

Management Of Hazards And Prevention Of Accidents And Injuries In Building Construction Using ‘Hierarchy Of Controls And Safety Education

Emmanuel U. Asogwa (PhD.)¹, Jude Blavo (PhD.)² and Evarestus O. Asogwa³

¹Department Of Human Kinetics And Health Education
University Of Port Harcourt

²Department Of Physical And Health Education
Adeniran Ogunsanya College Of Education
Lagos, Nigeria.

³Federal University Of Technology
Minna, Niger State, Nigeria



Abstract – Studies have shown that rates of accidents and injuries in building construction industry are generally high due to the fact that virtually all building construction sites are faced with unsafe conditions, especially in developing countries, exposing construction workers and users of such constructed structures to a wide range of hazards and dangers. Lack of adequacy of safety practices in building construction is evident in the numbers of building collapses and fatalities, injuries and damages reported in building construction industry in developing countries. However, most building construction accidents and injuries can be prevented, reduced or eliminated with an effective hazard control system in place, and the right safety education and practices among all stakeholders in building construction. This paper, therefore, discusses using the hierarchy of controls and safety education to control hazards and prevent accidents and injuries in building construction.

Keywords – Management Of Hazards, Prevention Of Accidents, Prevention Of Injuries, Building Construction, Hierarchy Of Controls And Safety Education

I. INTRODUCTION

Despite the significant role of the building construction industry in nation-building, its activities pose a serious threat to the health of construction workers, users of building facilities and the public. Study reports claim that twenty-five to forty per cent of fatalities in the world's occupational settings are contributed by the construction industry (International Labour Organization [ILO], 2012), and higher relatively in building construction. Idoro (2011) stated that accidents and injuries in building construction in developing countries are generally high due to the fact the safety of the workers and occupants of such buildings are not taken seriously by the employers, regulatory institutions or governments, and workers themselves. According to Adeagbo, Dakar and Izam (2019), the magnitude of casualties suffered in the execution of building projects across the globe has made the building construction industry the most dangerous or highly hazardous industry. Construction workers face different kinds of safety and health hazards while working every day. According to Lingard's study in 2013, over 60,000 fatal injuries are reported every year from construction projects around the world, and from the reports of the Occupational Safety and Health

Administration [OSHA] under the Department of Labour, one in ten construction site workers is injured every year (Adeagbo et al., 2019)

Safety is not considered during the construction project delivery process in most developing countries, it is deemed to be an unnecessary aspect of the process (Onibhagere, 2020). Most construction companies focus their attention on productivity improvement, technological advancement and profit maximization with less concern for workers' safety (Kassu, & Kitaw, 2016). Safety factors are not given priority in the processes of building design, planning, awarding contracts, and operation (Olatunji, Aje, & Odugboye, 2007). This development is in contravention of the Occupational Health and Safety [OHS] Act of 2012, referred to as Workplace Health and Safety Act, whose objectives, according to Hamalainen, Takala, and Kiat (2017) include to : secure and promote the health, safety and welfare of people at work; protect people at a place of work against risks to health and safety arising out of any activities of people at work; promote a safe and healthy environment for people at work that protects them from injury and illness and that is adapted to their physiological and psychological needs; provide for consultation and cooperation between employers and workers in achieving the objectives of the Act; ensure that risks to health and safety at a place of work are identified, assessed and eliminated or controlled; develop and promote community awareness of occupational health and safety issues; provide a legislative framework that allows for progressively higher standards of occupational health and safety to take account of changes in technology and work practices; and protect people (whether or not at a place of work) against risks to health and safety arising from the use of machinery that affects public safety. The strict compliance to the objectives will to a very large extent prevent occurrences of workplace accidents. This can be achieved through compliance codes, work-safe positions and non-statutory guidance.

Safety performance in building construction could be assured when there is a high level of safety education among the stakeholders in the sector (such as design engineers, contractors supervisors, regulatory agencies, workers, etc.), and safety facilities, guidance and regulations put in place to ensure safety compliance both in designs and operations. Through safety education, critical stakeholders in the building construction sector could be educated and be able to carry out their specific roles in ensuring safety performance in building construction.

Health Hazards in Building Construction

Construction workers face different kinds of safety and health hazards while working every day. Construction hazards frequently encountered on building construction sites include exposure to toxic chemicals, dust and vibration, high noise levels, manual lifting of heavy weights, unsafe openings, ionizing radiation, fire, exposure to live cables, and moving mobile construction plants. Hazard is something with the potential or risk to cause harm. This can be an object, substance, machine, way of working, or working environment. A risk is the likelihood of potential harm from a hazard.

According to Onibhagere (2020), Israel Institute of Occupational Safety and Hygiene [IIOSH],(2015) listed some common hazards that have the potential of causing accidents and injuries during building construction as: falls from elevated surface, high floor of a building, veranda/surface without railing, roofs or from ladder; falling into a cellar, shaft, trench or open pits, tunnels; falling from cliffs and slopes; slip, trip; collapse of an excavation, trench, floor or walls of a building or of an auxiliary structure; collapse of buckling components in a structure that is being built; collapse and slides of piles of materials or of stored building equipment; landslides of soil and stones; injury from falling objects; stepping on sharp objects, and by impact and collision with sharp or protruding objects; risk of being hit by heavy mechanical equipment on a site; contact with and exposure to extreme temperatures (during outdoor work) or cold and frost bites; electrocution as a result of unintentional contact with live electric wires or cables during construction or inspection and supervision rounds on sites; eye injury caused by flying splinters/particles of stones and metals created through demolition and operations; injury as a result of fire and/or explosion of inflammable materials (like bitumen tars, solvents etc.); exposure to noxious dust (asbestos, cement dusts);and dermatitis caused by contact with irritating and allergic materials; exposure to organic solvents, thinners, paints, and paint-removing chemicals; exposure to infectious diseases as a result of close contact with fellow construction workers; exposure and contact with allergic vegetation and insects (wasps, bees), snakes and similar creatures within construction sites; musculoskeletal injuries stemming from poor work posture; defective illumination (organizational hazard); sick-building syndrome, and poor work culture (psycho-social hazards)

These hazards are in the form of physical, chemical, electrical, psycho-social, biological, and ergonomic hazards. If these hazards are not properly checked, they can cause deaths, injuries, deformation, disorders, pains, and allergies to workers on construction

sites. The victims are always the site engineers, roofers, masons, carpenters, electricians, iron-benders, tillers, painters, helpers or labourers, supervisors and others.

Safety Challenges in Building Construction

There are many safety challenges arising from the designing and construction phases, exposing construction workers to a wide range of hazards and dangers. The main goal of construction companies and contractors, especially in developing countries is to maximize profits at the expense of the health and safety of construction workers. Despite the global emphasis on the importance of workplace safety and health welfare, safety performance in the building construction sector in these countries remains poor.

Idoro (2011) reported that survey studies on safety in building construction revealed that accidents and injuries in this industry in developing countries are high compared to the developed countries due to the fact that the safety of workers are not taken seriously by the employers. For instance, in Nigeria, Onibhagere (2020) stated that safety is not considered in building construction project delivery processes. Olatunji et al. (2007) also noted that though prequalification is widely practised in Nigeria in the process of awarding construction contracts, safety factors are not given priority in those processes. In practice, all categories of Nigerian contractors do not perform better than one another in health and safety issues for their employees. Dodo (2014) further stated that stakeholders in Nigeria do not attach much seriousness to the issue of safety, and most accidents and injuries are not often reported and at many sites, no training programmes on safety for the staff and workers. And effects of this neglect and inadequate health and safety education and provisions in building construction are evident in high rates of building collapse, accidents and injuries reported in different parts of developing countries (Ayedun et al., 2012). In Nigeria, there are many reported cases of building collapse in different parts of the country on daily basis causing inestimable damages and loss of life.

Most construction accidents occur as a result of poor knowledge of safety, lack of proper training, deficient enforcement of safety rules and regulations, unsafe tools and equipment, unsafe worksite conditions, and poor attitude towards safety (Onibhagere, 2020). Adeagbo et al (2019) listed five most causes of accidents among construction workers to include; lack of adaptability of workers to safety practices as against traditional practices, ineffective communication between safety personnel and workers, lack of training on key issues about health and safety consciousness, workers’ inadequate or lack of understanding about workplace safety rules, and workers engagement in improper conduct that affect another worker’s safety. Most often, these inherent hazards in building construction are not pointed out to the workers by design engineers and clients or contractors, which majority of them are usually novices in modern building construction, with little or no adequate safety knowledge and proper and good safety behaviours and positive attitudes toward safety. These deficiencies always lead to non-compliance with safety guidelines and regulations at a worksite.

Okoye et al. (2016) reported that accidents in the construction industry are higher than in the manufacturing industry because the working conditions in the manufacturing industry are controlled, and the personnel usually remains stable, whereas that of the construction industry is largely dynamic in nature. The workers are frequently changing; hence, control of working conditions is difficult. This is because, if a set of workers are enlightened on safety precautions, the enlightenment leaves with them when they stop working on the site, hence, the process needs to be repeated when new sets of workers are deployed to the site.

Another safety challenge in building construction is that different personnel work in stages on site making it difficult to have comprehensive safety guidelines and supervision procedures for all workers of different trades or professions at a time or period. Ibrahim and Abdul-Bello (2014) corroborated that building construction industry is made up of many personnel with different trades, and these personnel are assembled on sites at various stages of the process. According to them, this single factor adds more complexity to building construction process, making control activities of personnel in relation to safety not easy, because of the different occupational backgrounds with unique characteristics special to them based on their trades or professions

‘Hierarchy of Controls’ strategy for Hazard Control

Due to unacceptably high rates of casualties in the building construction industry, several efforts have been made for paradigm shifts from monitoring safety performance to preventive measures, such as using the ‘hierarchy of controls’ model of hazard management in the construction industry. To identify and control hazards in building construction, involves a series of processes from the design phase to the construction phase. Hazard control measure is more than simply inspecting out hazards, rather, a measure where both the employers and employees take recognition of characteristics of potential hazards and risks in various

stages of construction and the necessary steps to ensure that the hazards are promptly identified and analyzed, and tackled. To most effectively improve safety and health management system in building construction, there is need to anticipate potential hazards before they exist, and to control existing ones when they have been identified, which hierarchy of controls strategy is set to achieve.

Hierarchy of controls is prevention through design (PtD) strategy to prevent or reduce occupational injuries, illnesses and fatalities through inclusion of prevention considerations in all designs that impact workers (National Institute of Occupational Safety and Health [NIOSH], 2015). It is a system used in industry to minimize or eliminate exposure to hazards. McLeod and Curtis (2020) state that the system is widely accepted and promoted as standard practice in workplace, and has also been used to form public policy in other fields such as road safety. The Hierarchy of controls strategy has five methods, namely; elimination, substitution, engineering controls, administrative controls, and personal protective equipment. **Elimination method or control** involves physical removal of hazards from worksites. This method is the most effective control method. Substitution control involves replacing something that produces a hazard with something that does not produce a hazard or produces a lesser hazard (Canadian Center for Occupational Health and Safety, 2006). To be an effective control, the new product must not produce unintended consequences. It is the second most effective method hazard management in workplace, however, both elimination and substitution controls tend to be the most difficult in an existing process.

Engineering Controls

Ensuring a safe and healthful construction site means to design a workplace where tools, equipment, machinery, materials, and work environment are free from hazards that could cause injury or illness. The most effective plan to control hazard is to get rid of hazard (if feasible) to avoid exposure to it, and this can be done through sound engineering design. Engineering controls have two sets of hazard control strategies: strategies to eliminate hazards, and strategies to reduce hazards. These controls focus on the source of hazard itself, unlike other types of controls that generally focus on the employees exposed to hazards. Where these control strategies are not the need be, exposure control strategies can be used instead.

There are methods in engineering control strategies, with which hazards can be eliminated or reduced. These methods are substitution, design, enclosure, barriers, and ventilation. **Substitution:** It involves substituting hazard with something that is not hazardous or less hazardous. Replacing defective tools, hazardous equipment and machinery, or substituting toxic substances with non-toxic or less toxic substances are examples of substitution strategy. **Design:** If feasible, engineers can design or redesign facilities, equipment to remove potential hazard, and/or substitute something that is not hazardous or less hazardous. Examples of design control strategy include redesigning tools, equipment and materials and machinery to ensure the safety of the workers or users; redesigning work furniture or carpentry, or environment to be more ergonomically correct. **Enclosure:** This strategy involves enclosing or covering hazards to prevent exposure in normal operations. Complete enclosure of moving parts of machinery, complete containment of toxic liquids or gases, complete containment of noise, heat or pressure producing processes are examples of enclosure strategy in control of hazards on the worksite. This enclosure method is used when the removal of such hazard is not feasible. **Barriers:** This strategy is used when a complete enclosure is not feasible. Barrier strategy establishes or erects barriers to prevent access to hazard. Examples are machine guarding, electronic barriers, physical barriers, baffles and noise-absorbing barriers. **Ventilation:** this strategy is used to reduce exposure to hazard in normal operations. It involves creating local and proper ventilation to avoid suffocation and extreme temperatures. Examples include ventilation hoods in paint booths, and force air ventilation in confined places. All the strategies at the engineering control level should be ensured to be in place by employers of labour as their responsibilities to ensure the health and safety of workers on the worksite.

Work practice controls/Administrative controls.

These types of controls involve designing procedures and practices so that employees are free from exposure to hazards that could cause injury or illness. These controls have two control strategies; one is to eliminate exposure, and the other is to reduce exposure. Administrative or management controls are aimed at eliminating or reducing exposure to hazards through strategies such as changing work habits, improving sanitation and hygiene practices, or making other changes in the way the employees perform their jobs.

There are three basic management or administrative control strategies to eliminate or reduce exposure to hazards. These include practices, procedures, and schedules. **Practices:** Healthy practices are key to safety on worksite. The practices include activities

such as using personal protective equipment (PPE); placing warning signs that inform and restrict access to dangerous spots; removing tripping, blocking and slipping hazards; removing accumulated toxic dust on surfaces; wetting down surfaces to keep toxic dust out of air. **Procedures:** there are procedures that apply to specific jobs in work place which are, often, developed from hazard risk analysis. There are permit required for confined space entry procedures, lockout/tag-out procedures, fork-lift safety inspection procedures among others. **Schedules:** involve creating measures aimed at reducing employees' exposure to hazards by changing work schedules. Such measures include lengthened rest breaks, additional relief workers; exercise breaks for varying body motions, and rotation of workers through different jobs.

Personal Protective Equipment (PPE)

The use of PPE is the least effective way control to protect workers from hazards because it does not eliminate or reduce a hazard. It places a barrier between the worker and the hazard. This means that if PPE fails or is not used or used properly, the worker is not protected from the hazard. In as much as wearing appropriate PPE can reduce exposure to hazards, it is more effective in considering other methods to control hazards before resorting to PPE.

Safety compliance on the part of workers is embedded in the use of PPE. PPE is specialized clothing or equipment worn by workers for protection against health and safety hazards. It is designed to protect workers from serious workplace injuries or illnesses, resulting from contact with chemical, radiological, physical, electrical, mechanical or other workplace hazards.

Types of PPE

There are common types of PPE used in construction sites for eye and face, head, hand, and respiratory protection.

Eye and face protection: is the protection of the eye and face against injury resulting from impact or hit, heat, liquids, chemicals, molten metal splash, chemical gases or vapour, sprays, splatter, dust, flying particles, harmful light, and/or radiation such as lasers, ultraviolet and infrared.

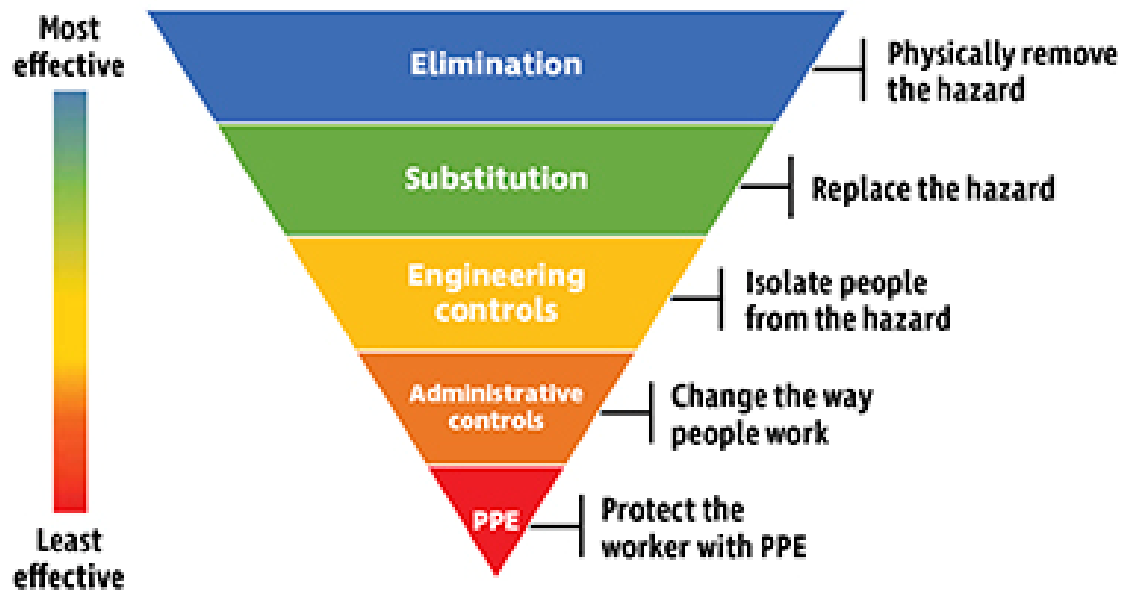
Head protection: This is a protection of the head against injuries resulting from falling or flying objects, risk of head bumping, hair entanglement, electrical shock and splashes, spills and drips that can irritate and burn the eye or skin. Wearing a safety helmet or hard hat is one of the easiest ways to protect an employee's head from injury.

Hand protection: It is a protection of hands against injuries resulting from skin absorption of harmful substances, chemical or thermal burns, electrical dangers, bruises, abrasions, cuts, punctures, fractures, and amputations. Protective hand equipment includes gloves, finger guards-and-arm coverings or elbow-length gloves.

Foot and leg protection: protection of foot and leg against injuries from falling or rolling objects, or from crushing or penetrating materials, hot substances or corrosive or poisonous materials, electrical hazards, chemical hazards, puncture hazards that can pierce or cut the soles or uppers. Foot and leg protection come in form of wearing a non-conductive foot wears.

Respiratory protection: It is a protection against inhalation of hazardous materials such as dust, fogs, and fumes. Mists, gases, smokes, sprays or vapour. These harmful materials cause damage to delicate structures of the lungs and other respiratory organs. Examples of this protection include air purifiers and air suppliers.

Hearing protection: is a protection against damage to the delicate structures in the ears that can cause hearing loss of conductive loss and sensorineural. Conductive loss is due to blocks of transmission of sound to the inner ear, while sensorineural involves damage to the corti and auditory nerve, and this damage is always irreversible.



Source: National Institute of Occupational Safety and Health [NIOSH] (2015)

The graphic representation of Hierarchy of controls depicts that the control methods at the top are potentially more effective and protective than those at the bottom. According to NIOSH (2015), following this hierarchy normally leads to the implementation of inherently safer system, where the risk of illness or injury has been substantially reduced

Responsibilities of Stakeholders in Building Construction Safety

The main parties responsible for construction safety include main contractors, clients, government/regulatory agencies, and employees.

Safety Duties of Government/Regulatory Agencies

Government and professional regulatory agencies do enact legislation and formulate regulations to help ensure that construction project is safe to build, safe to use, and safe to maintain and deliver good value. These ensure that there is good health and safety planning for any construction projects for management and minimizing unexpected costs and problems. Regulatory agencies and government principally ensure that safety regulations that govern building construction are strictly complied with by construction firms, and offenders are adequately punished.

Safety Duties of Contractors/Employers/Construction Clients.

An employer must assess the work being undertaken and the environment his employees will operate in, when determining the forms of safety regulations, guidance and guidelines to be put in place, and the appropriate personal protective equipment to be worn. Where potential health and safety risks are low, employers are required to insist and ensure that safety precautions and regulations are taken seriously by workers and their supervisors. They must always as far as be reasonably practicable, consult with their workers who are directly affected by certain health and safety matters. Employer's legal duties cannot be removed or limited through contractual arrangements with other employers, workers, or contractors. These duties remain even when they overlap with those of other employers.

International Labour Organization [ILO] (2012) and NIOSH (2015) set out guidelines which employers must comply with as part of their general duties. The set- guidelines include:

- Providing or maintaining plans or systems of work that are safe and without risks to health;

- Involve workers who, often, have the best understanding of the conditions that create hazards, and insights into how they can be controlled;
- Identify and evaluate options of controlling, hazards using a hierarchy of controls;
- Develop plans with measures to protect workers during emergencies and nonroutine activities;
- Evaluate the effectiveness of existing controls to determine whether they continue to provide protection or whether different controls may be more effective;
- Making arrangements for the safe use, handling and storage, or transport of substances;
- Maintaining the workplace under their management and control in a condition that is safe and without risks to health;
- Providing adequate facilities for the welfare of workers at the workplace under their management and control;
- Providing workers with information, instruction, training, or supervision that is necessary for them to work safely and without risks to health; and
- Monitoring conditions at workplaces under their management and control.

As a matter of responsibility, the main contractors should select the controls that are the most feasible, effective and permanent, and check that all subcontractors conform to safety rules and guidelines, and also provide PPE for all their workers free of cost.

Safety Duties of Employees(workers)

The Occupational Health and Safety [OHS] in 2012 outlined some employees’ responsibilities as applied in a workplace in the observance of health and safety procedures (Onibhagere, 2020). These include:

1. Identify all relevant OHS policies and procedures in such areas: equipment maintenance, a duty of care, emergency/fire/accident procedures, first aid, general maintenance, hazard identification and reporting procedures, health and hygiene, resolving issues, manual handling, personal safety and security, stress management, waste disposal, and safe working instructions.
2. Follow and maintain safety procedures to achieve a safe work environment, which includes; working safely with concerns for the safety of those around, following OHS laws, identifying hazards, reporting incidents and injuries, updating one’s knowledge of OHS issues, and managing one’s levels of stress and fatigue.
3. Identify safety issues such as environmental conditions, slippery surfaces, toxic substances, body fluids, fire, sharp objects, faulty-fitness-related equipment, and faulty electrical equipment.
4. Report work-related incidents, issues or accidents to designated personnel according to the policy of the organization.

Employees must be made aware of their responsibilities in worksite safety, which include the use of PPE appropriate to their trades, proper care of the equipment they use, and report of any defects on equipment and in the workplace environment. They should be knowledgeable on the use of PPE, compliance with safety rules and regulations, the benefits and consequences of not using them or obeying safety regulations, including the disciplinary actions meted out to the offenders. They should also have adequate knowledge and skills in their respective work, adequate knowledge of the associated hazards and risks in their work, and a positive attitude and behaviours toward safety compliance on the worksite.

Role of Safety Education in Prevention of Accidents and Injuries in Building Construction

Role of safety education in management of hazards and prevention of accidents and injuries on building construction sites cannot be over emphasized. It is only when workers are in a sound state of mind and healthy that work can go efficiently (Okoye, at al., 2016). Successes in building construction largely depend on health and safety of workers at

workplace, and this can be ensured by the level of good safety knowledge, attitudes and behaviors and safety compliance spirit they possess. All these qualities translate to good safety practices. Safety can be viewed as a point at which all associated skills with a particular job are well managed in a reasonable manner (Adeagbo et al., 2019). Safety should focus on curbing accident at work setting and its negative effects on the workers in all manners.

Safety practices are parameter to measure successful project delivery, which is most paramount to the client and workers in achieving efficiency and effectiveness in construction industry (Famakin et al., 2012). According to Dodo (2014), without compliance to health and safety practices, more accidents will result to pains, injuries, damages, and legal actions thereby delaying the project and escalating production cost. Adequate safety knowledge, attitudes, skills and practices can only be achieved through planned safety training and education. Safety education is the teaching of specific knowledge, skills and understanding that people need in order to stay safe in a given situation. It is the process of enabling people to keep themselves safe and contribute to keeping others safe any settings, including work places. Safety education in construction project is not mere about isolating workers from all hazards; it involves equipping them with adequate knowledge, proper and good attitudes and behaviours to deal safely with a wide range of situations.

Safety education in building construction involves establishing a systematic approach to the management of health and safety on work sites through key roles, responsibilities and activities among critical stakeholders in building construction. Effective safety education in building construction should include skills of hazard awareness and recognition, risk assessment and audit, and management, and a range of contexts appropriate to different trades or professions like mansion, carpentry, roofing, painting, tiling, welding, brick laying, among others. This education should run all through the stages of building construction, and the hierarchy of controls, from design or engineering controls to administrative and personal protective equipment (PPE) controls. Participants for safety education programme should include all categories of critical stakeholders in building construction such as engineers, architects, clients, main contractors, sub-contractors, supervisors, and workers including staff of regulatory agencies and governments. Safety education should underpin or support the whole culture of building construction, and the ethos of builders (moral ideas and attitudes).

Rationales for safety education in building construction are due to some facts and incidences. These include that building construction has the largest number of accidents in construction, with an estimation that 5,500 workers die daily from work-related accidents and diseases, and in Nigeria, for instance, two accidents and five injuries occur per 100 workers in a year (Agwu & Olele, 2014; Muhammed et al., 2015); building construction involves different types of workers with different trade skills and working tools with their inherent dangers; different working tools and practices by different types of workers increase the chances of accident on construction site; poor quality of work done by one set of workers can constitute a danger to the next set of workers that would work at the same project. That is, poor mansion work can expose fitters, roofers, tillers, painters to dangers of accidents, injuries, or deaths.

There are many benefits of safety education to all categories of stakeholders in building construction. Safety education generally improves and strengthens safety culture in building construction. Safety culture refers to specific organization, attitudes, beliefs, perception as well as values towards safety (Lianying & Yuan, 2012). Safety culture is the combination of attitudes, behaviours, rules, personal responsibility as well as human resource characteristics. When safety culture and ideology of construction companies are improved, hidden dangers will be prevented and controlled. Safety education is meant to provide workers and managers with a greater understanding of health and safety policies and practices for them to work safely and ensure their actions and inactions do not harm any other persons (Adeagbo et al., 2019).

Proper safety education would enable building designers, planners, architects, engineers to design, arrange or organize tools, equipment, machinery, materials, and entire worksite environment, taking into consideration the safety of workers according to their trade skills. These stakeholders can eliminate, enclose, or compensate hazards, and avoid or limit exposure to hazards at the engineering or architectural design levels. With good safety education, administration and management of building construction firms would be able to have good safety policies and culture, such as, having in place safety measures, rules and regulations, and guidelines, and punishment for violations or non-compliance to safety rules and regulations. Clients and management in construction industry through safety education can promote key skills

and thinking skills among construction workers, such as, information technology skills, improved workers’ learning and performance, information processing, enquiry, evaluations, problem-solving, reasoning and creative thinking skills. On the part of the workers, safety education would make them become aware of possible and potential hazards in different areas of their lives, and able to take appropriate decisions and actions on safety compliance.

However, there are challenges to having comprehensive and holistic safety education programme in building construction site. These challenges arise from the facts that workers in building construction are of different trades or professions, and all the workers in building construction process do not work at the same on the site, because one type of job proceeds another making it difficult to gather all workers on building site for a formal safety education.

Generally, positive effects of safety education in construction project include improvement of safety among workers, adequate provision of appropriate safety equipment and facilities, reduction in number of cases of accidents and impact among and on workers, enhancement of project performance and workers productivity, reduction in construction delay, reduction in litigations and claims about damages, and improvement in the environment and workplace quality. The aim of safety education in building construction is basically to help both the employers and workers recognize hazards and their sources, assess risks, avoid exposures, and prevent and control risks both within and outside workplace.

II. CONCLUSION

Control of hazards and prevention of accidents and injuries in building construction is a collective responsibility of both the construction designers, engineers, architects, employers and workers, regulatory bodies, and the governments. Successful completion of building construction process depends on effective safety management, and effective safety management on any building construction sites depends largely on level of proper general and specific safety knowledge, understanding, skills, attitudes, and practices employers and employees possess.

III. SUGGESTIONS

Based on the review of the literature, the following suggestions were made:

1. All the stakeholders in building construction should as a matter of priority be subjected to safety education programmes on areas such as hazard identification and communication, required safety practices, emergency management and proper instructions handling, safety rules, guidelines and compliance, and risk factors for accidents on construction worksites.
2. Safety education in building construction should be expanded from providing safety awareness, knowledge, skills, and modifying attitudes and behaviours, positive to workplace safety, to include consideration of stereotypes and pressures which affect safety behaviours of construction workers, such as beliefs, value systems, culture and religion, trending fashion, and education, age and gender factors.
3. There should be health and safety events, like emergency simulation and evaluation drills. This type of activity will ensure that workers of all professions or trades should be able to exit on time in face of dangers or emergencies, such as wall or building collapse, firebreak or quake. This also offers an opportunity to display the importance of health and safety in the workplace, and emergency preparedness
4. Safety knowledge and capacity of construction firms should be considered a priority prequalification in process of awarding construction contracts. Safety should be adequately addressed in all aspects of the building construction process.
5. Safety education in construction should include both the specific aspect according to types of jobs, and the general aspect as it relates to what is expected of every worker in a workplace setting to ensure safe working conditions. It should be a continuous exercise, as a different set of workers assume work at different stages and phases of construction.
6. There should be a minimum of one certificated and experienced safety educator or safety manager in every building construction firm.

REFERENCES

- [1] Adeagbo, D.O., Dakar, A.I.I. & Izam, Y.D. (2019). Safety practices on building construction sites for sustainable development in Nigeria. *Journal of Sustainable Development in Africa*, 21 (4), 111-120
- [2] Ayedun, C., Durodola, O.D., & Akinjare, O.A (2012). An empirical ascertainment of the causes of building failure and collapse in Nigeria. *Mediterranean Journal of Social Sciences*, 3 (1), 313-322
- [3] Agwu, M.O., & Olele, H.E. (2014). Fatalities in Nigerian construction industry: a case of poor safety culture. *British Journal of Economics Management and Trade*, 4 (3), 431-452
- [4] Canadian Centre for Occupational Health and Safety (2006). Hazard control. http://www.ccohs.ca/oshanswers/hsprograms/hazard_control.html
- [5] Dodo, M. (2014). The application of health and safety plan in Nigerian construction firms. *Jordan Journal of Civil Engineering*, 8 (1), 81-87.
- [6] Famakin, I.O., Makanjuola, S.A., Adeniyi, O., & Oladinrin, T.O. (2012). Impact of construction health and safety regulations on project parameters in Nigeria: consultants and contractors view. *FUTY Journal of the Environment*, 7 (1), 114.
- [7] Hamalainen, P., Takala, J., & Kiat, T.B. (2017). Global estimates of occupational accidents and work-related illness. *Workplace Safety and Health Institute*, 1-21.
- [8] Idoro, G.I. (2011). Effects of mechanization on occupational health and safety performance in the Nigerian construction industry. *Journal of Construction in Developing Countries*, 16 (2), 27-45
- [9] Ibrahim, D., & Abdul-Bello, K. (2014). An investigation into risk factors and preventive measures in building construction projects in Abuja FCT, Nigeria. *Journal of Scientific and Research Publications*, 4, 7. www.ijserp.org/research-paper-0714/ijserp.p3122.pdf.
- [10] International Labour Organization [ILO] (2012). Safety, health and welfare on construction sites. A Training Manual, Geneva in M. Grace and C. Mulinge (2014), Health and Safety Management on Construction Project Site in Kenya.
- [11] Kassu, J.D., & Kitaw, B.B. (2016). Workplace innovation influence on occupational safety and health. *African Journal of Science Technology and Innovation Development*, 8 (1), 33-42.
- [12] Lianying, Z., & Yuan, G. (2012). Safety culture model and influence factors analysis in construction enterprises of China. *Research Journal of Applied Sciences, Engineering and Technology*, 4 (18), 3297-3312.
- [13] McLeod, S., & Curtis, C. (2020). Integrating urban road safety and sustainable transportation policy through the hierarchy of hazard controls. *International Journal of Sustainable Transportation*: 1-30. <https://doi.org/10.1080/15568318.2020.1858376>
- [14] Muhammed, B.A., Abdulateef, I., & Ladi, B.D. (2015). Assessment of cost impact in health and safety on construction projects. *American Journal of Engineering Research [AJER]*, 4, 25-30.
- [15] National Institute for Occupational Safety and Health [NIOSH] (2015). Hierarchy of controls. <https://www.cdc.gov/niosh/topics/hierarchy/>
- [16] Olatunji O.A., Aje, O.I., & Odugboye, F. (2007). Evaluating health and safety performance of Nigerian construction sites. CIDB World Building Congress
- [17] Okoye, P.U., Ezeokonkwo, J.U., & Ezeokoli, F.O. (2016). Building construction workers' health and safety knowledge and compliance on site. *Journal of Safety Engineering*, 5 (1), 17-26.
- [18] Onibhagere, C. (2020). Safety compliance among workers in building construction companies in Delta State, Nigeria. *M.Sc. Dissertation*, Faculty of Education, University of Port Harcourt, Nigeria