EXAMINING COMPLIANCE WITH FALL SAFETY REQUIREMENT IN BUILDING CONSTRUCTION INDUSTRY

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Abstract

Despite the existence of Occupational Safety and Health Act (OSHA) regulations, promulgated to reduce the number of site work injuries and fatalities occurring as a result of falls,falls are still the most frequent cause of fatalities at construction sites and annually account for one of every three construction – related deaths. Most construction companies have policies in place aimed at reducing/eliminating falls and accidents on construction sites. This study attempted to examine the compliance with fall safety requirement of OSHA in Nigeria building construction industry with a view to improve fall prevention strategies employed on sites. Nineteen (19) projects met the study criteria. Ten items safety audit checklist was adapted for the work, and mean scores ranking was used to assess fall prevention performance. The result shows that the physical prevention of fall encountered on the sites varied considerably, as compliance range from very high to very poor. Thus, it can be concluded that much improvement need to be done in majority of the sites. The contractors of the building must ensure that the workers are not exposed to the risks associated with working at height. For the improvement to be effective there is need for effective methods/ways for routine sites audits and for the auditing to be effective, it must include effective system of monitoring the implementation of the safety standard and response to hazard identified on site. Adequate information, instruction and training necessary to protect all persons from risk to their health and safety arising from working at height should be provided.

Keywords: Fall accident, Hazard identification, Preventive measure, Safety requirement

INTRODUCTION

Construction is a potentially high risk/hazard industry with falls top the list of hazardous. Falls are the most frequent cause of fatalities at construction sites and annually account for one of every three construction – related deaths (Occupational Safety and Health Academy, 2017). According to Bureau of Labour Statistic, BLS, (2012) the number of construction workers fall to death over the years have increased and that in 2012 falls, slips or trips took the lives of 668 workers. Occupational Safety and Health Act (OSHA) regulations were promulgated to reduce the number of site work injuries and fatalities occurring as a result of falls, also a significant portion of the regulation are focused on fall protection (Ghule, 2008). Despite the existence of OSHA regulation the incidence and accidents rate are high which indicate the need for further improvement on the existing regulation. Lack of commitment from management, Poor supervision, and negligence on the side of workers, work hazard, unsafe condition and other factors are responsible for accident occurring on sites. OSHA classify accident involving falls as complex event and consequently OSHA standard ensure that both human and equipment are taking in to consideration while protecting workers from fall hazard. The revised OSHA construction industry safety standard was designed to prevent employees from falling off or through working levels and to protect employees from being struck by falling objects. According to OSH academy, (2017) the revised rule covers most construction workers except those inspecting, investigating or assessing construction worksite condition prior to the commencement of work or after completion of all work. The revised rules ensure that the employer must protect their employees from fall hazard and falling objects whenever an employee is working at 6 feet (1.8 meter) or more above lower level. Protection must be provided to workers who are exposed to the hazard of falling into dangerous equipment. Fall protection can be provided through the use of guardrail systems, safety net systems, personal fall arrest system, positioning device systems and warning line system etc. Most falls are preventable if proper safety measures are taken and fall prevention techniques implemented (OSH Academy Course 805 study guide 2017). Most construction companies have policies in place aimed at reducing/eliminating falls and accidents on construction sites, but the threat of fall still continues to be a concern to the construction safety professionals (Ghule, 2008). Most of the studies carried in this area are outside the study area ie Chi and Wu (1997), McDonald and Hrymak (2003),Ghule, (2008),Dong, Ringen, and Men. (2009). etc. it have been observed that fall accidents have been occurring in the study area but lack of reliable and adequate falls accident data has been a bottleneck in caring out such type study. This study will attempt to examine the compliance with fall safety requirement in building construction industry with a view to improve fall prevention employed on sites.

LITERATURE REVIEW

Construction workers engage in many activities that expose them to serious hazard, such as falling from above (OSH Academy Course 805 study guide, 2017). In many parts of the world, falls from height are leading causes of fatalities in construction operations (Sorock, Smith, and Goldoft, 1993). In Taiwan, Chi and Wu (1997) showed that fall contributed to more than 30% (377) of 1230 work related fatalities. In the U.S., between 1992 and 2006, falls accounted for 32% of fatal occupational injuries in general Dong *et al.*, (2009) and 37% of fatalities in the construction industry (Kaskutas, Dale, Nolan, Patterson, Lipscomb, and Evanoff, 2009). Falls from heights in New Zealand are the leading cause of occupational injuries (Bentley, Hide, Tappin, Moore, Legg, Ashby, and Parker, 2006). Falls account for approximately 51% of injuries in China's construction industry (Yong, 2009). In Hong Kong, work-related falls from heights represented more than 47% of the total fatal incidents in 2004 (Chan *et al.*, 2008). In a study conducted in Malaysia by Mohammed, (2015) of 20 construction sites in Klang Valley it was shown that fall from height represents the most common type of accident (51.95%), followed by Falling Objects accident (11.85%), Crane accident (8.9%), Electrocution (5.99%), Scaffolding Accident (5.86%) and others (9.6%). According to Mba and Hilda (2014), lack of reliable data or accidents record on construction site is due to the fact that contractors do not report accidents to appropriate authorities. The lack of reliable data or accidents record in the Nigerian construction industry is due to absence of OSHA. Contractors need to be aware that there is penalty if they fail to report accident to relevant authorities. As contained in the Factory and Machinery Act (FMA), it is the duty of every contractor to report any occurrence of accidents on their site to the Director General (DG) of the Department of Occupational Safety and Health (DOSH) in the Ministry of Labor and Productivity Nigeria. In the opinion of Idoro, (2011) that accidents and injuries rates in Nigeria as at the year 2006 were 2 accidents per 100 workers and 5 injuries per 100 workers. The records did not provide the types of accidents. The primary causes of fall accidents in construction were falling from a roof, erecting structural steel, exterior carpentry, exterior masonry, installing equipment, demolition (Murty, Chung, Yin, Loo, and Nurul. 2006). Hoonakker, Loushine, Carayon, Kallman, Kapp, and Smith. (2005); Chi, Chang, and Ting. (2005). described the situation in other countries, revealing a similar pattern. Fatal work-related falls continue to be a leading cause of death in the construction industry (Chicago land Construction Safety Council, 1993; Suruda, Egger, and Lui, 1997). In 1994, the construction industry accounted for 32.1% of all work-related fall deaths Bureau of labor Statistics (BLS, 1996). From 1980 to 1989, the construction industry had the highest annual average rate of deaths resulting from falls with 6.56 per 100,000 workers National Institute for Occupational Safety and Health (NIOSH, 1993). Special trade contractors had the highest frequency of fatal work-related deaths, accounting for approximately 57.5% of all fatal work-related falls in this industry in 1994 (BLS, 1996). Fall from roofs, ladders, and scaffolds account for approximately 28.5 % of the total fatal work-related events in the construction industry (BLS, 1996). A study conducted by Centre for Construction Research and Training, (2018), using data from NIOSH concluded that between 1982 and 2015:

1. 42% of the fatalities involves falls.
2. 54% of the workers killed have no access to a Personal Fall Arrest System (PFAS) and 23% had access to PFAS but did not use it.

The conducted by Centre for Construction Research and Training, (2018) revealed further that most of the workers with no access to PFAS worked for residential building contractors and contractors in roofing siding and sheet metal sector. Another revelation of the study is that 107 of the 325 falls accidents were from 30 feet or higher and 20% of the 368 death occurred in the victims first two months on the job. To prevent construction workers falls the National Institute of Occupational Safety and Health (NIOSH) and partners have launched a national construction falls prevention campaign, encouraging everyone in the industry particularly contractors and workers to work safely and use the proper equipment to reduce falls (NIOSH, 2007). One can never prevent falls in absolute term, but the use of safety method, i.e. safety net, security platforms and belt at construction sites can minimize the injuries that can result from these fall events (MaCann, 2002; Murty, *et al.* 2006).

Access to height

OSHA requires specific types of ladders to be used in order to climb heights. Person working on ladders should always face the ladder and at all-time maintain a three point contact with the ladder. Ensure that the ladder is set up with 4 to 1 slope to obtain the most stable position and stabilize the ladder using appropriate ladder footing. Workers must avoid standing on two steps of a step ladder. Regular or extension ladder shall always extend at least 3 feet above the upper landing surface. In a study on falls from ladder by OSHA from1991to 1996 it was concluded that falls from height constituted 20% of all disabling falls in the US construction industry. Another concluded that 60% of falls occurred while the employee was standing on the ladder, 26% of the falls occurred while employee was descending the ladder, and 14% of the ladder falls occurred while the employee was ascending the ladder (OSHA, 1991).

Scaffolding and Work Platform

OSHA requires the following while using scaffolding system;

1. The foot for scaffolding shall be sound, rigid and be capable to carrying the maximum intended load without settling or failure.
2. Scaffolds shall be assembled and placed in the presence of authorized persons.
3. Guardrails and toe board shall be installed on all open sides and end of platform more than 10 feet above the ground or floor level. The only exception in this case shall be needle beam scaffolds and floats. Scaffolds 4 – 10 feet in height having a minimum horizontal dimension in either direction of less than 45 inches shall have standard guardrails installed on all open sides and ends of the platform.
4. Scaffolds and their components must be able to withstand at least 4 times the maximum intended load.
5. All planking or platform must be overlapped (maximum 12 inches) and secured from movement. An access ladder or equivalent safe assess must be provided. Plank must extend over their end supports and ties them 6 inches or more. The poles legs or upright of scaffold must be plumb, and securely and rigidly braced to prevent swaying and displacement. Overhead protection must be provided while working in areas exposed to overhead hazards.
6. Slippery conditions on scaffolds shall be eliminated immediately after they occur.

Housekeeping

OSHA requires the following;

1. The worksite be inspected by an authorized person before the work begins so as to identify fall hazards and to determine the appropriate fall prevention system for workers.
2. While working around floor opening, there shall be provision of one of the appropriate fall prevention systems that use either cover or screen or railing or guardrails.

In a study to examine the fall accidents due to skylights and roof opening, it was found that there have been 55 – 75 such fatalities each year since 1980 (NIOSH, 2004). The study concluded that employers should work towards providing more protection for their workers by instituting a comprehensive fall – protection program.

RESEARCH METHODOLOGY

The study aimed at examining the compliance with fall safety requirement in construction industry. In particular, the study strategy adopted was to observe the compliance with a range of standard safety requirement. Due to the absence of a comprehensive database of the number and location of construction sites in Minna and Abuja and the current stage of their project, it becomes impossible to construct a probabilistic random sampling. As such the sample was stratified according to the following criteria.

1. The construction site must be in Minna and Abuja
2. The project must be building or civil engineering project
3. The construction company must be registered as Medium and Large Construction Company.
4. The progress of work on site must be above 50%
5. The contract price of such project must be above 10million Naira.

Based on the above criteria, 19 projects met the study criteria as shown in Table 1. The selection of 19 projects is similar to the work of McDonald and Hrymak, (2003)

Table 1: Sites Selection

Location	Medium size construction company	Large size construction company	Total
Minna	5	1	6
Abuja	3	10	13
Total	**8**	**11**	**19**

Source: Researcher Fieldwork, (2018)

Two research assistants (one in Minna and ine in Abuja) were involved in the visitation of each sites and spent approximately half a day on each of the 19 site. The 10 – items safety audit checklist was adapted from the work of McDonald and Hrymak, (2003). This covered site safety situation encountered under the general heading as shown in Table 2.

Table 2: Safety Audit Checklist

No.	Heading	Items
1	Housekeeping	1. Unguarded opening 2. Rubbish on access route 3. Storage of material
2	Scaffolding and work platform	4. Rubbish on scaffolding 5. Missing scaffold ladder 6. Missing guardrails or edge protection
3	Access to height	7. Ladder too short 8. Ladder incorrectly tied 9. Safe use of ladder 10. Defective ladders

Source: McDonald and Hrymet, (2003).

All the 10 – items were rated on percentage scale of compliance with recommended site safety practice. Mean value or score is used to analyse in assessing fall prevention performance.

RESULT AND DISCUSSION

Prevention of fall from Heights

Housekeeping

1. Unguarded Opening:

Six sites out of nineteen prevented any unguarded opening from occurring. Another 10 sites had 20% of opening left unguarded. Three sites had all opening left unguarded. Table 3 shows these incidences and how they breakdown.

Table 3: Incidence of sites with unguarded Opening

Number of Sites	% of opening found unguarded
6	100% prevent unguarded opening
10	20% of their opening unguarded
3	100% of their opening left unguarded

Sources: fieldwork, 2018

2. Rubbish on Access Route

There was a different pattern with regards to amount of rubbish found on access route on sites. Eight sites have a clean access route i.e. 100%. Nine sites have 40% of their access route unclean, while two sites have 100% of their access route fill with debris.

Table 4: Incidence of rubbish on access route

Number of Sites	% of rubbish on access route
8	100% clean access route
9	40% unclean access route
2	100% unclean access route

Sourcesfieldwork, 2018

3. Results of material storage on sites

The pattern of storage of material on sites is encouraging. Ten sites well-functioning material storage facilities on sites. Six sites have 50% of their material storage facilities well-functioning while three sites have 20% well-functioning facilities on sites.

Table 5: Results of material storage facilities on sites

Number of sites	% of well-functioning storage facilities on sites
10	100% storage facilities for material on sites
6	50% storage facilities for material on sites
3	20% storage facilities for material on sites

Sources: fieldwork, 2018

Scaffolding and Work Platform

1. Rubbish on scaffolding

Avoiding rubbish on scaffolding is encouraging as fifteen sites have less than 5% of their scaffolding obstructed while four sites have 20% scaffolding obstructed.

Table 6 Incidence of rubbish on scaffold lifts

Number of sites	% of rubbish on scaffold lift
15	5% less scaffolding obstructed
4	20% scaffolding obstructed

Sources: fieldwork, 2018

2. Misuse of scaffold ladder

Six sites had incidence where operatives were observed miss – using scaffolding. In all incidences this was not using ladder to access scaffolding lifts on different level. In thirteen sites incidence of miss – using ladder in access the scaffolding lift was not found.

Table 7 Results of incidence of miss use of scaffolding lift

Number of sites	Incidence of miss use of scaffold ladder
13	No miss use of ladder to access scaffolding lifts
6	Miss use of ladder to access scaffolding lift by operatives

Sources: fieldwork, 2018

3. Missing guardrails or edge protection
Two sites had 100% complete edge protection and eleven sites have 50% of their requisite guard rails or edge protection missing. Five sites had more than 50% guardrails or protection missing.

Table 8 Incidence of missing guardrails or edge protection

Number of sites	% of missing guardrails or edge protection
3	100% edge protection
11	50% of requisite guardrail missing
3	More than 50% requisite guardrails or edge protection missing

Sources: fieldwork, 2018

The Table 9 shows the observation and finding of access to height in all the nineteen sites that meet the research criteria in Minna and Abuja.

Table 9, Observation and Finding on Access to height

S/no.	Description	Observation
1	Ladder in use if too short	There were no instances of ladders being short for use in all the nineteen site
2	Ladder in used if not well tied	In ten sites all the ladders were correctly tied while in nine sites cases of incorrectly ladder tied were observed.
3	If ladders are used in a safe manner	In ten sites the workers were found using ladders in safe manner while in nine sites it was observed that workers are using the ladders in an unsafe manner. The letter was incidence of use of untied ladder.
4	Ladder used are defective	In sixteen sites no incidence of defective ladders was observed. Three sites have 10% of their ladder defect.

Sources: fieldwork, 2018

Prevention of Falls Performance by site

The prevention of falls from height, those items in the standard safety requirements related to the category were averaged, and mean and standard deviations of compliance performance per site were calculated. The mean scores were used in other to rank the most compliance site to the standard safety requirement. The measure of falls performance was used to rank the sites against each other as shown in Table 10.

The ranking mean score in terms of falls performance of the sites characteristic and location show anapparent patterns. Large and medium contractor's sites location in Abuja perform better than those in Minna. That is site 1, 2, 3, 8, 9, 10, 12, 13, 14, 15, 17, 18 and 19 respectively as shown in Table 10. This may be due to the fact that Abuja is the capital city of Nigeria were federal government resides. Large construction sites perform better in ranking when compare to medium sizes construction

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sites in both Abuja and Minna. The large construction sites are 1, 2, 3, 9, 11, 13, 14, 15, 17, 18 and 19 with their mean scores ranging between 4.86 – 2.09. The medium construction sites are 4, 5, 6, 7, 8, 10, 12 and 16 with their mean scores ranging between 3.21 – 0.71.

The finding of the study were of similar nature when compare to other studies like McDonald and Hrymak (2003), Ghule, (2008). In their studies compliance to standard safety requirement is higher among large contractors firm. In all the studies the large contractors firm are International Standard Organization (ISO) certified contractors. Under the ISO requirement large contractors are to comply with the standard requirement at the workplace. The result of medium contractors firm varied as in the McDonald and Hrymak (2003) that considered medium contractors firm, the performance of medium sizes contractors is higher when compare to this study.

Table 10.Mean scores ranking of sites by prevention of falls performance

	Location/size	Mean Non Compliance Rate	Standard Deviation	Ranking
1	Abuja – Large	4.86	39.29	1
2	Abuja – Large	4.69	48.21	2
3	Abuja – Large	3.65	9.27	3
4	Minna – Medium	1.33	20.35	12
5	Minna – Medium	1.12	25.18	14
6	Minna – Medium	1.33	6.99	12
7	Minna – Medium	0.71	10.29	16
8	Abuja – Medium	0.93	7.56	15
9	Abuja – Large	3.57	1.89	4
10	Abuja – Medium	1.27	6.07	13
11	Minna – Large	0.71	19.27	16
12	Abuja – Medium	3.21	9.23	8
13	Abuja – Large	3.40	7.23	5
14	Abuja – Large	3.33	4.76	6
15	Abuja – Large	2.86	20.10	9
16	Minna – Medium	2.10	10.59	10
17	Abuja – Large	3.21	16.06	8
18	Abuja – Large	2.09	15.11	11
19	Abuja – Large	3.33	8.93	7

Source: Researcher Analysis, 2018

CONCLUSION AND RECOMMENDATION

Despite the existence of fall safety requirement in building industry, the threat of fall accidents continues to be a concern to stakeholders. This study examines the compliance with fall prevention requirement in the building construction sectors with a view to improve fall prevention measures employed on sites. The physical prevention of fall encountered on the sites had several variabilities as compliance range from very high to very poor. The physical condition and placement of ladder on all sites was good only three sites that have 10% of their ladder being defect. In all sites there were no incidences of ladder too short for the job. Two sites prevented unguarded opening, ten sites have 20% of their opening unguarded and three sites have all their opening unguarded. Ladder in ten sites were well tied. The incidence of misuse of scaffold or ladder by operatives in all sites was low. Thus, it can be concluded that much improvement need to be done in majority of the sites. For the improvement to be effective there is need for effective methods/ways for routine sites audits and for the auditing to be efficient it must include effective system of monitoring the implementation of the safety standard and response to hazard identified on site. Adequate information, instruction and training necessary to protect all persons from risk to their health and safety arising from working at height should be provided.

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