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**ASSESSMENT OF CRANE SAFETY PRACTICES ON CONSTRUCTION SITES IN ABUJA, NIGERIA**

**Abstract**

Some crane accidents could have been prevented if construction managers had reviewed and evaluated the safety requirements, rigging equipment used, and had connections and operator certification for the cranes inspected. It is on the basis of these that the paper assessed crane safety practices on construction sites in Abuja, Nigeria through the use of combination of methods (30 questionnaires for professionals, 16 operators interviewed). Purposive sampling method was used to draw up the sample size in that the respondents had to be on sites where cranes were available and were willing to be part of the study. It was discovered that the adherence level of safety practices was high and professionals know the suitable type of crane used for each project as this was ranked 1st while load not being moved over workers was ranked 16th. Furthermore, results showed that the operators gained knowledge of the work based on experience. Hence, it is recommended that efforts should be made to provide avenues for the operators to be trained, whether formally or informally, so as to improve their knowledge base.

**Keywords:** Abuja-NigeriaAccidents, Construction sites, Crane, Safety practices

1. **Introduction**

The construction industry is very important in every country. The demand for building is derived from the need for buildings in which to live, to manufacture and store goods, and in which to carry out various services. Buildings are becoming more sophisticated, larger and more complex and require plant for efficient, fast, and easy construction. Thus, the key to achieving healthy and safe working conditions is to ensure that health and safety (H&S) issues are planned, organised, controlled, monitored, and reviewed (Stephen, 2006). Plant, materials, and people are the core resources on which all operations in the construction industry are successfully executed. This gives the indication that the absence of one part shall cause problems such as delays in operation, and productivity. Plant usage therefore is of great benefit to the execution of every construction activity. Transportation plant such as cranes, chutes, vans, hoists, and fork lifts have sped up construction activities over the years by transporting materials from one place to the other in various directions. Training is to be provided where necessary to reduce the risk of injury, or workers should be under the supervision of someone with such skills and knowledge (Doran, 2004). The lack of education, carelessness, overconfidence, and the trust in outmoded experiences have caused the failure, under-usage and over-usage of some plant such as cranes (Doran, 2004). The leading safety hazards on site are falls from height, motor vehicle accidents, excavation accidents, electrocution, machines, and being struck by falling objects (Ukpata, 2010).

1. **Literature Review**

Cranes are lifting devices designed to raise materials by means of rope and pulley operations and move the load horizontally and vertically within the limitations of any particular machine. The range of cranes available is very wide and therefore choice must be based on the loads to be lifted, height and horizontal distance to be covered, time period(s) of lifting operations, utilization factors and degree of mobility required. Crane types can range from a simple rope and pulley or gin wheel to a complex tower crane but most can be placed within 1 of 3 groups, namely mobile, static and tower cranes (Chudley and Greeno, 2006).

The consequences of any failure of a crane are likely to be extremely serious, with the potential for multiple fatalities. It is therefore important that mobile cranes are effectively maintained to ensure continued safe and efficient operation over time. In addition to the maintenance process, the thorough examination of mobile cranes, periodically and after exceptional circumstances is required to ensure that mobile cranes are safe to take into use and to continue in use (Philip, 2010).

The construction industry has the greatest number of deaths and accidents as compared to other occupations. In the USA, from 1992 to 2006, it was revealed that there were a total of 632 crane-related construction worker deaths. Of the total 632 crane-related deaths, 157 were caused by overhead power line electrocutions (25%), 132 deaths were associated with workers being struck by crane loads, 125 deaths involved being struck by cranes, crane booms/jibs or other crane parts (Michael, Janie and Walter, 2008).

On construction sites, crane operation is a complex undertaking that depends largely on skilled operators considering all the likely involved variables and factors affecting its safety. Safety is the opposite feeling or sense of the surrounding danger(s). It is, therefore, important to eliminate the sources of insecurity to crane users. A well designed environment is one of the key factors that contribute to users’ sense of security. Safety is considered to be the most critical issue in the success of any crane operation. Crane accidents involve tragic deaths of innocent people and destruction of property. A crane as one of the most utilized equipment in construction sites can be dangerous. Statistics show that there are main hazards that occur during normal working circumstances. Most injuries and deaths from crane accidents can be attributed to several basic hazards (Zayed & Abbas, 2013).

On March 15, 2008, a crane collapsed in a densely populated area of New York City killing seven people. The tower crane became unstable and fell onto several apartment buildings (Lambeck and Eschemuller, 2009). In 2002, two tower cranes toppled from the 60th floor of a steel frame building under construction in Taipei, Taiwan, during a severe earthquake. The failures were not caused directly by the earthquake, but rather by the cranes oscillating in resonance with the building (Shapiro and Shapiro, 2011). On 30th May 2006 in Abuja, a crane collapsed during the construction of High Court Building which led to the loss of six lives. In 2012 in Benin City, a section of the Central Hospital building where construction work was still on-going collapsed. It was reported that a pail carrying materials snapped from the rope connecting it to the hook of a crane and crashed into a freshly constructed beam linking the pillars of the top of the third floor of the building, resulting in the collapse of the affected portion (Gold, 2012).

It was revealed that some of these accidents could have been prevented if project managers had reviewed and evaluated the safety requirements, rigging equipment used and had connections inspected, and operator certification for the cranes inspected. It is on this basis that this study sets out to assess crane safety practices on construction sites in Abuja. To this end, answers were sought to the following research questions:

* What is the level of adherence of safety policies with regards to the use of the

 cranes, and

* What is the extent of the knowledge of the crane operators
1. **Methodology**

Combinations of a questionnaire survey and interview methods were adopted in the study. In order to select the sample size for the questionnaire survey, a purposive sampling technique method was adopted; this is was to ensure that only active sites where cranes were used as at the time the survey was carried out. To this end, 30 sites were identified which translated to the self-administration of 30 questionnaires to the professionals’ found and were in-charge of the sites (26 representing 86.7% were returned). In addition to this, 16 crane operators were interviewed.

1. **Results and Discussion**

Figure 1 below shows the age of respondents. This indicates that 34.6% are between 20-29 years of age, 46.2% of the respondents are between 30-39 years, 11.5% represent 40-49 years and 7.7% represents above 50 years. The respondents fall within the active years and an indication with familiarity with issue under study

**Figure 1: Age of respondents**

Figure 2 indicates that 30.8% of the respondents have 1-5 years’ experience, 23.3% have 6-10 years’ experience, 30.7% have 11-15 years’ experience, 7.6% have 16-20 years’ experience, and 7.6% have more than 20 years of experience. This shows that most respondents have 1-5 years of experience. This shows that 54% of the respondents have 6-15 years of experience in the construction industry; to this end, the responses could be deemed to be reliable.

**Figure 2: Years of experience in the construction industry**

Figure 3 indicates that 7.7% of the respondents are architects, 30.8% are builders, 34.6% are civil engineers, 3.8% are quantity surveyors, and 23% were other. Hence they are qualified to respond to the issues raised in the paper

**Figure 3: Respondents’ discipline**

**Table 1: Level of Adherence to Crane Safety practices**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Practice  | V.L1 | L2 | M3 | H4 | V.H5 | MS | RNK | RMK |
| Adequate policies and legislation regarding the operation of cranes | 0 | 1 | 9 | 6 | 10 | 3.96 |  4th | H |
| The level of adherence to the policies and legislation | 0 | 2 | 10 | 8 | 6 | 3.69 |  10th | H |
| adequate knowledge of the operator | 0 | 2 | 4 | 12 | 8 | 4.00 |  3rd | H |
| Is the best type of crane for the work used on the project | 0 | 0 | 5 | 11 | 10 | 4.2 |  1st | H |
| Provision of training and orientation on health and safety issues to crane operators | 0 | 3 | 7 | 9 | 7 | 3.76 |  8th | H |
| Provision for maintenance of cranes | 0 | 0 | 8 | 10 | 7 | 3.88 |  5th | H |
| Inspection carried out at regular intervals | 0 | 4 | 10 | 7 | 5 | 3.50 |  13th | H |
| Provision of protection for the public by barricading accessible areas | 1 | 3 | 5 | 6 | 11 | 3.87 |  6th | H |
| Load not being moved over workers | 5 | 8 | 4 | 5 | 4 | 2.80 |  16th | M |
| Watching out for electrical distribution and transmission lines. | 1 | 0 | 5 | 8 | 12 | 4.15 |  2nd | H |
| Ability to apply training acquired to the work by the crane operators | 0 | 3 | 8 | 10 | 5 | 3.60 |  11th | H |
| Crane operators participating in regular safety and health meetings | 1 | 1 | 9 | 5 | 10 | 3.84 |  7th | H |
| operators expressing their views on working procedures adopted by managers as it may affect safety | 1 | 3 | 7 | 10 | 5 | 3.57 |  12th | H |
| Adequate resources to carry out inspection for enforcement of laws | 0 | 9 | 8 | 6 | 3 | 3.11 |  15th | M |
| Space available to accommodate large cranes | 0 | 3 | 6 | 3 | 8 | 3.73 |  9th | H |
| Plant and pedestrian traffic segregation | 2 | 2 | 10 | 8 | 4 | 3.38 |  14th | M |
| Operators being under influence of alcohol and drugs while operating cranes | 15  | 2 | 2 | 1 | 6 | 2.26 |  18th | L |
| Operator using mobile phones while operating the cranes | 8 | 6 | 4 | 3 | 5 | 2.65 |  17th | M |

VL-Very low; L-Low; M-Moderate; H-High; VH-Very high; RNK-Rank; RMK-Remark

From Table 1, using the best type of crane on construction sites is ranked 1st with a mean score (MS) of 4.2, watching out for electrical distribution and transmission lines which comes in second with MS of (4.15). Adequate knowledge of the operator comes third with MS of (4.00). It is followed by adequate policies and legislation regarding the operation of cranes which comes fourth with MS of (3.96); provision for maintenance of cranes which comes fifth with MS of (3.88). Provision of protection for the public by barricading accessible areas comes sixth with MS of (3.87). Crane operators participating in regular safety and health meetings comes seventh with MS of (3.84), which is followed by provision of training and orientation on health and safety issues to crane operators which comes eighth with MS of (3.76). Space available to accommodate large cranes comes ninth with MS of (3.73). The level of adherence to the policies and legislation comes tenth with MS of (3.69). Ability to apply training acquired to the work by the crane operators comes eleventh with MS of (3.60). Operators expressing their views on working procedures adopted by managers as it may affect safety come twelfth with MS of (3.57). It is followed by Inspection carried out at regular intervals which comes at thirteenth with MS of (3.50). Plant and pedestrian traffic segregation comes in at fourteenth with MS of (3.38). Adequate resources to carry out inspection for enforcement of laws come at fifteenth with MS of (3.11). Load not being moved over workers comes at sixteenth with MS of (2.80). Operator using mobile phones while operating the cranes comes at seventeenth with MS of (2.65). Operators being under influence of alcohol and drugs while operating cranes come last with MS of (2.26).

**Table 2: Safe Means of Access to all Parts of the Crane for Maintenance**

Safe means of access to Frequency (No.) Percentage (%)

all part of the crane

Yes 19 73%

No 7 27%

Total 26 100%

From Table 2, it shows that 73% of the respondents stated that there is a safe means of access to all parts of the crane for maintenance. And 27% are of the opinion that there is no safe means of access.

**Table 3: Visit of City Authorities**

Visit of authorities to site Frequency (No) Percentage (%)

Yes 20 77%

No 6 23%

Total 26 100

Table 3 shows that 77% agree authorities visit the site to check safety of plant while 23% do not agree and say authorities do not come to site. Though the percentage may not be substantial, but operations of cranes should not be left in the hands of the contractors and clients alone as cranes accidents are known to be tragic. It is expected that people that are statutorily empowered to inspect the sites where cranes are used should always do so in order to ensure that proper procedures are followed. Jimoh, Ijigah and Nuah (2014) established that inspection is hampered by inadequate resources at the disposal of health and safety officers. In a related development, National Occupational Safety and Health Information Centre, Geneva in 2006 stated that the total number of factory inspectors in the Federal Capital Territory, Abuja was 1. This scenario leaves much to be desired.

**Table 4: Posting of Rated Load Capacities, Operating Speed and Instruction**

Post and make visible rated Frequency (No) Percentage (%)

Load capacities, operating speed

and instructions

Yes 25 96.1%

No 1 3.9

Total 26 100

The Table indicates that 96.1% of respondents post information about rated load capacities, operating speed and instructions while 3.9% do not agree. According to Beavers *et al*. (2005), the physical contributing factors leading to fatalities caused by “crane tip over” were overload, loss of centre of gravity control, outrigger failure, high winds, side pull, and improper maintenance.

**Table 5: Awareness of Regulations to Mounting of Cranes in Highly Populated Areas**

Awareness of Regulations to Mounting Frequency (No) Percentage (%)

of Cranes in Highly Populated Areas

Yes 18 69.2

No 8 30.8

Total 26 100

Table 5 indicates that 69.2% of the respondents are aware of the regulations to mounting of cranes in highly populated areas while 30.8% are not aware of the regulations. This portends serious danger as a result of the lack of awareness since many things could go wrong especially on confined sites and high populated areas.

Tables 6-12 are the results and discussion based on the interviews conducted with the crane operators.

**Table 6: Type of Crane Used**

Type of crane used Frequency (No) Percentage (%)

Tower crane 9 56.3

Mobile crane 7 43.7

Total 16 100

Table 6 indicates that 56.3% of the respondents operate tower cranes and 43.7% operate mobile cranes. This shows that most of the respondents operate tower cranes. The tower crane is a modern form of balance crane. Fixed to the ground (and sometimes attached to the sides of structures as well), tower cranes often give the best combination of height and lifting capacity and are used in the construction of tall buildings (Norman, 2008). Mobile cranes are the machines that set up the tower cranes at the onset of construction and dismantle them at the conclusion of their service on site. This is a classic demonstration of the mobile crane’s main features: its capacity to be rapidly deployed and to handle heavy loads (Avid, Gunnar and Clifford, 2007)

**Table 7: Daily Inspection of Crane**

|  |
| --- |
| Daily inspection of crane Frequency (No) Percentage (%) |

Yes 15 93.8

No 1 6.2

Total 16 100

The Table shows that 93.8% of the respondents carry out daily inspection on their cranes before the commencement of their daily operations while 6.2% of the respondents do not carry out daily inspection. This is a good thing because mechanical devices such as cranes have been known to perform optimally the previous day and only to refuse to start the follow day.

**Table 8: Maintenance and Inspection According to Manufactures Instructions**

|  |
| --- |
| Maintenance and inspection Frequency (No) Percentage (%)according to manufacturers Instruction |

Yes 10 63

No 6 37

Total 16 100

Table 8 shows that 63% of the respondents maintained and inspected their cranes in accordance to the manufacturer’s instruction while 37% do not follow it and have other ways of maintaining and inspecting cranes.

**Table 9: Frequency of maintenance**

How often is maintenance Frequency (No) Percentage (%)

 carried out

1 to 5 weeks 12 75

6 to 10 weeks 2 12.5

11 to 15 weeks 0 0

Above 15 weeks 2 12.5

Total 16 100

75% of respondents stated that maintenance is carried out between 1 to 5 weeks, 12.5% carried out maintenance between 6 – 10 weeks, and 12% of the respondents indicated above 15 weeks on the frequency of maintenance. This indicates that maintenance is mostly carried out between 1-5 weeks.

**Table 10: Operation of Crane Based on Education or Experience**

Operation of cranes based Frequency (No) Percentage (%)

On education or experience

Education 1 6.3

Experience 15 93.7

Total 16 100

6.3% of the respondents confirmed they operated cranes based on education while 93.7% of the respondent stated that they operated cranes based on their experience. This indicates that most operators operate crane based on experience. According to North Carolina Department of Labor (2010), formal training should be provided for all crane operators, to ensure a working knowledge of crane load charts. However, on-the-job training can be adequate if the trainer is qualified.

**Table 11: Know Weight of Load to be Lifted**

Know weight of load to be lifted Frequency (No) Percentage (%)

Yes 16 100

No 0 0

Total 16 100

100% of the respondents confirm they always know weight of the load to be lifted. Overloading occurs when poorly trained personnel are allowed to operate cranes. The operator must always know the weight of the load (North Carolina Department of Labor, 2010).

**Table 12: Manufacturers Manual in the Cab at all Times**

Manufacturers Manual in Frequency (No) Percentage (%)

the Cab at all Times

Yes 5 31.3

No 11 68.7

Total 16 100

31.3% of the respondents keep manufacturers manual in the cab while 68.7% do not keep manual in the cab. This is not a good development as the need for to refer to the manual may arise especially in an emergency situation. The consequence of the type of attitude may be dire in some cases.

**4. Conclusion**

The study assessed crane safety practices on construction sites in Abuja, Nigeria, by seeking answers to two research questions. It was discovered that having the best type of crane on site to perform its operations is ranked 1st meaning that at all times, stakeholders ensure that the right type of crane is used for obvious reasons, while operators being under the influence of alcohol and drugs was ranked 18th. This is an indication that operators are left at their whims and caprices to do what they like as long as their jobs are done. A substantial percentage of the operators interviewed (93.7%) do not have formal education, but acquired their skills from experience.

Based on the above, it is recommended that efforts should be made to provide avenues for the operators to be trained, whether formally or informally, so as to improve their knowledge base.

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