STAGE BUILDING INSPECTION: A POSSIBLE SOLUTION TO BUILDING FAILURES IN NIGERIA

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Building quality failures have become rampant in Nigeria, with the worst cases resulting in collapse of buildings and loss of lives. Several studies have attributed quality failures to a myriad of factors some of which are traceable to insufficient/lack of quality inspection during construction. Stage inspections are a common feature of most developed countries, which ensure that building works comply with consent documents issued by approving authorities. The more the checks and inspection on building performance, the more probable the final build will meet the required quality standards. Thus the primary objective of this paper is to suggest stage inspection during construction by approving authorities, as a feasible solution to building failures in Nigeria. Literature review methodology is used to discuss building inspection regimes operable in different developed countries. This is with a view for the Nigerian building construction industry to consider stage inspection as a mandatory process during building production. It is hoped that the findings of this paper will benefit property owners, building occupants and the overall construction industry through improved quality achievement levels. Stage inspections may guarantee peace of mind and confidence that buildings will eventually attain desired levels of performance because the culture of building it right first time would have been imbibed.

Keywords: building failure, construction industry, stage building, Nigeria

INTRODUCTION

House building is significant to the national development plan of every country. This is because the sector plays a crucial role in economic performance and prosperity. For example the construction industry contributes more than 50% of gross fixed capital budget in Nigeria (Wase, 2004). In New Zealand, the industry contributes about 5% of Gross Domestic Product (Building and Construction Sector Productivity Taskforce, 2009), while the residential output accounts for a total market value of between NZ$450 and NZ$500 billion making it the largest asset class in New Zealand (DTZ New Zealand, 2004). The house building sector has witnessed increasing quality failures which sometimes result in building collapse and their impacts have been found to be negative on economic growth and invariably on the sustainable development of the built environment (Windapo, 2006). Therefore, because of the significance of the house buildings sector and how it supports the economy of many countries, it is necessary to improve on its quality performance levels through innovative approaches (Sommerville and Craig, 2006). Achieving this quality objective in house building projects depend on the content of the original design and

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Rotimi F E and Tookey J (2012) Stage building inspection: A possible solution to building failures in NigeriA *In:* Laryea, S., Agyepong, S.A., Leiringer, R. and Hughes, W. (Eds) *Procs 4th West Africa Built Environment Research (WABER) Conference*, 24-26 July 2012, Abuja, Nigeria, 1295-1306.

specifications, and the level of workmanship and conformity to the design requirements during construction work. The overall aim in any house building project is to design and construct to meet the specific requirements of a client or homeowner at optimal quality. Thus when buildings fail to render the function for which they were built, numerous benefits which could have accrued to the nation and society become elusive (Windapo, 2006).

Structural failure is a common feature of the construction industry in most countries especially the developing countries (Aini, Fakhru'l-Razi, Daud, Adam, and Abdul Kadir, 2005; Taiwo and Afolami, 2010). The worst cases of structural failure in Nigeria manifest themselves in major urban centres like Lagos and Abuja, probably because of the pressing need for housing development as a result of exponential population growth. Dahiru and Okotie (2010) confirm further that unsafe buildings are mostly located in the urban cities across Nigeria and consequently result in building failure. Rather than improving, it seems that building failure in Nigeria is on the increase, as have been widely reported in local press and in published articles. Several Nigerian authors have sought to understand the reasons for this continuing trend and occurrences. Reference to some of their publications will be made in later sections of this paper. However the reasons may generally not be unrelated to a significant lack of understanding of the fundamentals of good building practices that occur at every stage of the design and build process; from designers, to builders, to inspectors and so on. Bates and Kane (2009) suggest these reasons are apparent when quality failure occurs in building construction. The quality failure problem has questioned the competencies of professional bodies responsible for designing and monitoring construction works on building sites.

In view of the above situation, a more aggressive and proactive measure is required to address the issues of quality failures and in particular, developing countries like Nigeria. Governments and approving authorities have a huge responsibility to ensure that the quality of building construction is at a level that is acceptable by all stakeholders, most importantly the homeowner.

AIM AND OBJECTIVES

The aim of this paper is to suggest stage inspection by approving authorities during building construction as one of the possible ways of improving quality of buildings in Nigeria. Some of the objectives formulated to address the aim of this study include:

- To evaluate causes of poor quality resulting in building failures
- To determine the frequency of building failures in Nigeria building construction.

LITERATURE REVIEW

Quality Failures and the Construction industry

Construction industry is continually criticised for its poor quality performance. Sommerville and Craig (2005) agrees that quality failure has almost become part of the house building cultural paradigm and the wider construction industry. The term ‘quality failure’ could be used interchangeably with construction faults, repairs, defects, deviations, non-conformance, rework and snags (Abdul-Rahman, 1995; Burati, Farrington, and Ledbetter, 1992; Georgiou, Love, and Smith, 1999; Josephson and Hammarlund, 1999; Kim, Oh, Cho, and Seo, 2007; Love and Edwards, 2004; Sommerville and Craig, 2005). However the word ‘snags’ and ‘snagging’ is gradually

becoming a common term used within the construction environment outside the UK construction industry which was the origin of the terminology. However within this study, the word quality failure will be used.

The term quality failure will be explained by looking at the definition of quality and then the word failure. The ISO8042 (1996) define quality as the totality of features and characteristics of a product or service that bear upon its ability to satisfy stated or implied needs. The Oxford dictionary simply defines failure as the neglect or omission of expected or requires action. That is failure to comply with basic rules. Wardhana and Hadipriono (2003) define failure within the context of the construction environment as the inability of a constructed facility to perform its specific design and construction requirement. Bringing these definitions together may present a more acceptable definition of quality failure within the house building sector. Quality failure can be defined as that resulting from a product or service that does not comply or fulfil its stated needs and other performance criteria. Possibly the common term used for non-achievement of quality standards within the construction industry is rework. Love and Li (2000) define rework as the unnecessary effort of re-doing a process or activity that was incorrectly implemented the first time. Abdul-Rahman (1995) agrees that an organisation's reputation and its profit margin can be affected because the cost of redoing a project that is not up to standard is high. The needs to reduce costs and at the same time improve quality standards are mutually supportive for any project. If the building process must achieve the principle of doing things right the first time and every time, it should be appreciated that quality failure has a price (cost increase). Similarly, the end products that have to be repaired invariably leads to a perception of low standards from the point of view of the customer. Several studies have shown that rework is a problem in the construction industry and exists in both developed and developing countries as well.

Table 1 highlights rework cost in countries like the UK, Australia, South Africa, Malaysia, Hong Kong and Sweden. It collates general information on the cost of rework for different building types, while the cost of rework are expressed in actual percentages and statistical values relative to tender costs and contract values. Figures like those presented on the table initiate interests into the problems of quality failure within the construction industry. Although these rework costs should not be taken to be authoritative, but merely suggestive, as levels and interpretations of rework differ between countries. Of note however is that while the developed countries continue to combat issues like rework in building construction, developing countries deal with extreme cases of building failures and collapse of buildings.

Frequency of building failures in Nigeria

The drive to reduce incidences of building failures in the Nigerian house building sector arises not solely from the house owner but also from governments, approving authorities and professional bodies (Dimuna, 2010; Idoro, 2010). Okedele (2008) identified the problem of building failures as one of the key challenges facing the Nigerian built environment. Building failures cut across all building categories in Nigeria, but the worst affected are residential buildings with failure records higher than in other sectors (Oke and Abiola-Falemu, 2009). Windapo (2006) finds that 40% of reported cases of building collapse between 1974 and 2006 were residential buildings. Table 2 gives a breakdown of the frequency of building failures that was collated through literature analysis of three key articles. The authors of these articles had compiled data on building failure from different sources at various time periods. For example Dimuna (2010) compiled data from 1976 to 1995 and 2004 to 2006.

Oni's (2010) compilation is more recent as it covers up to 2007, but with emphasis on Lagos State as opposed to Windapo (2006) and Dimuna (2010) national records. In re-presenting their works, Table 1 compares the respective failure data from the three authors to arrive at a worst case scenario (see column 6) for individual locations and periods. The worst case represents the highest number of defects recorded by any of the three authors for each time period.

Table 1: The work of various authors on cost of rework

Authors	Project Types	Calculated Cost of Rework
UK		
Burati et al, 1992	Industrial engineering projects	Cost of quality deviations 12.4% of total project cost
Barber et al, 2000	Civil Engineering (road)	82% of failures result in 10% of cost of overall failures. Only 4 failures result in 44% of rework costs
South Africa		
Rhode and Smallwood, 2003	Range of projects	13% of value of completed project
Malaysia		
Abdul-Rahman, 1995	Civil Engineering (road)	5% of tender value is cost of non-conformance
Hong Kong		
Palaneeswaran, 2006	Private building projects	Between 3.5% to 16.1% of contract value
Australia		
Love 2002	Range of projects	Direct and indirect rework cost was 6.4% and 5.6% of contract value
Love et al 2010	Civil infrastructure projects	Mean cost of rework was 10% of contract value
Love 2002	Range of projects	A mean of 12% and a standard deviation of 13.56% of total project value
Love and Sohal, 2003	Warehouse and apartment block	3.15% and 2.14% of total project value respectively
Sweden		
Josephson et al 1999	Museum, school, housing, University, fire station, shopping centre, industry	2.3% to 9.3% of contract value Another project 2% to 6% of contract value

As observed from the failure data, the worst incidence of quality failure is in Lagos State. This is significant in that it supports the views held by Akinsola (2008) that such failure persists in major urban centres because of exponential population growth patterns. Attempts to meet the pressing needs of housing development, has reduced the time to build an average house. Quicker building times with little attention to details coupled with the increased complexities of the design and construction of new housing combine to make quality performance challenging. Invariably this results in quality achievement being compromised on construction projects.

Other cases of building failure in Nigeria that were not listed in Table 2 include the collapse of a hotel under construction in Akure (Taiwo and Afolami, 2011). The study showed that developers of collapsed buildings often deviate from approved specifications. More recently cases of building collapse were reported in Oshodi, Lagos on 28th April 2010 and in Abuja on 11th August 2010 (Ede, 2010). These incidences of building failures result in significant casualties and loss of lives that

could be avoided. This needless loss of lives demonstrates how flawed our current monitoring systems are and suggest that drastic improvement measures are required. Especially the residential sector needs to rethink its approach towards building production process in the light of these tragedies.

Causes of building failures in Nigeria

The need to improve quality standards in the wider construction industry is in part driven by the extent of building failures and building collapses found in the house building sector and also various reports and articles particularly in developing countries. Several high profile instances have shown that quality failures have enormous impact on construction project. Quality failure may cause discomfort to the primary user (home owner) and in worst cases loss of lives while the reputation of the constructor and the industry is damaged in the process.

Often there are several causes of the same erroneous action. These may be either combined causes, or a chain of causes. Whichever the case, causes of building failure is a proven reason for the existence of quality failure (Craig, 2008). Table 3 highlights the causes of building failures and the number of times building failures have been attributed to each category. From the Table it could be observed that the vast majority of the literature reviewed (n = 7), building failures in Nigeria are due to the use of poor quality materials. Table 3 also show that poor workmanships and design faults contribute significantly to building failures in Nigeria.

Incompetency of professionals and unethical practices were highlighted by several authors. Three authors indicated environmental factors, change in building use, and inadequate enforcement of building regulations as contributing factor to building failures in Nigeria. Other factors that were highlighted include improper supervision, absence of inspection by approving authorities, non-compliance with specifications and construction fault. The least factors highlighted from the table are absence of approved drawings, frequent work variation and poor building practices. Investigations into causes of building failures are progressive with more recent studies generating more causal factors in Nigeria.

Several studies have recommended solutions to the incessant building failures experienced in Nigeria. Some of these recommendations include proper and efficient supervision of workmen, enforcement of the building code, professional development, monitoring of professionals and penalties for those responsible for building collapse (Ede, 2010; Oke and Abiola-Falemu, 2009; Oloyede, Omoogun and Akinjare, 2010; Taiwo and Afolami, 2010; Windapo, 2006). However few have explored a review of the building approval process or the introduction of inspections during house construction by approving authorities. Thus this study believes the pursuance of an inspection regime could act as a preventative rather than a corrective measure to the factors identified as causes of building failures in Nigeria. For example it is possible for approving authorities to pick up on poor quality materials and workmanship, design faults etc. during actual construction works before they result in collapse and fatalities. Hence the focus of this paper is on stage building inspections as the possible solution to building failures in Nigeria.

Table 2: Frequency of building failures collated from three articles

State	Year	(Dimuna, 2010)	(Windapo, 2006)	(Oni, 2010)	Worst Case
Ibadan	1974	-	1	-	1
	1986	-	1	-	1
LAGOS	1978	-	-	1	1
	1982	2	-	-	2
	1983	2	-	3	3
	1984	-	-	1	1
	1985	3	5	7	7
	1986	1	-	5	5
	1987	2	4	7	7
	1988	1	-	-	1
	1989	2	2	4	4
	1990	-	1	3	3
	1991	1	1	2	2
	1992	2	-	3	3
	1993	-	-	1	1
	1994	2	-	6	6
	1995	1	3	8	8
	1996	1	2	3	3
	1997	-	2	-	2
	1998	-	1	2	2
	1999	-	6	5	6
	2000	-	1	7	7
	2001	-	-	2	2
	2002	-	-	6	6
	2003	-	-	6	6
	2004	-	3	3	3
	2005	2	4	6	4
	2006	2	1	7	7
	2007	-	-	7	7
Kaduna	1977	1	2	-	2
	1980	-	1	-	1
	1999	-	1	-	1
Ondo	1976	1	-	-	1
	1982	1	-	-	1
	1994	1	-	-	1
	1999	-	1	-	1
Anambra	1985	-	1	-	1
	1986	-	1	-	1
Kano	1987	-	1	-	1
	1991	1	-	-	1
	1993	1	-	-	1
Kwara	1994	1	-	-	1
	1997	-	1	-	1
Edo	1989	-	1	-	1
	2006	-	1	-	1
Rivers	1978	1	-	-	1
	1990	1	1	-	1
	2005	2	1	-	2
	2003	-	1	-	1
Ogun	1990	-	1	-	1
	2005	1	-	-	1
Abia	2004	1	-	-	1
Aba	2005	1	-	-	1
Borno	1977	1	-	-	1
Benue	1985	-	1	-	1
Imo	1986	-	1	-	1
Osun	1986		1	-	1
Cross River	1987	-	1	-	1
Sokoto	1991	1	-	-	1
Oyo	1994	2	-	-	2
Enugu	1997	-	1	-	1
FCT	1999	-	1	-	1
Adamawa	2005	1	-	-	1
FCT	2006	-	1	-	1

Table 3: Causes of building failures

Authors	(Oyewande, 1992)	(Ayininuola and Olalusi, 2004)	(Windapo, 2006)	(Olajumoke, Oke, Fajobi, and Ogedengbe, 2006)	Aluesogan, and Ogunkoya, 2007)	Abiola-Falemu, 2009)	(Dimuna, 2010)	(Taiwo and Afolami, 2010)	(Ede, 2010)	(Oni, 2010)
Poor material										
Poor workmanship										
Frequent work variation										
Design fault										
Construction fault										
Incompetent professionals										
Human error										
Environmental factors										
Ignorance										
Change in building use										
Unethical professional practice										
Improper supervision										
Absence of approved drawings										
Absence of inspection by approving authorities										
Inadequate enforcement of building regulations										
Poor building practices										
Non-compliance with specifications										

INSPECTION PROCESSES

Current inspection process on building construction in Nigeria

Building consent documents are submitted to Town Planning Authorities to ensure that architectural and structural designs comply with design principles. A building permit will only be granted for commencement of work if the Town planning Authority is satisfied with building consent documents. It is important that the Town Planning Authority enforce its development control regulations so that the incidences

of non-compliances do not occur. Thus additional inspection(s) could well be a solution to reducing the incidence of building failures in Nigeria. Dimuna (2010) confirms that there is absence of inspection by approving authorities during building construction for compliance with documented specification and this has led to some of the cases of building collapse. Similarly, Dahiru and Okotie (2010) identify lack of enforcement of building regulations as a significant factor responsible for the problem faced in the Nigeria building construction sector. In order to overcome this problem, the approving authorities needs to be staffed with competent people with the right expertise and integrity (2010). Oke and Abiola-Falemu (2009) recommend that proper and efficient supervision of workmen by building professionals may reduce the incidence if collapse. Although this could be more efficient when there is a follow up of supervision by qualified professionals within the approving authorities. Thus the authors' believe that there is a pressing need to improve the current inspection process during the construction of residential buildings in Nigeria. This will enable better monitoring during the building production process.

Current inspection process for residential buildings in developed countries

In most developed countries, it is a requirement that a building consent is granted by an approving authority before any construction works begins. The consent documents normally contain compliance requirements which are necessary for proposed building works. The consent also specifies the inspection requirements for the building project based on the submitted plans and specifications. Building inspections are usually carried out at specific stages corresponding to building progress. In most European countries, it is explicit that building permit may contain conditions that must be carried out before and during construction. During construction, site inspection is carried out to ensure that the building work is built according to designs and that it complies with building regulations. Inspections are done by either public or private parties or a combination of both (building surveyor). The stages of inspection and the choice of inspectors depend on counties. Once construction is completed, a final check is conducted and a completion certificate or building permit is issued (Pedro, Meijer, and Visscher, 2011).

In New Zealand, typically the inspections will cover: foundations, framing and insulation, plumbing, drainage, cladding and flashings, and the finished building. Work cannot proceed until the inspection for each stage is completed and approved. The purpose of the inspection is to ensure that building works comply with consent documentation. If the council inspector finds work that does not comply with the building consent during the inspection regime, a notice will be issued to rectify these defects. The inspection regime concludes with a final inspection of the completed build after which a Code Compliance Certificate (CCC) is issued. The issued CCC confirms that the work has been done in accordance to plans and specifications approved in the building consent. House sales and purchase contracts are often conditional on the issuance of a CCC (Gibson, 2010).

In Australia, the Building Code of Australia controls the details of building and construction works. Building work may involve a series of inspections at various stages of construction to determine if they are being constructed correctly and in accordance with the building permit documents. Typical inspection stages include: foundations, footings and floor slabs construction, framing up, Occupancy Certificate and Certificate of Completion. At appropriate stages of work, a building surveyor will inspect the work and issue Occupancy Permit. A building must not be occupied until an Occupancy Permit is issued, indicating it is safe and healthy to be occupied. A

Certificate of Final Inspection will be issued by the building surveyor when all building work is completed. At the final stage in the building process, a Certificate of Completion (Building Work) may then be applied for and issued by the Council Permit Authority (Derwent Valley Council, 2009). In light of the above explanations it is important for the residential sector of developing countries to examine their building production process so that high quality performance could be achieved from design through to physical execution.

Proposed stage inspection process for residential buildings in Nigeria

It is vital that the building construction process is monitored from start to finish as stated in the consent documents. Inspections during the building process ensures that all building works remains consistent with what has been approved in the consent documents and building regulations, and that the building will meet acceptable standards of health, safety and quality. Rotimi, Tookey, Craig, and Rotimi (2011) advocate that the more the checks on building construction, the more probable the final build will meet the required quality standards.

The stage inspections proposed are to be carried out by the Town Planning Authority at pre-defined stages to ensure that all works meet the consent document requirements. Despite regular monitoring of work progress by contractors and consultant on constructions site, it is important that the planning authority consultants carry out additional inspection at specific stages during construction. These stages should be set out on the building consent document, so that is clear to the builders and the Town Planning Authorities when works will be inspected. Inspection may necessitate a partial or complete suspension of work to allow for inspection to be conducted. The stages at which this inspections will be done will depend on the complexity and type of the residential building. The Town planning Authority will appoint an approved Inspector or an independent inspector/consultant to carry out building inspections and to assess for compliance with Building Regulations. The builder is obliged to notify the Town planning department when the major stages specified on the consent documents are reached. The inspector will carry out all stage completion and building control inspections.

The TPA selects key stages to inspect construction works and may undertake any other inspection as deemed necessary. The stage inspection could correspond with the completion of major structural elements in residential buildings. For example, completion of foundation, walling, roofing, cantilevers etc. it is important to note that inspection for concrete elements should focus on framework and reinforcement adequacy before casting is done. The approving authority should also insist on sampling of concrete pours for major concreting works. The inspection regime will be such that progress into the next stage is contingent on certification/approval of previous stage. A stage completion certificate may be granted to show that all work at a particular stage has been completed accordingly. During site inspections, all parts of the construction work may be inspected. Once construction is completed, a final check is conducted and a completion certificate or building permit is issued. The inspector is expected to provide a report at each stage inspection. Random inspection could be carried out by the inspector. The inspections would address the consistent need for stronger enforcement of building standards and regulations. The stage inspection provides a total quality control program for new homes, because at every major stage the house is inspected for quality of construction and building materials as well as compliance with building regulations and codes.

CONCLUSIONS

It is evident that building failures and in worst cases, building collapse is an issue facing the construction industry especially the residential sector in Nigeria. Urban areas are mostly affected because of their continuous growing population rate. In order to meet the growing need of these rising population, the residential sector has to work towards improving quality performance of its final product. In so doing there has to be measures put in place to achieve this objectives. One important measure that will help in accomplishing this task accurately is to establish an efficient and effective inspection process during the building production process. The inspection will ensure that construction is completed in compliance with building code standards and regulations. So that when quality failures are later identified and serious problems occur such as building collapse, then there is a project party that could be held accountable. The inspection process proposed will ensure a regular and systematic monitoring of all building works right from the inception stage until the completion of the building. As it is, there is an enormous backlog of violations that remain unfixed in Nigeria, many of them serious. Beyond creating a stage inspection in the building process, this paper suggest that the Town planning department should begin a thorough auditing of professionals in charge of checking design, drawings and specifications for all quality and safety related issues. It should not take more tragedies to prompt the review of current building production process and its inspection regimes. The building production process requires a creative and sustainable solution that will transform quality performance within the residential sector.

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