

APPRAISING ACCIDENT CAUSATIONS ON BUILDING CONSTRUCTION SITES IN PORT HARCOURT NIGERIA

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ABSTRACT

Given the fact that accidents on building construction sites are globally notable occurrences and particularly with evident, beyond average level, occurrences in Port Harcourt city, Nigeria, this paper thus, seeks to appraise the accident causation factors on building construction sites in Port Harcourt, in order to improve the ideals of building construction site safety. To evaluate factors that cause accidents on construction sites, questionnaire survey was conducted and weighted mean and ranking was used to establish the topmost causes of building construction accidents in Port Harcourt. The study, in the same vein, further appraised the rate, effect and category of accident victims of construction accidents. In grouping the factors into 5 major groups, construction related problem was found to be topmost. In making an aggregated assessment of all the groups, the top three factors are found to be unsafe site working condition, poor physical health condition and faulty tools/plant/equipment. Recommendation was made to construction company head office and site management, and the local government on measures of ensuring effective accident control

Key Words: Accident Causation, accident control, Construction sites, Site safety, Port Harcourt

1. INTRODUCTION

In Africa, one of the largest construction products markets is the Nigerian construction industry, with an average of 5-7% improvement of economic growth and above 42% of the fixed capital formation over the last 40 years (Olatunji and Bashorun, 2006). Although a lot of contribution to the national economy comes from the construction industry, the number of accidents, injuries, and fatalities in the industry are considerably high. Eguh and Adenaiya (2020) opine that construction works are one of the most hazardous works in the world's industrial activities, and the number of injuries occurrences is higher in the construction industry than other industries. Accidents, injuries, risks and hazards to workers are predominant occurrences on construction sites (Phoya, 2012). The Nigerian construction industry is no doubt affected by the same accident causing factors and Rivers State, the petroleum boom state of Nigeria, a notable example. Rivers State is one of the six states of South-South Nigeria with the capital being Port Harcourt city. The state is located in the Niger Delta region, and lies within latitudes 4°20' and 5°50'N and longitudes 6°20' and 7°35'East. The state has one of the largest economies in Nigeria because it accounts for more than 40% of national crude oil production (AOAV & NWGAV, 2013). It is the most populous South-South state with about 8.1 million currently; it is usually the highest in budget figures in the South-South Nigeria; it is usually the highest in internally generated revenue in the South-South; it accounts for 100 percent of Nigeria's liquefied natural gas (LNG) exports to several countries (Beals, 2020). Port Harcourt is a wealthy city of various commercial activities and infrastructural developments. Building/civil engineering projects are visibly on the rise and the need to be safety conscious on construction sites quite inevitable. However, in recent times a number of fatal accidents have occurred through building collapse at various sites in the city of Port Harcourt that have raised great concern and anxiety to the public. Ebiri (2018) reported on the collapse of a seven storey building under construction in Government Residential Area (GRA), phase II Port Harcourt, suspected to be structural failure, in which several persons were feared dead and others severely injured. Beyond this report are a number of other worrisome accident occurrences in the city of Port Harcourt from time to time. To improve the strategies of accident prevention there is the need to understand accidents causation factors and properly address them. This paper thus, seeks to appraise the accident causation factors on building construction sites in Port Harcourt, in order to improve the ideals of building construction site safety.

The objectives are:

1. To examine the causes of accidents on building construction sites
2. To determine the rate, effect and category of victims of accident cases on building construction sites
3. To propose ways of effectively controlling accidents on construction sites in Port Harcourt.

The research questions that were formulated to address these objectives were: What are the factors that cause accidents on construction sites? What are the rate, effect and category of victims of accidents on building construction sites in Port Harcourt in the last five years? What are the measures to be taken to effectively control accidents on building construction sites in Port Harcourt?

2. LITERATURE REVIEW

2.1 Theoretical Literature

On construction sites, workers are exposed to hazardous works, so frequent that the workers seem to be used to it. According to Olatunji et al (2007), construction workers are commonly exposed to various hazardous substances, physical agents, ergonomic factors and severe environmental hazards through hazardous conditions and materials like asbestos, lead, silica dust, organic solvents, sewer gases, welding fumes, radiation, noise and vibration. Other accident risk factors are fatigue, loss of concentration at work, poor health condition, site condition, constantly changing environment and distraction by other activities on site also increases the risk of accidents. Hazards are situation or occurrences on site that has the potential to harm the health and safety of people or to damage plants and equipments. The situation could involve a task, substance or equipment used. 'Safety first' is a very notable phrase of management and workers and such slogans even posted on signboards or posters in some construction sites, but the words are easier said than adhered to. Thus accident occurrences are inevitable. Safety refers to the quality of being safe or the freedom from risk and danger to protect people against harm, error, failure, accidents, or any non-desirable event. The controlling of hazards to achieve an accepted level of risk can also be referred to as safety. Simply put, an accident is an unexpected, uncontrolled and undesirable occurred event that was not preplanned (Hamid, Abd Majid and Singh, 2008). Accidents can lead to personal injury, hazards, damage to plants, machinery or other things. Since unsafe acts and conditions are usual causes of accidents, safe working method and procedures are good ways of preventing accidents on construction sites. Unsafe behaviors and accidents causation on construction sites have multiple factors that generally relates to organization, individual characteristics, society, project management, supervision, work group, contractor and site condition (Khosravi et.al, 2014).

2.2 Empirical Literature

Hamid, Abd Majid and Singh (2008) carried out a survey using questionnaire forms to obtain data from respondents who are contractors, developers and consultants in the construction industry. The study reveals that accidents occur due to many contributing factors or causes, the notable ones being unsafe construction method, unsafe equipment, conditions of the job site, human element, management issues, negligence and disobedience of workers. From 18 number of accident influencing factor selected from literature, Hoque, Ahmed and Sobuz (2017) carried out a study using questionnaire design. From the survey, data ranks were calculated and the main causes of accidents found to be lack of: proper attention from authority, safety awareness and expertise/training. In Nairobi County, Kenya, occurrence of accidents at building construction sites was modelled against working environment, technical factors, occupational health, skills and safety practices by Makori, Mamati and Njoroge (2018). Project sites sampled and evaluated were thirty and respondents covering government officers, site developers, foremen, supervisors and unskilled/skilled employees were involved. Using regression and correlation analysis the survey findings showed that working environment and technical factors were negatively, insignificantly related to accidents occurrences, but occupational safety practices and skills related to accidents occurrences significantly. Ramya and Ramadasan (2016) identified 12 major causes of accidents from literature namely: site conditions, unsafe working conditions, individual factors, trenching and excavation hazards, falling hazards, Struck by tools, equipment, falling objects, fire, electrocutions and power tool accidents, slips and trips, scaffolding accidents, construction vehicle accidents and stepladder misuse. Questionnaire design for 50 respondents was employed in the study, and through descriptive and chi-square statistical analysis concluded that unsafe working conditions, stuck between tools and equipments and scaffolding failure are the most accidents causing factors. The questionnaire method was used by Kavya and Pradeep (2019) to get data of responses from various persons of the construction sector and analyzed using Excel sheets. The results show that in the construction industry, the most significant accidents comprise fall from a height, from scaffoldings, and collapse of building. Arunkumar and Gunasekaran (2018), using questionnaire and descriptive statistical analysis, identified the most possible construction site accident causation factors as disobedience to safety rules, Personal Protective Equipment (PPE) ignorance, space congestion, improper use of safety items and improper equipment. Cost of medical expenses, project execution time loss, productivity loss, distrust of firm and cost of new workers training, were found to be the most possible effects of accidents in the construction industry.

2.3 Summary of Literature Review

In the various researches carried out in this area of study, numerous accident causation factors on construction sites were noted. After a careful observation of all, this study comes up with a summary that suits the common construction site accident situation in Port Harcourt. It is broken down as follows in table 1:

Table 1: Summary of Literature on Accident Causation

Accidents Causing Factors		
1.	Construction related Problems	Faulty tools/plant/Equipment, poor handling of tool, Faulty construction method, on-job indiscipline, Object/human fall from height, Scaffolding failure, Fire/electrocution, Building collapse. (8 Sub factors)
2.	Environmental Problems	Exposure to dust/fumes/gases/ radiation, exposure to solid and chemical hazardous substances, noise and vibration, Bad weather condition, Acts of God. (5 Sub factors)
3.	Health Problems	Poor physical health condition, poor emotional/psychological health condition, Poor personal health management, Fatigue, Poor access to health facilities, Existing injury, Exposure to work health hazard, Poor hygienic condition of site. (8 Sub factors)
4.	Site Condition	Unsafe working condition, No personal protective equipment (PPE), Dirty and congested site, poor site drainage that causes flooding, poor site lighting at night, Absence of false fencing (Hoarding) of site, absence of site security and safety personnel. (7 Sub factors)
5.	Management Problems	Lack of safety awareness, Lack of safety training, no measures for emergency response planning, no provision of safety clothing/first aid kit, no safety officer. (5 Sub factors)
Effect of Accidents- Severe bodily injury, Minor bodily injury, Damage to plants, machinery and other things		
Category of the Accident Victims- Site management, Site Technical work personnel, unskilled labour, Others		

Source: Author's compilation

In this study, the information of Table 1 served as background for the design of the study questionnaire.

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3. METHODOLOGY

The research design adopted in this study was the descriptive survey design. The target population for the research work is professionals in building construction (Engineers, Builders, Architects, Quantity Surveyors, Contractors and Technical site Operatives) in Port Harcourt metropolis of Port Harcourt local government area. A random sample size of sixty (60) professionals was chosen to administer close ended, self-structured questionnaires. The questionnaires were designed to investigate the causes, level and nature of accidents on construction sites. Respondents' opinions were sought on five main groups of accidents identified from literature. The subjective opinions were measured on 5 point Likert scale. Sixty (60) questionnaires were administered and 41 returned, and the data were analyzed through statistical descriptive tools such as frequency, weighted mean and percentage.

4. DATA ANALYSIS

All completed and returned questionnaires (distributed and collected between December 2022 and March 2023) were properly arranged in a tabular format and analyzed to get the weighted mean and hence ranking of the variables.

4.1 Analysis of Respondents' Demographic Variables

The demographic characteristics of respondents show that 85.4 % of respondents are within the ages of 30-40 and above. Academic qualification was more of bachelors to PhD degree holders (totaling 78.1%). Respondents' working experience from 5-20 years and above was 92.7%. The demographic characteristics quality of table 1 is quite good as maturity in age, academic qualification and years of working experience are considerably high. In relation to the

objectives of this study, respondents assessed the causes of construction accidents using a scale of 1-5: **1** = not occurred, **2** = rarely occurred, **3** = neutral, **4** = often occurred and **5** = very often occurred.

4.2 Analysis of Surveyed Data and Discussion

Respondents' opinions were tabulated and analyzed through weighted means in order to showcase the major causes of accidents, evaluate their effect, and category of victims on building construction sites. Using the Likert scale of 1-5 as explained earlier, the results of the analysis of data are presented on tables 2-6 below. The table explicitly reveals the weighted means and corresponding ranking. Table 2 gives an indication of the construction related accident causation factors. The top three factors according to respondents' opinion are: faulty tools/plant/equipment, Poor handling of tool and on-job indiscipline, in descending order. This finding is in agreement with the result of a study carried out by Olatunji, Aje and Odugboye (2007) and Hamid, Abd Majid and Singh (2008) where tool problem was found to be one of the topmost factors causing accidents on building construction sites. On-job indiscipline covers things like carelessness and disobedience to safety rules. This third factor is a resounding one in a number of studies found in literature.

$$\text{RELATIVE IMPORTANCE INDEX} = (\sum M) / (HN) \quad (1)$$

In Equation (1), M represents the mean value obtain to each factor by the survey which ranging from 0 to 10, H is the highest value (i.e. 10 in the study) and N is the total number of samples of survey. Based on equation (1), the relative importance index (RII) can be calculated. And based on the relative importance index (RII) the rank of factors is arranged. In Equation (1), M represents the mean value obtain to each factor by the survey which ranging from 0 to 10, H is the highest value (i.e. 10 in the study) and N is the total number of samples of survey. Based on equation (1), the relative importance index (RII) can be calculated. And based on the relative importance index (RII) the rank of factors is arranged. In Equation (1), M represents the mean value obtain to each factor by the survey which ranging from 0 to 10, H is the highest value (i.e. 10 in the study) and N is the total number of samples of survey. Based on equation (1), the relative importance index (RII) can be calculated. And based on the relative importance index (RII) the rank of factors is arranged.

Table 2: Construction related problems causing accidents

S/N	Details of Causes	Weighted mean	Ranking
i	Poor handling of tool	3.97	2 nd
ii	on-job indiscipline	3.71	3 rd
iii	Object/human fall from height	3.07	5 th
iv	Building collapse	2.80	7 th
v	Fire/electrocution	2.90	6 th
vi	Scaffolding failure	3.41	4 th
vii	Faulty tools/plant/Equipment	4.32	1 st
viii	Faulty construction method	2.78	8 th
Average weighted mean = 3.37			

Source: Respondents' Opinion, analyzed and rated by Author

Accident causing factors due to environmental problems have exposure to dust/fumes/gases/ radiation, Bad weather condition and Exposure to solid and chemical hazardous substances as topmost accident causing factors (from 1st to 3rd). This is exhibited in table 3.

Table 3: Environmental Problems causing construction accidents

S/N	Details of Causes	Weighted mean	Ranking
i	Noise and vibration	2.87	4 th
ii	Exposure to solid and chemical hazardous substances	3.15	3 rd
iii	Bad weather condition	3.36	2 nd
iv	Acts of God	2.22	5 th
v	Exposure to dust/fumes/gases/ radiation	3.56	1 st
Average weighted mean = 3.03			

Source: Respondents' Opinion, analyzed and rated by Author

Poor physical health condition, Poor emotional/psychological health condition and Poor access to health facilities are the priority health factors that cause accidents as shown in table 4. For site condition related factors in table 5, the uppermost accident causing factors in descending order are: unsafe working condition, no personal protective equipment (PPE) and dirty and congested site. Ramya and Ramadasan (2016) agree that unsafe working condition is a top priority factor that causes accidents. Management Problems causing construction accidents are mostly lack of safety awareness, Lack of safety training and no provision of safety clothing/first aid kit as displayed in table 6.

Table 4: Health Problems causing Construction Accidents

S/N	Details of Causes	Weighted mean	Ranking
i	Poor physical health condition	4.39	1 st
ii	Exposure to work health hazard	3.22	5 th
iii	Poor emotional/psychological health condition	4.27	2 nd
iv	Poor access to health facilities	4.02	3 rd
v	Fatigue	2.90	6 th
vi	Poor personal health management	3.61	4 th
vii	Existing injury	1.76	8 th
viii	Poor hygienic condition of site	2.05	7 th
Average weighted mean = 3.28			

Source: Respondents' Opinion, analyzed and rated by Author

Table 5: Site Condition causing construction accidents

S/N	Details of Causes	Weighted mean	ranking
i	Absence of false fencing (Hoarding) of site	2.10	6 th
ii	Dirty and congested site	3.39	3 rd
iii	Unsafe working condition	4.42	1 st
iv	No personal protective equipment (PPE)	4.12	2 nd
v	Poor site lighting at night	3.17	5 th
vi	poor site drainage that causes flooding	2.07	7 th
vii	Absence of false fencing (Hoarding) of site	3.22	4 th
Average weighted mean = 3.21			

Source: Respondents' Opinion, analyzed and rated by Author

Table 6: Management Problems causing construction accidents

S/N	Details of Causes	Weighted mean	Ranking
i	Lack of safety training	2.22	2 nd
ii	No provision of safety clothing/first aid kit	2.10	3 rd
iii	no safety officer	1.83	4 th
iv	Lack of safety awareness	3.51	1 st
v	No measures for emergency response planning	1.76	5 th
Average weighted mean = 2.28			

Source: Respondents' Opinion, analyzed and rated by Author

Table 7 below is a summary table showing the five groups of accident causation on building construction sites, their average weighted means and ranking. In ascending order of ranking we have management problems, environmental problems, site conditions, health problems and construction related problems. Figure 1 depicts table 7 in a pie chart format.

Table 7: A summary of the ranking of causes of accidents on construction Sites

S/N	Causes of Accidents	Average Weighted Mean	% Appraisal of Groups	Ranking
1	Construction related Problems	3.37	22.2	1 st
2	Health problems	3.28	21.6	2 nd
3	Site Condition	3.21	21.2	3 rd
4	Environmental Problems	3.03	20.0	4 th
5	Management Problems	2.28	15.0	5 th

Source: Respondents' Opinion, analyzed and rated by Author

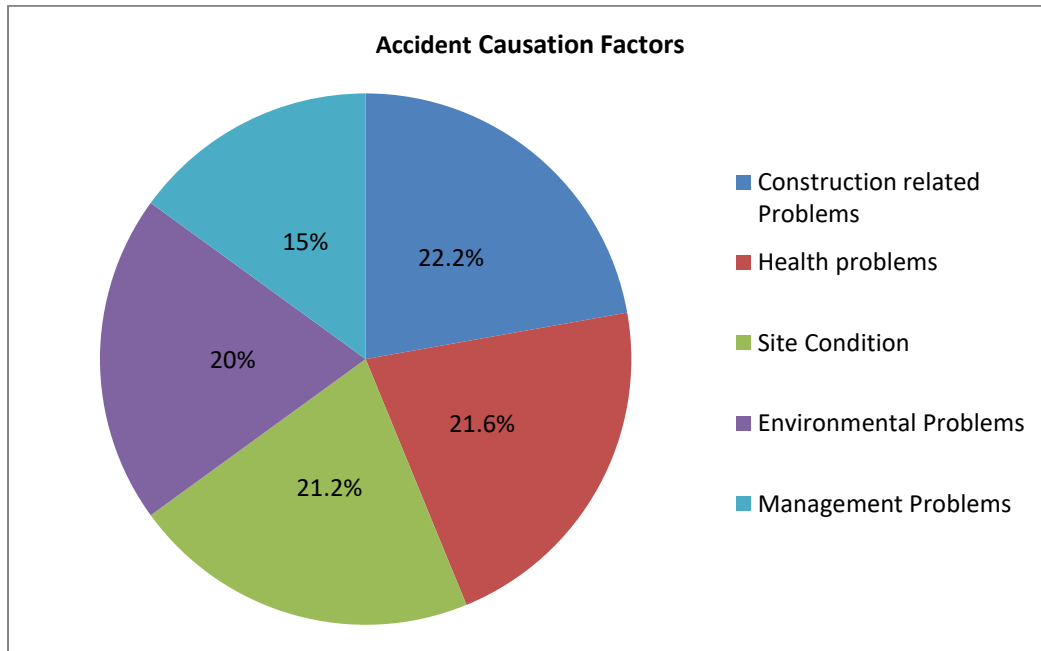


Fig 1: Ranking of Main Groups of Accident Causation Factors in %

Table 8 depicts the rate, nature and effect of accident occurrences on building construction sites in Port Harcourt in the last 5 years based on respondents' opinion. In the last 5 years 73.2% of accidents have occurred in Port Harcourt metropolis on building construction sites. The effect of such accidents has 48.8% resulting to minor bodily injury, 36.6% to severe bodily injury and 14.6% to damage to plants, machine and other things. The work category of victims most affected by accidents is site technical operatives (48.8%), followed by unskilled labour at site (34.1%) and then followed by site management (7.3%).

Table 8: Rate, Effect and Category of victims of Accident occurrences

DESCRIPTION	FREQUENCY	PERCENTAGE (%)
Accident Occurrences Recorded in the last 5 Years		
Yes	30	73.2%
No	11	26.8%
Effect of Accident Occurrences Recorded in the last 5 Years		
Severe bodily injury	15	36.6%
Minor bodily injury	20	48.8%
Damage to plants, machinery and other things	6	14.6%
Work Category of Accident Victims in the Last 5 Years		

Site management	3	7.3%
Site Technical Operatives	20	48.8%
Unskilled labour	14	34.1%
Others	4	9.8%

Source: Respondents' Opinion, analyzed and rated by Author

5. CONCLUSION AND RECOMMENDATION

The aim and objectives of this study have been pursued and effectively achieved in this paper. The accident causation factors on building construction sites in Port Harcourt have been grouped into five and analytically appraised through respondents' opinions. According to their weight in the findings of the study, in descending order, they are: Construction related Problems, Health problems, Site Condition, Environmental Problems and Management Problems. Each group of factors has various sub factors that have been subjected to analytical test and ranked in this study. Ten topmost factors established by considering the highest weights from the groups taken as a whole in descending order are: (1) Unsafe working condition, (2) Poor physical health condition, (3) Faulty tools/plant/Equipment, (4) Poor emotional/psychological health condition, (5) No personal protective equipment (PPE), (6) Poor access to health facilities, (7) Poor handling of tools, (8) On-job indiscipline, (9) Poor personal health management and (10) Lack of safety awareness. The study has further established that the rate of accident occurrences in the last 5 years (2018-2022) has been on the high side to the level of 73.2%, with the effect of such accidents being majorly minor injuries (48.8%). However the 36.6% finding of major injuries to people is worrisome as such occurrences (and some may be fatal in nature) will financially drain people medically. The study also points to the fact that site technical operatives (skilled workers) are more prone to accidents on site followed by general labour (unskilled) work force. This finding tallies with the one of the main accident causation factor of tools problem (tools are mainly used by the technical site operatives).

The following recommendation is put forward to manage the occurrences of accidents on site.

1. Construction companies head office and site management should heighten their concern on safety awareness, training and provision of personal protective equipment (PPE) so as to condition construction site activities to good safety modes.
2. Particular attention of management should be given to tools/plant/equipment proper use, servicing and maintenance, quality of product and operatives training.
3. Most times construction companies in a bid to be more business and profit conscious do not pay required attention to workers health condition on site. Their first aid and medical unit, if exists at all, should be more focused on health condition checks and emotional/psychological counselling, as proactive accident prevention measures, than giving medical treatments on injuries.
4. With the notable rate of accident occurrences the local government of Port Harcourt city should be of utmost concern by fanning afresh its already existing site safety rules, planning and enforcements, and also by establishing revised rules and implementation actions to impact construction business players. This will help in alerting construction companies to the demands and discipline of government.

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