) standards are met. Engage a health and safety inspector.
- Prepare for emergencies, operators and site workers should know what to do in case of electrical, mechanical and power failure or injuries.
- Protect the public by barricading the construction site during work hours. After working hours lock all point of entry.

III. DISCUSSION

By comparing health hazards, in different studies, it can be seen that health hazards having acute effects such as workers fall from height, have been reported more frequently. It was reported that 1107 major injuries are due to falling from a height according to the Health and Safety Statistics Highlights for the time period 2003- 2004.. It has been estimated that reoccurring musculoskeletal injuries range from 30,000 to 50,000, respiratory diseases affect up to 20,000 construction workers and skin diseases affect up to 10,000 workers every year. However, in studies, especially conducted in countries like Pakistan, Sri Lanka and Malaysia, musculoskeletal injuries, respiratory diseases and skin diseases among construction workers were not reported. This does not imply that the workers in these countries did not suffer with these chronic effects. It seems that construction sites in developed countries pay their attention to both acute and chronic health effects of construction workers. The research study, which aims to identify challenges that international contractors face, when, attempting to transfer techniques to developing countries on short-term global projects, also found that contractors of these countries have different cultural perceptions of acceptable level of safety. Many of acute effects identified in previous studies include falls in construction sites.

Possible causes of these hazards might be unclear walkways and risky slips, trips and falls. Generally, workers walk in the site, by carrying things. Therefore, the worker may not be able to balance the body and difficult to see things in the site. Uncovered holes or trenches in the site might also be a cause for slips and falls in construction sites as workers carrying things cannot see such obstacles. Therefore, keeping clean pathways in construction sites will help to reduce injuries and improve the efficiency of workers. Keeping the site clean with the help of workers could be one of the responsibilities of site supervisor. Wearing boots will also help to prevent some injuries although many workers wear thin-soled athletic shoes.

Contractors are suggested to give a site plan to safe access to the site, provide fences to keep the unauthorized persons away, display warning signs, declare proper walking and vehicle paths to lead safe access to working places, keep the site tidy and clean to avoid disease, similar to the recommendations. It appears that noise and vibrations are risk factors which are having chronic effects on the health of workers, but the workers are not much aware of them. However, construction workers are exposed to a combination of noise and vibration, which are inevitable in construction sites.

Exposure levels of construction workers to noise and vibration are generally high. Negative effects of noise and vibration on construction workers have been reported in previous studies. However, noise and vibration have been identified as construction hazards by 11% and 3% of workers, respectively. Depending on the type of construction sites, workers may get exposed to noise induced by one or more sources. In addition, it was found that type and size of the work sites are important factors in noise level: large sites, generally, have high exposure levels. The large projects show a high and consistent level in safety while small projects show a low and varied safety levels. The report mentioned that repeated exposure to noise levels about 85 dBA (such as years of working around construction noise without hearing protection) or exposing above 140 dBA for a short time period, such as 1 second, can damage nerves in the inner ear, resulting in permanent and in reversible hearing loss. Construction workers in Washington states are five times more likely to request workers' compensation claims for hearing loss than workers in all occupations.

Vibration induced from construction machines may effect on major part of the worker's body or only a particular organ to vibrate. In Whole Body Vibration (WBV), energy enters the body through a seat or the floor; it affects the entire body or a number of organs in the body. The symptoms of WBV are not so readily recognizable and are often mistaken for other unrelated conditions. These results in hyperventilation, increased heart rate, oxygen intake, pulmonary ventilation and respiratory rate.

Improving of knowledge of construction personnel's safety cognition might be important in improving safety performance. Mostly identified poor safety practices are categorized under Safety equipment. To develop the knowledge on Personal Protective Equipment (PPE) and risk factors in construction sites, awareness campaigns, through many methods like "on site safety charts, displaying pictures, posters or films", can be used. In addition, practical demonstrations on site, arrangement of appropriate forms of formal or informal education and training programs for the

workers on the site can be recommended, although the workers' participation in such programs would be totally dependent on their interest. Incentives on completion of such trainings would be a good process to enhance workers' interest. It would be better to introduce a system to evaluate the attitude towards safety implementation plan of project construction firms before giving them a contract. Contractors' top management should formulate strategies and develop policies to create a safe culture as a catalyst for maintaining a safe project, while considering construction needs to be completed within the given period at a given cost. Designing for safety has also been identified as viable and needed intervention to improve safety performances.

IV. CONCLUSIONS

This review attempts to identify health hazards, risks and causes of poor safety practices in construction sites. In addition, the differences in safety practices in both developed and developing countries and methods to improve construction site safety are discussed. Health hazards in construction sites can be categorized into two: acute health hazards and chronic health hazards. Mostly reported acute health hazards are "workers fall from height" and "electric shocks", while mostly reported chronic health hazard is "exposure to hazardous substances". Lack of awareness about site safety or dislike to wear Personal Protective Equipment (PPE) was identified as one of the main causes for scarcity of safety practices in construction sites. Other causes of poor safety practices include "Lack of productivity after lunch", "lack of training facilities", "lack of effective labor training (possibly due to the transient nature of the construction work force)", "lack of understanding of the job", "unsafe behavior found at industry (working with moving machinery, wearing dangling clothes, unsafe lifting, carrying and placing)", "financial difficulties" and "influence of alcohol and drugs". Workers' and contractors' awareness on possible risk factors and site safety were more concentrated in studies in developed countries compared with developing countries.

There is no systematic study on the chronic effects of health hazards on construction workers, although possible risks were reported in some studies, implying that less attention has been paid for chronic health effects of workers. Noise and vibration associated with construction activities may have chronic effects on the health of workers.

To enhance safety practices, one of the major needs in the construction industry is to enhance professionals' interests in active safety management and implementation of awareness programs, which must be developed and implemented among construction workers. An additional training for the workers,

which could be provided by contractors about equipment they use, before workers engage in their duty, would also help to prevent accidents. Awareness on possible risk factors and knowledge on how to reduce these risk factors among workers and contractors will enhance site safety

REFERENCES

- [1] MervFingas. (2000,May 10)Basics of oil spill cleanup. (2nded.)[Online].Available: [https://www.crcpress.com/The-Basics-of-Oil-Spill-Cleanup-Second-Edition/Fingas Fingas/9781566705370](https://www.crcpress.com/The-Basics-of-Oil-Spill-Cleanup-Second-Edition/Fingas-Fingas/9781566705370)
- [2] Pendlebury, M. C., Brace, C. L. and Gibb, A. G. F., (2006), Construction Health: Site Hazards and Risks, The Future of Sustainable Construction.
- [3] Rameezdeen, R., Pathirage, C. and Weerasooriya, S. (2003), Study of Construction Accidents in Sri Lanka, Built-Environment-Sri Lanka, Vol. 04, no. 01:2003.
- [4] Shibani, A., Saidani, M. and Alhajeri, M. (2013), Health and Safety Influence on the Construction Project Performance in United Arab Emirates (UAE), Journal of Civil Engineering and Construction Technology, Vol. 4(2), pp 32-44.
- [5] Tam, C. M., Zeng, S. X., and Deng, Z. M. (2004), Identifying Elements of Poor Construction Safety Management in China, Safety Science, Vol.42(7),pp 569-586.
- [6] Abdul Hamid, A. R., Wan Yusuf, W. Z. and Singh, B., (2003), Hazards at Construction sites, 43 ENGINEER Proceeding of the 5th Asia-Pacific Structural Engineering and Construction Conference, Johor Bahru.
- [7] Ahamed, M., Nafeel, A., Rishath, A., and Dissanayake, P., (2011), Site Safety of Sri Lankan Building Construction Industry, Proceedings of the International Conference on Structural Engineering, Construction and Management (ICSECM), Kandy, Sri Lanka, 15-17 December 2011.
- [8] Chia- Kung Lee and Jaafar' Y., (2012), Prioritization of Factors Influencing Safety Performance on Construction Sites: A Study based on Grade Seven (G7) Main Contractors' Perspectives, International conference on Business, Management and Governance (ICBMG 2012), Hong Kong. [24] Farooqui, R. U., Arif, F. and Rafeeqi, S. F. A. (2008), Safety Performance in Construction Industry of Pakistan, in First International Conference on Construction in Developing Countries, Karachi, Pakistan.
- [9] Galappatti, L. L., Subashi De Silva, G. H. M. J. and Sudhira De Silva, (2013), "Investigation on Methods to Improve Health and Safety Practices in Construction Sites", Special Session on Structural Solid Mechanics, 4th International Conference on Structural Engineering and Construction Management, Kandy, Sri Lanka.
- [10] Gunawardana, N. D., and Jayawardane, A. K. W., (2003), The Training needs of Construction Workers in Sri Lanka, Proceedings of Annual Sessions of IESL, Oct. 2001.
- [11] Jeyakanthan, J. and Ahamad, Z. (2012), Causes and Effects of Accidents in Building Construction Industry in Sri Lanka", Proceedins of the 2nd Annual Sessions of the Society of Structural Engineers-Sri Lanka.