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# Quality of Work Delivery Practices at the Building Sites: Case Study of Building Sites at Gomoa Nyanyano-Ghana

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**Abstract**
Inadequate attention to quality issues has culminated in substandard work which could partly be attributed to unqualified project participants and non-compliance with building regulations and codes leading to inadvertent collapse and demolishing of building structures. The main objective of the study was to assess the quality work delivery practices at the sites. The study applied qualitative method of collecting data using questionnaires, interviews and observation. A total of 86 respondents took part in the study, 71 completed questionnaires while 16 were interviewed. The population constituted Artisans, Supervisors, Building Inspectors, Engineers, Architects and Clerk of Works. The most significant findings were that majority (64.8%) of the artisans had basic education with (16.9%) possessing intermediate or vocational qualification. 81.69% were apprenticeship trained whereas the rest 18.31% had both apprenticeship and schooling or schooling only. Most of them lacked the basic knowledge in Building Regulations pertaining to their field of work. Due to inadequate supervision and control of works, the use of poor quality materials and work processes was rife leading to substandard work at most sites. The principal conclusion was that much premium be placed on quality work at the sites so as to ensure quality structures and a remarkable increase in the satisfaction of end users.
**Keywords**: Quality Control, Building Sites, Workforce, District Assembly Officials, Local Authority Byelaws, National Building Regulation, supervision, enforcement, Artisans, Qualification
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## 1. Introduction

Research over the last decades has investigated the quality of building work, the essence of improved performance and housing quality within the complete building process and in effect has resulted in the evolution and subsequent adoption of quality assurance in building works (Clift, 1996).

In an attempt to ensure quality in the construction industry worldwide, there are international standards such as the British Standards (BS), International Organisation for Standardisation (ISO) and the like and other Local Authority (LA) standards regulating the construction works. This is to make sure that there is utmost sanity in the Construction Industry and that construction defects manifesting in products and processes are reduced to the barest minimum thereby optimising building efficiency. Like the construction industries in the world, Ghana's Construction Industry has a set of regulations governing it. The National Building Regulation (NBR), 1996 L.I. 1630 was instituted primarily to ensure that acceptable standards are adhered to with respect to designing, siting and general construction of building structures in Ghana.

Quality control in construction fundamentally entails insuring that minimum standards of materials and workmanship are complied with so as to ensure performance of the facility as demanded by the design and which are contained in the specification (Project Management for Construction: Quality Control and Safety During Construction). Quality of work at the building site largely depends upon the correct interpretation of the information provided, control and monitoring of the work (Emmitt and Gorse, 2005). The gross negligence and ignorance on the part of the Clients, the Project Participants and the Planning and Control Officers at the assemblies may have led to a considerable level of shoddy works (Osei -Tutu & Morgan, 2008). This in effect has led to the loss of precious lives, waste of resources and properties running into millions of Ghana cedis and above all shattering people's dreams.

This paper seeks to make contribution to the existing literature on quality work delivery issues at the small scale building sites. The rest of the paper deals with the background, methodology, results, and discussion with conclusions drawn and their implications for policy making.

### *1.2 Research Questions*

i) To what extent does the expertise of the site personnel, supervision and work control affect quality workmanship?
ii) How quality are the building materials and the work processes employed at the building sites?

 

## 2. Background

Quality can be defined from the viewpoint of function, by how closely the project conforms to its requirements. In this instance a high quality project could be described in terms like ease in understanding drawings, level of conflict in understanding drawings and specifications, economics of construction, ease of operation, ease of maintenance and energy efficiency (Arditi and Gunaydin 1997). In the construction industry, quality can also be defined as meeting the requirements of the designer, builder and regulatory agencies as well as the owner (Ferguson and Caylon 1988). To Bennett, (2003 p.281) "*Quality in its broad sense is a degree of excellence: the extent to which something is fit for its purpose*". According to Clift (1996), "*it is the degree to which the design and specification meets the requirements for that building"*.

Over a long period of time attaining acceptable levels of quality in the construction industry has been a problem but a great potential of quality improvement exist in the industry (Arditi and Gunaydin, 1997). Emmitt and Gorse, (2005 p.3.) opine that for building structures to perform as expected, certain qualities must be ensured right from the beginning to their completion stages. They continue that, "*The quality of a completed building as well as the process that brings it about will be determined by the quality of materials and products specified and the quality of the work undertaken*". Even though good quality materials and workmanship initially goes with higher cost than lower quality alternative, the overall advantage of its long-term durability and serviceability is improved considerably hence assuring users of their safety, security, ease of use and operation amongst others (Gauld,1995; Emmitt & Gorse, 2005).

Lack of attention to quality issues at the building sites has resulted in collapse of building structures leading to loss of precious lives and major properties running into millions of dollars. Examples of such incident of structural failures are the Royal Plaza Hotel in the city of Nakhon, Rachasima, Thailand (Worsak, 1994), Petionville school collapse (Beaumont, 2008) and others. Ghana has also had its fair share of such building failures over the past decades owing to poor quality work. Some of these are the Melcom disaster in November 2012 at Achimota –Accra, three storey residential building at Krofrom- Kumasi in April, 2013), two storey court complex in 2009 at Accra (Danso and Boateng, 2013), OA transport terminal at Asafo- Kumasi in December 2006 (Daily Graphic report) and a four storey building in June 2010 at Spintex road near Accra (Graphic front page stories) and the like.

In Ghana's bid to uphold quality in the building construction industry appertaining to the others on the globe, the National Building Regulation (NBR), 1996 L.I. 1630 has been instituted primarily to ensure that acceptable standards are adhered to with respect to designing, siting and general construction of building structures. Nonetheless, there is still the challenge of poor quality work at some building sites culminating in the collapse of buildings due to structural failures in the country (Arthiabah, 2013). As reported in the BRRI, 2008 journal on housing, (Kyei, 1974; Wahab, 1983; Abloh, 1994) revealed that low-income earners who have managed to secure some resources for building projects often are not able to solicit project advice from expert but employ non-competent designers and artisans who do not adhere to the NBR leading to sub-standard structures all to the detriment of their clients. Unfortunately, Planning and Control Officers at the assemblies mandated to enforce the building codes and the LA byelaws do not frequent themselves at the building sites. Also, most clients persistently shy away from the building professionals due to the lax attitude of the building regulations (Sampson, 2006).

In the quest for more houses to be constructed to reduce the housing deficit of about one million in the country (PHC Report, 2000), government as well as the private individuals and the estate developers are making unrelenting effort to ensure that at least people get decent accommodation for living, working and playing in, hence building structures are springing up across the country with all manner of expertise and workforce. Ayedum et. al., (2012) and Ede, (2011) identified the use of sub-standard materials, poor workmanship among others as the contributory factors of building failures in Lagos State. Additionally, inadequate design information and poor site practices are a consequence of building defects (Ilozor *et al, 2004*). The prominent causes may be attributed to bad design, awarding contract to unqualified builders, low quality materials coupled with incorrect dose of batching materials for concrete and mortar as well as inadequate columns and beams (Kattamaney, 2007). Though there have been some research works on quality issues in respect of construction industry such as Delgado-Hernanadez (2006)'s doctoral thesis on building a new framework that will ensure quality into construction projects, (Arditi and Gunaydin, 1997)'s Total quality management and their implications in the construction industry and Agbenyega (2014)'s master's thesis on quality management practices of building construction firms in Ghana evaluating the quality management practices of Ghanaian contractors with emphasis on D1K1 contractors registered with the Ghana Cocoa Board but none of them have worked on quality delivery issues at building sites with respect to the small- scale construction industries. This current research therefore seeks to highlight the poor quality issues militating against work at the building sites in Ghana specifically at the Mellenium City in Gomoa Nyanyano.

 

## 3. Methodology

Gomoa Nyanyano is in the Gomoa East district while Kasoa is in the Ewutu Senya East municipality both in the Central Region of Ghana. Gomoa Nyanyano is a community of about 7,139 populations (2010 PHC report) with its source of employment being fishing, farming and salt winning. Kasoa on the other hand is a peri-urban town situated on the Accra- Cape Coast road approximately 36km west of the Kotoka International Airport with a population of 69,384 (2010 PHC report) (en.wikipedia.org/wikikasoa). Millenium City is a vast land where a lot of new structures earmarked for estate development and other private development are springing up at a faster rate probably due to its nearness to Kasoa. The area was selected because it has the semblance of other towns and cities in the country in terms of housing problems and the massive land development for building purposes and also due to their accessibility and therefore the methods used for the study could be applied to other similar areas.

The study was conducted in March 2014 and data was gathered on variables relating to quality of work delivery practices at the building sites at the study area such as bio data / personal records, training and experience of workforce, site supervision and enforcement of regulations and byelaws as well as quality of materials and work processes.

A sample of 86 participants made up of 71 artisans who were sampled through questionnaire and 15 assembly officials consisting of architects, engineers and clerk of works drawn from districts assemblies like Ga South, Ewutu Senya and Gomoa East were also sampled through purposive sampling technique and interviewed with response rate of 95%. To increase the internal validity of the study, mixed- method approach (questionnaires, interviews and observation) was adopted.

The questionnaires consisted of (1) the background and demographic data (e.g. gender, age, educational background, occupation etc.) (2) Training and Experience (frequency of training, years of work, places worked etc.) (3) Enforcement of regulations and supervision (presence of supervisors, frequency of control by officials from the assembly etc). Appropriate Likert scales were employed. For example, Likert scale ranging from "Never" to "Yes frequently" was used to obtain information regarding training whilst "Don't know to Yes" was also used to collect data concerning experience of workforce (Osuala, 1993; Cohen, Manion & Morrison, 2007). Again as regards site supervision, awareness and support for the NBR and LA byelaws, "Not applicable to Yes" was applied whereas "Not at all to Very frequently" was employed for the frequency and performances of DAOs at the site.

Additionally, both semi–structured interviews (Patton, 2002) and unstructured interviews (Depoy and Gitlin, 1998) were conducted to elicit data from key informants such as the District Assembly Officials (DAOs), structural engineers, architect and clerk of works. Semi-structured interview was employed when collecting information from the DAOs under whose jurisdiction the study area was and with the rest, unstructured interviews used. This method of data collection was applied in order to obtain clarification of the responses on the questionnaire and further information about the study.

Direct observation was also carried out at the various building sites within the study area for better acquaintance with the attitude and competence of the workforce, supervision and control of works as well as quality delivery practices such as quality materials and work processes (Osuala, 1993; Cohen & Manion, 1994; Babbie, 2002). Observation checklist was used to collect data regarding materials and work processes. Additionally, photographs of relevant portions of work were taken at the sites to enhance data gathering and presentation.

For data credibility the researchers had to explain to every respondent the rationale for the study so as to win their trust and confidence. They were assured of the utmost confidentiality and anonymity required (Frankael & Wallen, 2003). However, in spite of the assurances given them some of the workforce declined to participate. The researchers assisted those participants who had challenges in completing the forms and were given enough time to finish.

Statistical analysis was carried out with the use of SPSS for windows (Version 16.0). Descriptive statistics and frequency analysis was employed to evaluate most of the data. To establish the significance of association between variables such as qualification of workforce as against job type, (table 1), frequency of assembly officials versus regulation enforcement at the site (table 3), opinion of workforce and the performance of DAOs at the sites (table 4), Pearson Chi -Square was used with P-values $\leq 0.05$ considered significant. Cross-tabulations were also used to analyse the other tables (Cohen, Manion & Morrison, 2007). Tables, charts and texts were used in the presentation of the results.

## 4. Results

### *4.1Research Question 1*

In order to establish the extent to which the expertise of the site personnel affects quality work it was important to determine their qualifications, mode of acquiring their skill/knowledge, their experience and their knowledge in the NBR and LA byelaws. It was also necessary to verify the degree of supervision of works at the sites and

 

how regulations and byelaws were enforced.

Table 1 deals with the educational qualification of the site personnel. From the table, 64.8% had basic education, (14.1%) had no basic education, another (14.1%) had intermediate or vocational educational qualification whilst (7%) had either secondary or technician educational background. The results thus show significant association between respondents' highest qualification and their jobs ($\chi^2$ =82.918: df =30: P-value=0.000). It further implies that one is more likely to meet an artisan with basic education at the building site than the other qualifications in the study area.

**Table 1**: Respondents' Highest Qualification ($\chi^2$ =82.918: df =30: P-value=0.000)

| **Variables** | None | Basic Education. | Intermediate / Vocational Education. | Secondary. Education | Technician Education | **Total** |
|---|---|---|---|---|---|---|
| **% frequency** | 14.1% | 64.8% | 14.1% | 5.6% | 1.4% | 100% |

Figure 1 also indicates Artisans' mode of acquiring their skill/knowledge. This may indicate their proficiency in their job area hence it is very important for the study. From the sample 12.68 % acquired their skills through schooling, 81.69% through apprenticeship whilst the remaining 5.63 % were through apprenticeship and formal training. This means that most of the artisans were trained by master craftsmen on the job.

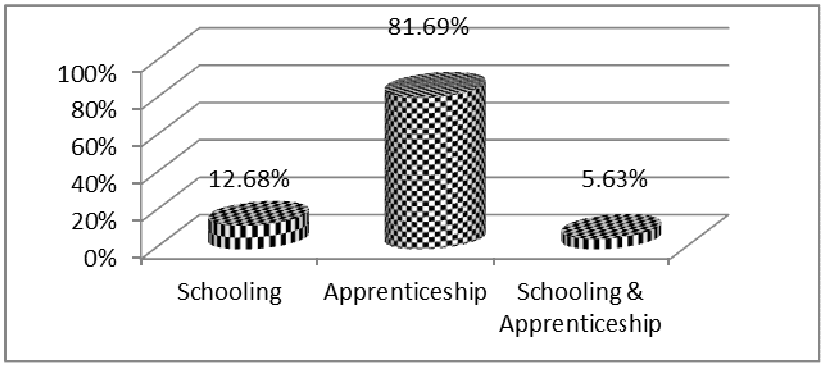


**Figure 1**: Mode of skill / knowledge Acquisition

The sample in table 2 displays the work experience of the respondents. It can be found that majority of the workforce (97.2%) have had more than two years' experience in the building construction industry working as artisans and more than half of them (53.2%) have worked in many places in and around Accra and Kasoa with the rest having worked in other places including Accra and Kasoa or excluding Accra. This result may imply that the artisans have considerable degree of experience to bring to bear quality at the sites.

**Table 2**: Results of Respondents' Work Experience

| | | **Number of Years Worked** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | ≤ 1yr | 2-6yrs | 7-11yrs | 12-16yrs | 17-21yrs | 22-26yrs | 27yrs ≥ | Total |
| **Places worked** | In and around Accra and Kasoa. | 2<br>100% | 8<br>53.3% | 8<br>38.09% | 10<br>66.7% | 8<br>57.1% | 1<br>50% | 0<br>0% | 38<br>53.52% |
| | In and around Kasoa only. | 0<br>0% | 3<br>20% | 5<br>23.8% | 3<br>20% | 3<br>21.4% | 1<br>50% | 0<br>0% | 15<br>21.1% |
| | Accra, Koforidua and Kasoa only. | 0<br>0% | 0<br>0% | 1<br>4.8 | 0<br>0% | 0<br>0% | 0<br>0% | 0<br>0% | 1<br>1.4% |
| | In and around Accra, Kasoa and Kumasi. | 0<br>0% | 0<br>0% | 0<br>0% | 0<br>0% | 2<br>14.3% | 0<br>0% | 0<br>0% | 2<br>2.8% |
| | Accra, Takoradi ,Kasoa and Volta Region. | 0<br>0% | 2<br>13.3% | 0<br>0% | 0<br>0% | 0<br>0% | 0<br>0% | 0<br>0% | 2<br>2.8% |
| | Many places in Ghana. | 0<br>0% | 0<br>0% | 3<br>14.3% | 2<br>13.3% | 1<br>7.1% | 0<br>0% | 1<br>50% | 7<br>9.9% |
| | Many places in and outside Ghana. | 0<br>0% | 0<br>0% | 0<br>0% | 0<br>0% | 0<br>0% | 0<br>0% | 1<br>50% | 1<br>1.4% |
| | Accra, Tema And Kasoa only. | 0<br>0% | 0<br>0% | 1<br>4.8% | 0<br>0% | 0<br>0% | 0<br>0% | 0<br>0% | 1<br>1.4% |
| | Accra, Cape Coast, Dunkwa On-Offin and Kasoa. | 0<br>0% | 0<br>0% | 1<br>4.8% | 0<br>0% | 0<br>0% | 0<br>0% | 0<br>0% | 1<br>1.4% |
| | Swedru and Kasoa only. | 0<br>0% | 2<br>13.3% | 1<br>4.8% | 0<br>0% | 0<br>0% | 0<br>0% | 0<br>0% | 3<br>4.2% |
| | Total | 2<br>100% | 15<br>100% | 21<br>100% | 15<br>100% | 14<br>100% | 2<br>100% | 2<br>100% | 71<br>100% |

 

Artisans' awareness of the NBR and the LA Byelaws can be used as a barometre to measure their ability to comply and meet acceptable standards and therefore ensure building quality. Presented in fig. 2 is the result of the knowledge that artisans have about the NBR and the LA byelaws.

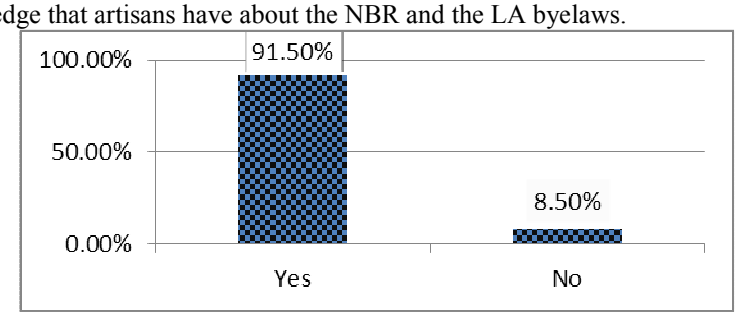


**Figure 2**: Awareness of NBR and LA Byelaws

The sample indicated that 91.5% of the participants reported being aware of the existence of the NBR and LA bye laws whereas only 8.5% were ignorant (fig 2). This presupposes that one is likely to meet at the site an artisan who is aware of the regulations and thus can ensure building quality.

The level of support for the enforcement of the NBR and LA byelaws is indicative of the level of cooperation required to promote building quality. For this reason it is important to ascertain the degree of support for the enforcement of NBR and LA Byelaws by the respondents. The result from the study emerged that all the 71 respondents (36 masons, 4 plumbers, 11 Carpenters, 13 Steel Benders, 4 Electricians, 1 Labourer and 2 Supervisors) unanimously support the enforcement of the regulations.

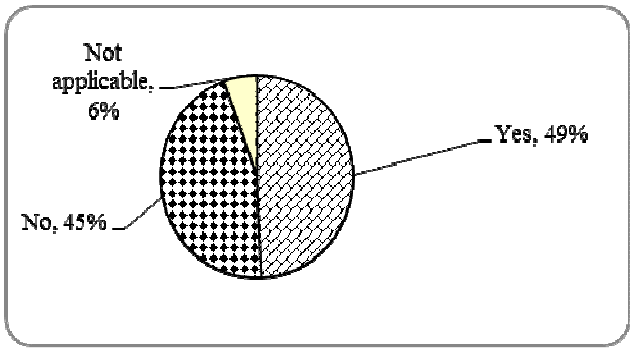


**Figure 3**: Level of Supervision at the Study Area

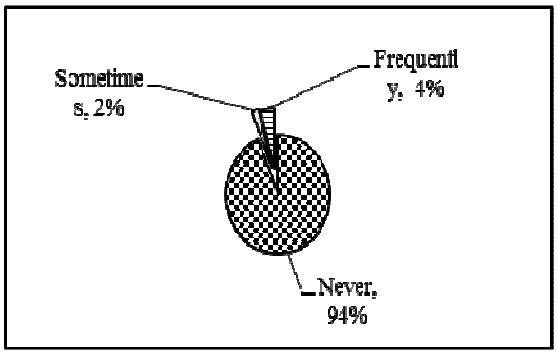


**Figure 4**: Frequency of Training of the Workforce at the Study Area

The state of supervision at the study area was worthwhile since it can influence the degree of quality work. From figure 3, about half of the respondents 49 % had supervisors, 45% had no supervisors, while 6% reported not applicable. This presupposes that more than half of the respondents work on their own without any form of supervision.

Frequent training of the workforce is a key factor to ensuring quality work. Therefore knowledge about how the artisans are given training in respect of their jobs is essential to the study. As presented in figure 4, majority of them (94%) reported that they have never been trained since starting their jobs whereas a few 4% reported receiving frequent training with the remaining 2% receiving training sometimes. It can therefore be inferred from the result that the probability of an artisan not likely to be trained at the site is very high whilst the likelihood of better workmanship is also low.

Frequency of the DAOs to the building site is very necessary because it may determine the degree at which the NBR and LA byelaws are enforced which in effect will ensure that set standards are met and ultimately quality achieved. From table 3, 43.7%, 40.8% and 7.0% of the respondents reported that the DAOs did not visit their sites at all, were not frequent and were frequent respectively. The rest of the respondents having similar percentages 2.8% in each case cited that the DAOs' visited their sites twice in the lifetime of their projects or at every stage of work or had no idea about them.

 

**Table 3**: Respondents Opinion about the Frequency of the DAOs to Building Sites

| **Variables** | Not Applicable | Not frequent | Twice in project's lifetime | Every stage of work | Frequent | No idea | **Total** |
|---|---|---|---|---|---|---|---|
| **% Frequency** | 43.7% | 40.8% | 2.8% | 2.8% | 7% | 2.8% | 100% |

Table 4 presents the report on the respondents' opinion as to the performance of the DAOs' at the study area. It can be seen from the table that 38% of them find the performance of the DAOs' as either very unsatisfactory or unsatisfactory while only 8.4% find them either satisfactory or somehow satisfactory with a few 2.8% being very satisfied with their performance. 43.7% have no idea about their performance with the rest (7%) indicating that they find them to be money conscious. Majority of them may not have any idea about them due to their infrequency at the sites. The chi-square value ($\chi^2$=53.594; df =36; P-value=0.030) as indicated by the table implied a significant association between the opinions of the artisans and the performance of the DAO's.

**Table 4**: Respondents' Opinion about the Performance of the DAOs at the building sites ($\chi^2$=53.594; df =36; P-value=0.030)

| **Variables** | Very unsatisfied | Unsatisfied | Satisfied | Somehow satisfied | Very satisfied | No idea | Money conscious | **Total** |
|---|---|---|---|---|---|---|---|---|
| **% frequency** | 1.4% | 36.6% | 5.6% | 2.8% | 2.8% | 43.7% | 7.1 | 100% |

*4.2. Research Question 2*

In order to determine the extent of quality materials and work processes at the building sites, it was required to explore material quality and acceptable work processes employed in the study area.

Generally all the sites visited except a few did not pay much attention to the quality of materials being used for constructional operations. Fine aggregate used which was mostly pit sand was full of contaminations such as tree roots, clay and other impurities inimical to construction operation. The coarse aggregates mostly used were locally cracked except a few. Some of these were also not clean. Grading of aggregates was very poor except the few quarry ones. Moreover, the reinforcements, mostly mild steel were not contaminated, easy to be bent to any required shape. Some of the timbers used for the formwork were substandard resultantly there was the problem of bulging and its attendant leakage of cement grouts. While there were problems with the aggregates used, the study was pleased with the reinforcement quality used at the site. Most of the water used was not drinkable and unclean. The cements used were fresh and flourlike in consistency ideal for construction purposes.

Close observation at the various sites revealed that setting out operations at most sites were fairly good. They were on the right plots of land and in the right orientation. However depths of trenches for most sites were shallow, trench bases were haphazardly bottomed up and vertical sides not well prepared (Plate 1). Interactions with the artisans, brought to light that because they perceived the soil to be hard and firm they thought it wise not to dig it deep to the required depth as expected. Most of them overlook the essence of preparing the base and sides of the trenches before foundation concrete are cast.

**Plate 1**: Depth of Foundation Trench at some sites

**Plate 2**: A Bulged Column due to Poor Quality Formwork used

Aggregates batching were poorly done. Most artisans did not know the essence of accurate batching of aggregates hence batching was inaccurate. Generally, the tried and tested batching methods were not practised at the sites by most artisans. Batching was not considered in relation to an acceptable mix design such as 1:2:4, 1:3:6 and so on. It mostly based on guesses. The usual method used is "2 for 5", meaning with two bags of

 

cement added to five barrows of fine aggregate, and an unspecified quantity of coarse aggregate. This means that it is only the cement and fine aggregates that are somehow batched, the coarse aggregate as well as the water are added haphazardly. Artisans did not know what is water cement ratio and aggregate cement ratio therefore a considerable degree of inconsistencies characterised the batching operations.

It was again discovered that quality of mixing and placement of concrete at most sites particularly hand mixing were not the best. Because most sites were small scale, about 95% of them employed the use of hand mixing, and hence confirms what Seeley (1987) wrote that this method is for small jobs. Majority of the artisans did not ensure the uniform mix of the dry materials before adding water and consequently the resultant mix was not homogeneous. Most concrete mixes were running. Concrete was placed long after the final setting time had elapsed and also lacked sufficient tamping. Curing of concrete products essential to increase strength and durability was unpopular at most sites even though it was badly needed.

Erection of formwork for columns and beams was also poorly done. Due to inferior quality of formwork materials and inadequate bracing coupled with inaccurate plumbing, some columns were out of place (plate 2). Another notable practice was that majority of the artisans did not appreciate the function of cranking the ends of rods in beams/ lintels and columns. In consequence, instead of bending the ends of the rods both top and bottom; only the top ones are cranked (Plate 3 and 4).

**Plate 3**

**Plate 4**

**Plate 3 & 4:** How Ends of Reinforcement for Beams and Columns are Cranked and Connected *at most sites*

Almost every site visited appeared to be doing well with the quality of laying. There was neat appearance, good alignment, accurate plumbing and levelling. Nonetheless, most sites did not use builder's square and for that matter corners of walls were fairly at right angle. Furthermore, majority of the blocks used were substandard in that they were not strong and not uniform in size too.

The study as well brought to light some building sites which were using poor quality materials for hardcore filling. The materials had notable quantity of dead tree roots, tree stumps and weeds (Plate 6). The fillings were moreover being done on grown weeds (Plate 5). Perhaps their knowledge about filling (hardcore and back filling) is weak. They are unaware of the repercussions of such bad site practices. It was also observed that inappropriate methods of filling and consolidation were used. Resultantly some parts of the walls got damaged (plate 7).

 

**Plate 5**: Hardcore being filled on Grown weeds at some sites

**Plate 6**: Poor Quality Hardcore material used at some sites

**Plate 7**: Evidence of the Result of using wrong Consolidation Equipment for Hardcore Filling

**Plate 8**: A Type of Oversite Concrete Method ("German Concrete") Used at Most Sites

Some sites did not ensure that thickness of concrete bed was uniform. This was probably due to poor control measures taking by the artisans. While most artisans were breaching the operations involved in placing concrete foundation and therefore resulted in variation in thickness of concrete bed, a few ensured and maintained accuracy especially those with competent supervisors.

Majority of the sites used "German Concrete"- concrete cast exclusively along the perimeter of the internal and external walls of the substructure after which the walls for the superstructure are laid over it (Plate 8), instead of oversite concrete. While a few sites provided blinding course at the base of the matt, majority did not. More so, very few of the sites provided DPC to check rising damp. Almost every site visited which had reached the superstructure stage had provided enough openings to receive windows and doors.

*4.3 Interviews with the Workforce and the Experts in the Building Industry on Quality Issues*

Unstructured interviews with the artisans and supervisors at the various sites revealed that some of them did not understand the implications for bad site practices. They saw it to be an acceptable norm and hence did not see anything wrong with it.

Again some of them reported that … *but for their clients and supervisors, they could have used better materials knowing the problems that accompany the use of substandard materials*. It was also reported that often those who did not ensure quality work were those artisans who did not complete their apprenticeship training and therefore were unqualified. According to them, such people would charge unreasonably low and do whatever the client instruct them whether good or bad and later abandon the work when problems crop up. To this end, a supervisor suggested that artisans must be awarded certificate on completion of their training and this could be used to differentiate the qualified from the quack ones and that, clients must be made to inspect certificates / licenses before awarding contract. Another supervisor commenting on the expertise of artisans remarked that …"*the artisans we have on the sites are good only that they lack common sense to reason to suit a particular moment. Therefore they need constant supervision to ensure quality work."*

In his contribution to the issue of reinforcement bending, a structural engineer condemned the practice

 

that only the top bars are cranked leaving the bottom ones and continued that only God knows what will happen when there is a disaster in future.

The respondents (artisans and supervisors) further lamented on the actions of some of the clients and added that… *because they are cheats we also need to find our way out by selling some of the materials to compensate for our losses.*

Apart from the interviews held at the sites, separate interactions with the DAO's within and around the study areas (Ga South and Awutu Senya) concerning workmanship quality at the site reported amongst other things such as lack of material quality control, poor grading of materials, poor batching of materials, poor mixing, placement and consolidation at most sites. They added that some of the clients and artisans do not implement what is prescribed in the approved document. For example most foundation trenches are not dug to the approved depths. They are mostly shallow. On the issue of the competence of the artisans, it was reported that about 60% of the artisans are competent with the other 40% being otherwise. They attributed their incompetence to lack of understanding of construction processes, their uncompromising attitude towards acceptable construction standards mostly taking things for granted, and concluded that most clients solicit their services due to cheap labour.

## 5. Discussions

Obviously, with more than 2/3 (64.8%) of the respondents having basic educational background as against the few (14.1%) having the basic formal training in construction and 7% with either secondary or technician education, indicates that the greater proportion of the sample has a low educational background which needs to be upgraded in order to ensure the required work quality. Though the basic level education in Ghana seeks to introduce some technical education, the aspect devoted to construction is insignificant and therefore cannot provide the beneficiaries the requisite basic knowledge and skill essential at the building site. Typical of apprenticeship training, there is often lack of theoretical reasoning that will support their practical ability hence most of them become limited in terms of certain challenges of which their counterparts with theoretical background can reason to solve. The evidence of their incapability was exhibited during the observation exercise at the site and which were presented in the findings (Pates 1 to 8). Practice has shown that combining theory with practical skills enhances the competency of an individual. Again artisans being able to use tools and equipment in their various fields of work, but lacking the competency to ensure quality work is a challenge that should be addressed. With most of them (81.69%) not equipped with the required basic principles in construction processes they are bound to face certain challenges like the right use of quality materials and work processes that would lead to building quality. Key informants to the study intimated that artisans have taken things for granted and therefore break the NBR and the LA byelaws with impunity. For instance, they lack the ability to perform to set standards and cut corners to get things done which eventually lead to poor quality work. Against this background, it can readily be concluded that their long work experience does not translate into quality delivery practices at the site.

Though the result in figure 2 indicates a higher proportion of the artisans claiming to be aware of the NBR and the LA byelaws, an interaction with them proved otherwise. No wonder regulations are flouted with impunity at the sites probably due to ignorance or negligence. Invariably, for work to be quality, it must conform to set standards and requirements (Crosby 1984). The extent to which something is fit for its intended purpose can be used to measure quality (Bennett 2003). This stands to reason that if they cannot work to set standards and hence cannot achieve the intended purpose, then the required quality will most be affected thus affecting customer satisfaction. Interestingly, these are the people whom most clients engage their services. Being only skillful does not guarantee quality product but accompanying it with the expected principles and regulations to bring about quality is what is most important.

With the result in figure 3 suggesting that supervision at the site was not keen, it may mean that the supervisors are not competent to play their role or better still the need for supervision is not appreciated by the clients or the workforce. Resultantly, wrong methods of work having the potential of creating major problems at the site and to the building structure at the later stage of use were employed. It also emerged that those who claimed to be supervisors rather need to be supervised. This finding contravenes what Emmitt and Yeoman (2001) advocated that supervision must be ensured in order to turn out quality product.

It is essential to strictly enforce regulations to forestall substandard work in the face of recent occurrences of rampant demolitions and building failures befalling the nation and their attendant effects such as serious injuries, loss of precious lives and monies running into millions of cedis. It is therefore apt to leave no stone unturned to enforce the laws. Any attempt to render it unworkable will be most unfortunate and must thus be condemned. As the construction industry is dynamic with new methods, processes and techniques emerging day in day out, its workforce must be trained to be in tune with the changing trend. According to Lorraine (1992), training must be considered as a sine qua non of site production. In agreement, Bennett (2003), Foster (1992) and Lorraine (1992), wrote that standards can only be maintained if those associated with the construction industry

 

are provided with the requisite knowledge and mental skills. With majority (94%) of the artisans and supervisors never receiving training of any kind whilst on the job (fig. 4), it can be deduced that it will be difficult maintaining acceptable standards at the sites. The lack of training of the project participants as reported is not in line with the views of Bennett (2003), Foster (1992) and Lorraine (1992) and therefore should be noted.

The result in table 3 readily pre-supposes that building inspectors do not go to the sites to enforce the regulation as expected. From table 4, because they were not frequent at the sites, 38% of the respondents judged their performance as being either 'unsatisfactory' or 'very unsatisfactory' whereas 43.7% had 'no idea' about their existence. Interaction with the building inspectors and engineers confirmed what the artisans reported concerning the study area. The interview with personnel in charge of the study area at Gomoa Afransie attributed their inability to visit the sites to lack of the needed logistics especially vehicles. Threats by clients and artisans, boundary issues coupled with the lack of political will to prosecute offenders were the other challenges confronting the DAOs thus stifling their work. This development contravenes with Foster (1992) which advocates that on-going projects must be visited by inspectors to ensure conformity to specification of the approved document and current building regulation and amendments.

The use of aggregates containing considerable amount of organic impurities such as clay, silt, decayed plant life, tree roots among others are injurious to concrete and mortar. Such impurities in their excess in materials will create soft and unreliable patches in the mix and thus affect the setting action of cement and also result in discolouration (Gambhir, 2002). The practice at the sites certainly contravenes the acceptable standards above and the NBR 1996 Part IV which states that "*any material used in the erection of building shall be of suitable nature and quality for the purpose and conditions in which they are to be used*". Most artisans did not understand the essence of well grading of materials and therefore the issue of poor grading was rife. Incontrovertibly, well graded aggregates produce stronger mix than a poorly graded one for a mix of a given consistency and water cement contents and in effect influence the strength of the mix (Chudley and Greeno, 2006; Wilby, 1991). This stands to reason that the practice whereby artisans neglect the grading factor of aggregates is simply dangerous and unacceptable. The result of the study ones again is in conflict with the acceptable standards.

Water being one of the most indispensable constituents of concrete causes the mix to be sufficiently plastic and readily placeable into position (Emmitt and Gorse, 2005; Gambhir, 2002). By virtue of its function, Handoo and Puri, (2000), cautions that it should not contain any substance inimical to the hydration of cement and durability of concrete. To Walton (1995), for the purpose of construction, water should be drinkable and be as clean as tap water and that river water may not be suitable since it can contain soluble salts. Against this background, the practice at most sites appears to be deviating from the views of Walton (1995) since the use of river water, dirty stagnant water in gutters and in ponds as well as water collected on the surface of the ground after rainfall were mostly employed for constructional purposes. It appears that they do not know the implication and the effect of such waters on the quality of building structures.

According to Hodge (1983), depth of trench should be such that the sub foundation cannot be influenced by the weather which is usually 600mm to 900mm. Unfortunately, most sites at the study area had their foundation depths far less than 600mm. The respondents explained that, since the soil is hard to dig and therefore makes it difficult to meet the minimum depth, they find it expedient to situate the foundations at such depths. Presumably, the implication for such practice may be that the sub foundation may be exposed to the weather due to erosion hence many foundations are exposed. Again there can be unequal settlement of the structures at the later date since the right bearing capacity of the soil might not be met as they based their decisions on mere assumptions. Additionally, because trench sides and bases were not adequately prepared, thicknesses of foundation concrete varied within the trenches on most sites. Thus a concrete foundation supposed to be 150mm thick throughout the trench length differed. The result thereby conflicts with Hodge (1983) and Walton (1995). The problem of foundation failure in Ghana as Afrane and Osei Tutu (1999) reported showing that about 4.3% of all houses had foundation problem may be attributed to such practices above.

Due to the role concrete plays in construction purposes, its operations such as right material selection, correct batching, thorough mixing, right placement and finishing and right curing must not be overlooked (Canon and Hartley 1982). On the contrary, the operations at the sites were ostensibly at variance with Canon and Hartley (1982), Handoo and Puri (2000), Grundy (1997) and Seeley (1987) since they were carried out haphazardly characterised by inconsistencies and lack of uniformity. Interactions with the respondents revealed gross ignorance and negligence of the workforce regarding the right work processes that will ensure quality concrete. This has resulted in substandard product contributing to building failures in Ghana which needs to be curbed. This finding may explain what Afrane and Osei Tutu (1998) reported during their research conducted in Accra, Kumasi and Tamale that 11% of building structures were having cracks in their floors.

By virtue of the function of formwork it is advised that it should be sufficiently strong, watertight, and easy to be stripped and leave an acceptable surface finish to the concrete structure when removed (Grundy 1997; Obande 1996; Seeley 1987). The findings indicated that some of the formworks were having loose joints, not

 

strong and not well positioned. Consequently, the issue of bulging, grout leakages and sagging were more pronounced (Plate 2). This could probably be attributed to the strength and grade of timber used, accuracy in positioning of the formwork and how well the bracing and strutting was done. The implication for the grout leakage will be the loss of strength of concrete as the required water cement needed for ensuring the strength would have been lost. Additionally, bulging affects the required shape of the structure hence defeating the very essence of quality control and therefore needs to be properly addressed.

To prevent structure failure, ends of reinforcing rods should be bent either in "L" or "U" hook (Obande 1996). The practice of bending the ends of reinforcement haphazardly is very dangerous and should there be any major disaster one will not be certain of what will happen. Inaccurate erection of concrete structures as well as insufficient concrete cover thus exposing the reinforcement bars to the vagaries of the weather and consequently causing the structure to fail disagrees with Emmitt and Gorse (2006); Obande (1996) and Seeley (1987) which suggest that enough cover must be given to steel rods in order to avoid failure.

Materials for filling purposes are supposed to be inert and therefore the inclusion of such unwanted materials like organic matter and sulphates for filling should be discouraged. Inadequate consolidation coupled with contaminated hardcore materials will in consequence cause the floor to sink (Seeley, 1987; Osbourn and Greeno 2002). Filling hardcore on grown weeds and using the wrong equipment to fill and compact it will certainly affect quality work and subsequently the durability of the structure. The right operation to lay hardcore filling in general must be strictly adhered to forestall such incidence occurring. These practices do not corroborate with the authors above and should not be encouraged.

Undoubtedly, the implication for the nonuse of builders square is that roofing and finishing operations will be greatly affected as the corners of the building will be out of square. Artisans should therefore be encouraged to use the right tool for the right job so as to avert that problem. Inferior blocks used for the laying at most sites should be stopped in that their use will cause cracks due to stresses and resultantly affect the load bearing capacity of the wall. Afrane and Osei Tutu (1998)'s report of the survey carried out in Accra, Kumasi and Tamale indicating that about 21.6% of walls in Ghana have cracks in them while 3.2% are tilted may be as a result of poor work standards.

The result of the use of the "German Concrete" may be that if the joints between it (Plate 8) and the subsequent floor concrete are not well sealed, it could provide an avenue for the passage of rising damp and insects into the dwelling hence creating additional problems and ultimately affecting user satisfaction. Since this method is widely used, there is the need for research to be conducted to improve its effectiveness.

## 6. Conclusions and Implications

This paper has so far dealt with quality issues at the building sites at Gomoa Nyanyano against the backdrop of substandard work leading to building failures in Ghana. The result indicated that most artisans were trained through apprenticeship (Fig.1) and that, due to lack of frequent in-service training (Fig. 4), quality of work delivery practices was below expectation. Again most sites used poor quality materials and work processes which ended up in poor quality work (Plates 1 to 8). Consequently, for lack of quality control measures, building quality was badly affected. Most sites lacked proper supervision of works (Fig. 3) and control of building works by the DAOs and other assembly officials was very loose particularly in the study area where it was revealed that no building inspector had visited there for the past year. It also came to light that lack of logistics for the assembly officials, boundary issues and lack of political will had rendered the NBR and LA byelaws very ineffective making it very difficult to enforce. Added to that, the uncooperative attitudes of some clients have also hindered the smooth enforcement of the law.

The result thus implies that frequent in-service training must be organised for artisans and supervisors so as to bring their expertise to an acceptable level capable of ensuring good quality work practices at the site. Artisans must also be sensitised and encouraged to be abreast with the basic knowledge of the regulations so as to help ensuring quality work. Certificate must be awarded to qualified artisans to distinguish them from the quack ones. The government or policy makers should therefore institute appropriate certification agencies to see to the issuance of appropriate certificates to them after passing a prescribed test in their various trades. The Labour Office must thus be strengthened and equipped to see to the certification of the beneficiaries of the informal training. Collaboration among Labour Office, the Industry and COTVET (Council for Technical and Vocational Education and Training) will ensure wide acceptability of certificates. Enough education must be given to the public through both the print and electronic media to drive home the need for upholding the regulations and byelaws as well as the various implications of relaxing them. The need for the formation of artisanal associations so that at their meetings the building inspectors and assembly officials can be invited to educate them on the issues of good quality work delivery practices will be in the right direction. The DAOs must be seen working at their various places of jurisdiction in ensuring the enforcement of the regulation. Government must give them the needed logistics and legislative support to facilitate enforcing the rules to the letter. The seemingly "political immunity" that some government officials and some party members enjoy to flout the

 

regulations with impunity must be stopped. Rather governments must exercise the necessary political will to flush such political opportunists out of the system. After all, everybody must be equal before the law.

In the course of the study, the researchers got faced with challenges that had to do with accessing of information from artisans, and DAOs, current reading materials for review and above all logistical supports.

This paper has provided some insight of quality issues at a particular study area, and as such the findings cannot be considered to have presented the total picture throughout the country. Extension of similar studies to other areas in the country may highlight more on the quality delivery issues.

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