

Evaluation of Strategic Measures for Effective Quality Control Management of Concrete Works in Anambra State, Nigeria

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Abstract: *Concrete is universally the most common building material in Nigeria construction industry but had also been reported as one of the major causes of structural failure. However, in spite of the popularity of concrete structures, if not properly constructed and the quality maintained, it can deteriorate prematurely which is often referred to as our crumbling infrastructure. The study aimed at evaluating strategic measures for effective quality control management of concrete works in Anambra State, Nigeria. A survey research method was adopted for this study. Data was obtained through both primary and secondary sources. The population for this study comprises of registered construction professionals in Anambra state and was surveyed through a well structured questionnaire survey approach. Data generated were analyzed using Tables, Percentage, Ranking and Mean Score. A total of one hundred and fifty eight questionnaires were distributed to registered construction professionals in Anambra State and one hundred and twenty nine questionnaires were returned. The sample size for the study is therefore 129. The findings of the study revealed that quality concept, quality management system, quality control in construction, quality management standard, quality plan, professional regulatory bodies, companies own quality control document, various acts /decrees for construction professionals, the national building code, action to be taken at each stage are all quality control management strategies responsible for ensuring quality concrete works in buildings in the study area. The study also unveiled that quality concept is the most important strategic measure to ensure good quality of concrete elements and that there little or no enforcement from both*

Government and its Agencies on quality control of concrete elements in buildings industry in the study area. The study recommended that Government agencies, professionals and other key stakeholders need to implement regular inspections of stages of concrete works at building sites; to continuously survey and monitor concrete elements as to detect impending failure and also ensure that every quality control strategy should be covered in the aspect of concrete, provide effective guidance on the project to achieve quality concrete works.

Keywords: evaluating, quality control, management, concrete, element, building, measure.

INTRODUCTION

The contribution of buildings to Nigeria's development has not yet yielded the desired potentials because of building failure/collapse issues and more commonly their poor functional performance (Windapo and Rotimi 2012). Okechukwu, Okafor and Osegbo (2021) posits that there is a need for continuous survey and monitoring of concrete structures during service life to detect an impending failure and examine the performance of the buildings to save lives and properties, as the investigation will show the performance of the structural elements and suggest measures for their maintenance in order to sustain structural stability Failure in buildings can occur in two different ways, namely, cosmetics and structural defects. The former occurs when something has been added to or subtracted from the building, thus affecting the building fabrics and its stability. The later affects both the physical outlook and structural stability of the building (Ayininuola and Olalusi, 2004). All buildings ought to be of good quality; however this is not the case in developing countries as evidenced by the existence of some buildings which are of very sub-standard quality. Buildings are structures which provide shelter for man, his properties, and programs and as such, they must be properly planned, designed and constructed to enhance desired satisfaction for man and his environment (Okolie 2011). Obiora, Ezeokoli, Belonwu and Okeke (2022) as well asserted that concrete structures are designed and constructed so that they maintain their required serviceability, durability, and performance for a sufficiently long period, which is expected to be a design life of 50 years.

Moreover, Deming (2000) sees quality as a multidimensional concept that cannot be defined using a single feature. Okoye et al (2023) later suggested that the most effective way to define quality is through the level of customer satisfaction. Quality has remained in the forefront amongst factors used to determine the degree of success or failure of a project. Quality therefore is defined as pre-determined standards (basis) sets to ensure a minimum level of requirement for achievable outcome. A quality concrete is that which is capable of meeting the requirements of the job in terms of strength, durability and appearance. Quality concrete work produces structures that are lasting, pleasing in appearance, and require comparatively little maintenance (Millers *et al*, 2004). Cheng (2004) summarized quality as meeting the client's needs, fitness for use and conformity to

requirement. Anosike (2011) supported the assertions by defining quality as the ability of a product or system to satisfy all the requirements it was designed to meet. Amana (2010) went further to opine that a good example of how quality and strength play out in our building is in the wide variability of the quality of concrete used in our construction sites.

Essentially, concrete is recently the most common building material in Nigeria construction industry [8] (Olanitori, Alabi and Afolayan 2012). Concrete is also the basis for infrastructural civilization and its physical development [1] (Windapo and Rotimi 2012). [9] Nwofor and Eme (2016) states that concrete is one of the most important construction material, comparatively economical, easy to produce, offering continuity and solidity and fast to bind with other materials. Concrete is an artificial stone that is cast in place in a plastic condition, in other words concrete could be a composite material, which is made up of filler and a binder [10] (Falade 2009). Concrete is used in the essential parts of the building like foundations, slabs, columns, beams, lintels, roof, staircases, walls, arches. Concrete quality is reported as one of the causes of building collapse [11] (Rubaratuka, 2013).

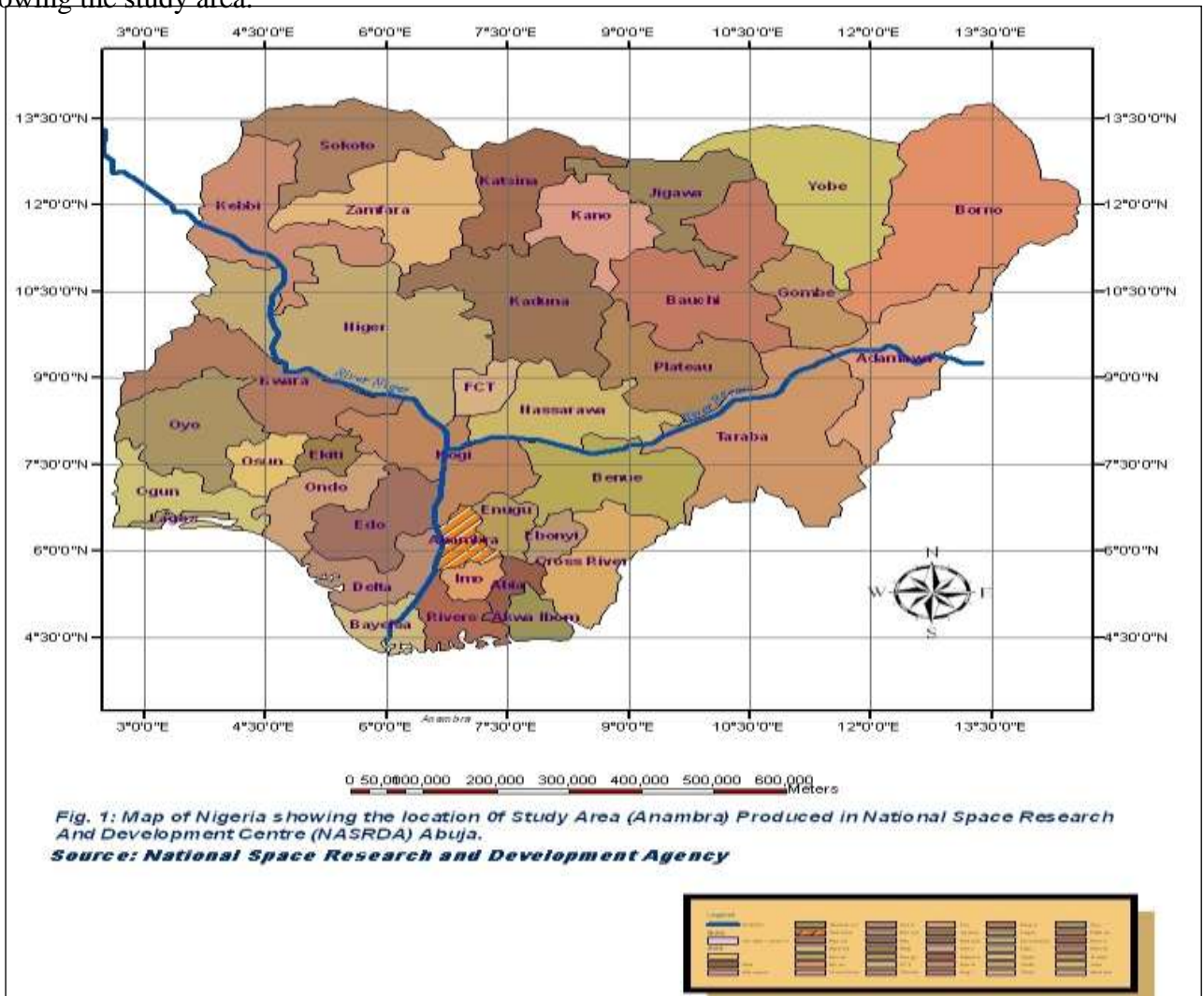
However, [12] (Okechukwu, Okafor and Osegbo 2021) asserted that the compressive strength tests results of the cored concrete samples from a collapsed building ranged from 1.9N/mm² to 3.5N/mm². The results showed that the concrete compressive strength values are far less than the required standard value of 25N/mm² for the structural elements of such number of floors. Thus, it was revealed that the concrete mix quality was less than the expected standard and could be one of the major errors in construction procedure that compromised the integrity of the building. The concrete used was also of low grade and unfit for a structural frame of that number of floors. A strategy is defined as a combination of long term goals, specific targets, technical measures, policy instruments, and processes which are continuously aligned with the societal context [13] (Ezeokoli, 2019).

Therefore the aim of the study is to evaluate the quality control management measures for effective quality concrete works in Anambra State, Nigeria, with a view to enhance structural stability in the study area.

AREA OF THE STUDY

Anambra State is a State in South Eastern Nigeria, made up of 21 local government areas and dominated with high rise buildings made of concrete works. It is the eight most populated states in the Federal Republic of Nigeria and the second most densely populated state in Nigeria after Lagos State and recently in the high list of structural failures and building collapses. The State lies approximately between latitudes 5⁰50' and 6⁰ 45' North of the Equator. It is bounded on both Western and Eastern sides by latitudes 6⁰35' and 7⁰30' east respectively. According to the 2006 National Population Census (NPC), the state had a total population of 4,055, 048 with an average density of 837.10/km² Umenweke, (2000). The State is bounded by Delta and Edo States to the west, Imo and Rivers States to the South, Enugu State to the East and Kogi State to the North.

Anambra State derived its name from Anambra River that transverses the state. Anambra State has become characterized by incessant building collapse. Fig 1.1 represents the map of Nigeria showing the study area.



LITERATURE REVIEW

Procedures for Effective Quality Control (QC) Management.

The control of concrete quality entails attention to not only the materials but also effective quality control strategies. A careful consideration of the quality control standards of concrete works in construction projects is expedient if viable solutions to the problem of poor quality on concrete production are to be proffered. According to [14] Zairi (1997), quality as applied to construction

process generally means that a building meets the client's needs, is fit for purpose and in many cases provides value for money.

For effective Quality Control on any construction project, the following procedures must be strictly adhered to [15] (Ezeokonkwo, 2014). The procedures are as followed:

Quality Concepts (QC): This is procedure through which it is verified that the approved standards and specifications for concrete works are fulfilled to meet the requirement of the client by making sure the value for money spent on the project is met/or realised. According to [16](NIOB, 2013) Quality tends to mean producing a product or service that is of high standard when applied to the construction process, it is generally understood that quality means that product, service or building meets the customer's needs, is fit for purpose it is meant for.

When quality concepts are put in place, they often lead to greater efficiencies as the systems are designed to standardized processes, to minimize waste, reworking and thereby increase profit. In general, the implementation of quality concepts in concrete works, will lead to a focus on the doing the right thing at first time so as to eliminate waste of material, time, cost and/or corrections of errors.

Quality Management System (QMS): The (QMS) is a system used to ensure that the quality standards which lead to assurance on a project are met through quality management system. It is a management discipline concerned with preventing problems from occurring by creating the attitudes and controls that make prevention possible [17] (Battikha, 2000). Most quality management systems in use are derivatives of relevant ISO standard which construction companies can use as variety of methods for quality assurance. One of the ways in which they show that they are producing quality is by having a clear scope defined and detailed specifications to use. There should be standard documents showing ways of achieving quality outcomes in construction.

Quality Control in Construction: Quality control in construction is that aspect of the quality management system (QMS) that assist in test to make sure that a product or service meets the required standards. Quality control requires decisions to be made about the type of checking required for different aspects of the project whether this is inspecting, testing, measuring or analysis.

The primary objectives of quality control assignments are to:

- Avoid duplication of effort
- Assure that every quality aspect is covered
- Provide a clear delineation of responsibilities
- Provide effective guidance on the project to achieve quality work.
- Provide documentation of materials, installations and tests.

The quality control is a process which is an on-going one and extends to all parts of concrete works. There are three stages of construction under processes.

Quality Management Standard: [15] Ezeokonkwo (2014) defines a standard as documents used to describe acceptable conditions or behaviour's and provides a baseline for assuming that conditions or behaviours meet the acceptable criteria. The quality system standard is used to judge the adequacy of a quality system [18] (Cheng, 2004).

ISO (International Organization for Standardization) is the world's largest developer and publisher of International Standards. ISO is a non-governmental organization that forms a bridge between the public and private sectors. On the one hand, many of its member institutes are part of the governmental structure of their countries, or are mandated by their government. On the other hand, other members have their roots uniquely in the private sector, having been set up by national partnerships of industry associations.

Moreover, in construction industry especially where concrete is a major building material production standards will ensure the quality of components materials that are used in concrete works, standards requirement are to envisage from the onset will make sure the control of quality in the concrete works. There are international standards that are always available for consultation in concrete production process. They are; ASTM (American Society for Testing Materials), BS (British Standards) NIS and SON (Nigeria Industrial Standards and Standard Organization of Nigeria)

Quality Management Plan in Construction: The construction Agency Co-ordination Committee [19] CACC (2012) defined quality management plan as a project or contract specific plan developed by the service provider by applying an appropriate quality management system to plan and carry out the work involved to ensure conformity with the requirements for the project and to manage the quality risk. The quality management plan is therefore a tool to guide the proper execution of a construction project in terms of quality.

According to CORBON (Project Quality Management Plan), the quality plan should include the following;

a. Quality policy statement: (vision and mission). This outlines the intentions and aims of the company with respect to achieving quality work. Usually, these statements will refer to meeting or exceeding requirements of the client and will be a broad statement of intent.

b. Project quality structure or quality management system: This sets out how quality achievement is incorporated into the project and who is responsible for achieving quality at project level. The system for dealing with quality documentation should be set up at the planning stage and should be clearly delineated in the plan so that each person on the project knows where the information is and how to access it.

c. Quality objectives for the project: These objectives will be read alongside the contract documents and scope of work information. The plan will refer to the drawings, specifications and will outline the specific objectives that need to be met in respect of different quality aspects of the project.

d. quality control and rectification of problems and prevention of future problems: This part of the plan will set out the ways in which problems will be rectified, including a system for dealing with wastage should it arise and collective action to be taken in order to deal with any problem. A section containing an updateable list for prevention of future problems should be used as part of the continuous quality management process.

6. Professionals and Regulatory Bodies: Quality recognizes professional bodies and regulatory agencies as a team to achieve a common goal. Their quality control roles will entail setting standards, checking and monitoring of production which will lead to a product of a consistently satisfactory standard. [20] (Taylor, 2002) opined that documentary evidence of all quality control procedures is required on any project so as to guarantee quality assurance. It is the duty of this board to review concepts during the design stage for both quality assurance and economy, and continue to follow the project through the construction phase, making recommendations regarding the cost-quality trade-off in the event of charged physical conditions, proposed design changes or other newly discovered factors which impact upon the overall quality-cost trade-off. So to achieve quality on a construction activity such as concrete work, stakeholders must team up to achieve the set goal.

The Client: A successful project begins with the owner/client who is responsible for providing complete and realistic requirements for the project at the briefing stage. A well thought out brief reduces the amount of variations - omissions or additions, which might come up at a time when the quality of the final product may be affected. Another important obligation of the client at the project execution stage is the provision of finance. It is the responsibility of the client to source for money if he wants a competent construction firm to provide the best quality management services, within a reasonable period. The client may not be knowledgeable of the roles of each professional as contained in the various Decrees and Acts that established them, the onus is on him to get full enlightenment from different reliable sources and not depend on the information provided him on first contact with any of the industry professional. At the same time, it is ethical wrong and a professional misconduct for any professional to misinform the client on role play of any of the industry professional.

Architects: Building Plan: The quality of the concrete designed for site production is determined by the provisions made by the architect in the building plans. The building plans in this context shall mean design drawings with specifications representing intent to develop a building as prepared by registered architects [16]. It is actually from the architect's drawings that the structural engineer prepares the actual quality requirements of the concrete elements. The professional is responsible for:

- i. Spatial rationing/allocation, Specification prescriptions and general designs for forms and functions.
- ii. Producing both preliminary and final designs. They analyze the clients requirements and where necessary co-ordinate the specialist consultants

- iii. Preparing production drawings and details including preparation of specifications and other relevant contract documents
- iv. Work inspection in accordance with their inputs and monitoring quality during production.

Engineers: Engineers perform a number of quality control functions in order to achieve quality control. A number of engineering professions are grouped together here based on their design inputs to the building services required in the building, they are the Civil (structural), Electrical (electrical services machines and equipment) and mechanical (plumbing and sanitary appliances) designers. Section 2.32 of the NBC provides that the structural engineer handles the design of all the structural engineering works after detailed calculations and comes out with the project concrete structures in drawings and specifications including accompanying mix ratio. The electrical and mechanical engineers handle electrical, mechanical systems particularly those services that will be embedded in the concrete element before production. Other services which cut across the practice of each of these consultants are:

- i. Feasibility and viability studies, ii. Variation and fluctuation, iii. Project management
- v. Resident supervision for builders and or engineers depending on the type and need of the project.

In terms of workmanship and supervision, Section 13.12.2 of the NBC specified that all building works shall be generally supervised by a registered architect and engineer in line with their inputs. When these services are rendered the way they are stipulated in the various scope of services as prepared by various regulatory councils and professional bodies as approved by the Federal Government and the NBC, quality concrete production will certainly be assured and failure minimized.

Professional Builder: The work of a Professional Builder includes Building Production Management/ Construction Methodology design, Site activity Process monitoring and control. The first major work of a builder is to assess the build-ability of a project and prepare a comprehensive build-ability report. The professional builder has the responsibility of producing construction planning report after reviewing the contractors method statement, construction program, early warning signals, information requirement schedules, project health & safety plan (Section 2.32 (c) NBC, 2006). It further stated that it is the responsibility of the professional builder to provide the Project Quality Management Plan (QMP) through which he monitors all works including concrete production site activities ensuring complete compliance with relevant statutory instruments in relation to Development Control, Building Regulations, Construction and Fire Regulations requirements. Section 13.12.4 of the NBC provides that, the management of the execution of the building works including the supervision of artisans and tradesmen shall be carried out by a registered builder. In nutshell, the professional builder assesses the level of workmanship, skills of craftsmen and provides solution to technical problems and responsible for the daily production

activities on any project site in Nigeria. Other responsibilities of the professional builder are documented in Section 15, pp. 459-481 of the NBC.

Quantity Surveyor: The quantity surveyor prepares budget estimate, determines cost limit. Section 2.32 of the NBC provides that the preparation of priced Bill of Quantities (BOQ) is the responsibility of the Quantity Surveyor. The quantity surveyor also monitors the designers design in order to bring cost within established cost limit. He advises on the suitable type of contract and or tendering methods to be used and prepares documents necessary for tender action. In conjunction with other consultants, he assists in examining and reporting on submitted tenders and making recommendations to the client or tender board for the selection of contractors using concrete works production as a major element of assessment. At the point of measurement of works for payment only approved finished works are recommended for payment as a contribution to quality control.

Workmanship: There is practically no building or structure of some kind that can be carried out without a human activity. Therefore unless an adequate supply of appropriately trained workers can be ensured, the industry will consistently fail to satisfy the demands of the market for an adaptive, innovative and capable service. The industry has a responsibility to its customers to be an enlightened, progressive employer; the needs of the workforce are inextricably linked with the requirements of its professionals and heed must be paid to each. History has shown that the efforts of an ill-prepared and disenchanted workforce have failed to produce good service and as a result the industry is burdened with a poor image. The industry must therefore reconcile the need for a supply of manpower capable of high productivity in the carrying out of simplified sequential operations and at the same time retain a substantial number of craftsmen capable of highly skilled work.

The industry will have to respond by providing manpower of a quality and capacity to undertake this concrete works successfully, and there will be increasing demand for the ‘knowledge worker’. The knowledge worker is the worker that has both specific knowledge e.g. working of concrete and general knowledge of whole subject area e.g. construction technology, work study and methodology.

Companies Own Quality Control Document (Policies and Plans): Construction companies or organization may have a series of documents that deal with different aspects of quality of the concrete work. However, the ISO 9001:2000 provides the basis for a generic quality document that outlines a responsibility for quality, quality policy, quality planning, quality organizational structure, guidelines on quality and the review processes. Individual quality plans for specific construction projects will be derived from this generic one; additions will be made depending on the circumstances. Since each construction project is an entirely new experience, quality plans are developed for each one and are used throughout the project to ensure quality. The purpose of such

plans is to put in place a quality control system for the project which as mentioned earlier set out inspection, testing, control and verification requirements for all aspects of the project.

Various Acts /Decrees for Construction Professionals: Government enacted various Decrees or Acts to regulate the practice of various professionals for the reason of accountability and quality control and assurance in the construction industry. The responsibilities of each professional body is clearly stated in the decrees and Acts that established them and these responsibilities are also defined in the National Building Code to remove role ambiguities some of which are highlighted in this study. See Section 15, pp.459-481 of the NBC. The construction industry professionals' Regulatory Decrees and Acts that are in existence in Nigeria are:

- a) Cap 40 (formerly Decree 45 of 1989) established the Council of Registered Builders of Nigeria (CORBON)
- b) Decree 22 of 1986 established the Quantity Surveyors Registration Council of Nigeria (QSRCN).
- c) Cap 20 Law of Federal Republic of Nigeria (formerly Decree 10 of 1969) establishing Architects Registration Council of Nigeria (ARCON)
- d) Decree 55 of 1970 amended by Decree 27 of 1992 establishing Council for Regulation of Engineering (COREN) practice
- e) Cap 111 Law of Federal Republic of Nigeria (formerly Decree 24 of 1975) established the Estate Surveyors & Valuers Registration Board of Nigeria (ESVRBN).
- f) Decree 3 of 1988 established Town Planning Registration Council of Nigeria (TOPREC).
- g) Decree 44 of 1989 established Surveyors Registration Council of Nigeria (SRCN).

The National Building code (NBC): The aim of establishing the National Building Code in Nigeria in 2006 was to set minimum standards on building pre-design, designs, construction and post-construction stages with a view to ensuring quality, safety and proficiency in the building industry in line with international best practice. The provisions of the code applies to and control of all matters concerning the design and specification, costing, construction, alteration, addition to, moving, demolition, location, repair and use of any building or structure for existing or proposed building works within the Federal Republic of Nigeria. According to the code, before the code came into force, the following existing conditions were prevalent; incessant collapse of buildings, fire infernos, built environment abuses and other disasters, dearth of referenced design standards for professionals, use of non-professionals, use of untested materials and products and lack of adequate regulations and sanctions against offenders. It is expected that the code will address these problems highlighted if the government will fully implement and enforce its provisions. For example, sections (3) and (15) of the code recognized the various inputs of the professionals in the industry and made it mandatory for them to certify the successful completion of work at every stage of construction using the compliance form provided. This implies that a non-certified stage of work renders the project unsafe for use and at the same time quality may be said to have been compromised.

Actions to be taken at each stage: At design and construction stages, errors found in the drawings are handled as follows. What to do with error and who to make the correction at both design and tendering stages. While during construction stage, materials found to be unacceptable are rejected, and removed from the site to avoid contamination of other materials.

METHODOLOGY

Considering the nature of the research, survey research method was adopted for this study. Data was obtained through both primary and secondary sources. The population for the study comprises of registered professionals in Anambra State and was surveyed through a structured questionnaire survey approach. Data generated were analyzed using Tables, Percentage, Ranking and Mean Score. Respondents were asked to rate the frequency of strategic measures using a five-point Likert scale.

RESULTS AND DISCUSSIONS

Table 1 shows the population distribution of the respondents and the percentage response to the questionnaires. A total of one hundred and fifty eight (158) questionnaires were distributed to registered professionals in Anambra State and one hundred and twenty nine (129) were returned.

Table 1: Population Distribution of Questionnaire and Percentage Response

Categories	Number of questionnaires distributed	Number of questionnaires returned	Percentage (%)
Registered Building Professionals	158	129	81.6
Total	158	129	81.6%

Source: Field Survey (2021).

Table 2 shows that 45% of the respondents are registered members of CORBON, 25% are registered members of ARCON, 46% are registered members COREN and 13% are registered members of QSRCON. The results show that an acceptable number of our respondents belong to a construction professional organization, and that is an advantage to our study

Table 2: Professional Registration Status of Respondents

Professional Registration	Frequency	Percentage (%)
CORBON	45	34.9
ARCON	25	19.4
COREN	46	35.7
QSRCON	13	10.0
Total	129	100.0

Source: field survey (2021)

Quality Control (QC) Management Measures.

Table 3 shows the response of the professionals on the quality control management strategies to improve the quality of concrete works in buildings in Anambra state, Nigeria.

Table 3: Quality Control (QC) Management Measures

Measures	SA(%)	A (%)	U (%)	D (%)	SD (%)	$\bar{X} \pm Std$	Rank
Quality Concept	64.3	31.8	3.9	0	0	4.60±0.565	1
Quality Management System	60.5	31.0	8.5	0	0	4.52±0.651	2
Quality Control in Construction	68.2	15.5	11.6	4.7	0	4.47±0.876	3
Action to be taken at each stage	45.0	42.6	7.8	4.7	0	4.28±0.800	8
Various Acts /Decrees for Construction Professionals.	36.4	51.2	7.8	4.7	0	4.19± 0.771	10
Quality Management Standard	51.9	31.8	11.6	4.7	0	4.31±0.855	6
Quality Plan	41.1	47.3	11.6		0	4.29±0.666	7
Professional Regulatory Bodies	45.0	47.3	7.8		0	4.37±0.626	5
Companies Own Quality Control Document	40.3	43.4	16.3		0	4.24±0.716	9
The National Building Code.	64.3	15.5	15.5	4.7	0	4.40±0.914	4
Cluster Mean & Std. deviation	51.7	35.7	10.2	2.3	0	4.367±0.74	

Source: field survey (2021)

The result in table 3 revealed that all the factors have a mean above the Likert mean in use (3.0), thus we could say that these factors are all procedures required to ensure structural stability in existing buildings. Quality concept was ranked 1st with a mean of 4.60, Quality Management System ranked 2nd with a mean of 4.47, Quality Control in Construction was ranked 3rd with a mean of 4.47, The National Building Code ranked 4th with a mean of 4.40, Professional Regulatory Bodies ranked 5th with a mean of 4.37, Quality Management Standard was ranked 6th with a mean of 4.37, Quality Plan ranked 7th with a mean of 4.29, ranked action to be taken at each stage 8th with a mean of 4.28, Companies Own Quality Control Document ranked 9th with

a mean of 4.24 and finally Various Acts /Decrees for Construction Professionals ranked 10th with a mean of 4.19.

Importance of the Primary Objectives of Quality Control.

Table 4 shows the responses of the professionals on the importance of the primary objectives of quality control, alongside the mean, standard deviation and the rank of each response.

Table 4: Importance of the Primary Objectives of Quality Control

Primary Objectives of Quality Control	VI	I	U	NI	NVI	$\bar{X} \pm Std$	Rank
Avoid duplication of effort	0	36	77	10	6	3.11±0.731	4
Assure that every quality aspect is covered	0	93	30	6	0	3.67±0.561	1
Provide a clear delineation of responsibility	0	41	62	21	5	3.08±0.797	5
Provide effective guidance on the project to achieve quality work	0	72	51	6	0	3.47±0.729	2
Provide documentation of materials, installations and tests	0	72	41	11	5	3.41±0.817	3
Cluster mean	0%	48.7%	40.5%	8.4%	2.5%	3.348±0.727	

Source: Field Survey (2021)

The result in table 4 shows the importance of the primary objectives of quality control in the study area with a cluster mean of (3.348 > 3.00). The cluster mean value of 3.348 that is greater than the likert mean of 3.0 is an indication of strong support that employing all the primary objectives of quality control in concrete elements in existing buildings is very important to ensure structural stability in the study area. The order of importance for the primary objectives is as follow; assure that every quality aspect is covered, provide effective guidance on the project to achieve quality work, provide documentation of materials, installations and tests, avoid duplication of effort and lastly provide a clear delineation of responsibility.

Importance of the Contents of a Typical Quality Plan.

The table 5 shows the respondents' (professionals) views on the importance of the contents of a typical quality plan.

Table 5: Importance of the contents of a typical quality plan

A typical quality plan VI I U NI NVI $\bar{X} \pm Std$ Rank contains;	VI	I	U	NI	NVI	$\bar{X} \pm Std$	Rank
A quality policy statement (vision and mission)	0	72	51	6	0	3.51±0.588	4
Quality objectives for the projects	0	82	41	6	0	3.59±0.581	1
Project quality management system	0	81	42	0	6	3.53±0.729	3
Quality control and rectification	0	97	21	0	6	3.58±0.872	2
Cluster mean	0%	65.0%	30.3%	2.3%	2.3%	3.55±0.693	

Source: Field Survey (2021)

From the descriptive result in table 5, quality objectives for the projects was ranked first with a mean of 3.59, this is followed quality control and rectification which ranked 2nd with a mean of 3.58, while project quality management system and a quality policy statement (vision and mission) ranked both 3rd and 4th respectively. The cluster mean value of 3.55 that is greater than the likert mean of 3.0 is an indication of strong support to the fact that these factors are important content of a typical quality plan.

FINDINGS

The research showed that majority of the building sites within the study area are managed by non-professionals who are ignorant of the quality standards/principles and have no regard for Building code. More professionals are needed in the study area to help in curbing the excesses of quacks and there is need for training the unskilled labours. Professionals who are aware of these principles do not put into practice the best practices for production of quality concrete. Reasons range from cutting corners to making of maximum profit. In line with the National Building Code in Nigeria in 2006, the aim of establishing the code was to set minimum standards on building pre-design, designs, construction and post-construction stages with a view to ensuring quality, safety and proficiency in the building industry in line with international best practice.

There is little or no authority supervising the quality of concrete being produced in different building sites within the study area as there is low compliance from the construction stakeholders. The study revealed that there no enforcement from both Government and its Agencies on quality control of concrete elements in buildings industry in the study area. Government and regulatory bodies have little or no contribution in improving the quality of concrete being produced in the state.

Quality concept is still a new philosophy within the study area but is the most important strategic measure to ensure quality concrete in the study area. Implementation of quality management principles in concrete production is still very poor in the study area as they find it hard to comply with the regulatory authority despite its significant importance. Clients also contribute in poor implementation of quality control as they might see some of the important aspects of QC principles as waste of time and money. This result affirmed the result of NIOB/CORBON (2008) and Ezeokonkwo (2002) that quality systems are designed to standardize processes, minimize waste and obviate reworking or making good any deficient work at extra cost

Enforcement and better knowledge of the strategic measures have great impact on the structural stability of the buildings in the study area. Strategic measures required to ensure structural stability in existing buildings are Quality System, Quality Control in Construction, Quality Management System, Quality Management Standard, Quality Plan, Professional Regulatory Bodies, Companies Own Quality Control Document, Various Acts /Decrees for Construction Professionals, The National Building Code, Action to be taken at each stage are all Quality System is a major technical measure required for ensuring quality concrete elements in existing buildings Majority of the building sites within the study area are managed by non-professionals (quacks) who are ignorant of the quality standards/principles and have no regard for Building code (See Table 3).

Quality control is still a new philosophy within the study area. Implementation of quality management principles in concrete production is still very poor in the study area as they find it hard to comply. The primary objective of quality control in concrete elements in existing buildings is to ensure structural stability of buildings in the study area. A typical quality plan is very important in quality control of concrete elements in existing buildings. The primary objective of quality control in concrete elements in buildings is very important to ensure structural stability in the study area. The order of importance for the primary objectives is as follow; assure that every quality aspect is covered, provide effective guidance on the project to achieve quality work, provide documentation of materials, installations and tests, avoid duplication of effort and lastly provide a clear delineation of responsibility. (See Tables 4).

There is need for quality objectives for the strategic measures as well as a good project quality management system and a quality policy statement (vision and mission) as these factors are important content of a typical quality plan that will ensure that the that a quality concrete works are achieved in the study area (See table 5).

CONCLUSION

From the findings of the study it can be concluded that quality concept is the most important measure to improve the quality of concrete elements. However, there is strong need for quality management system and quality control in construction projects should be given great priority in

construction of building projects in the study area to ensure good quality of the building projects. Action to be taken at each stage implies that the building projects be mandatorily be done orderly. Professional Regulatory Bodies significantly need to operate only in areas where they are trained and licensed to practice. Quality management standards, quality plan, companies own quality control document and various acts /decrees for construction professionals should be set, followed orderly and not compromised.

Moreover, the primary objectives of quality control must be made to clearly assure that every quality aspect is covered, provide effective guidance on the project to achieve quality work, provide documentation of materials, installations and tests and provide a clear delineation of responsibility.

Essentially, a typical quality plan is needful in concrete production and should contain quality objectives for the projects, quality control and rectification, project quality management system and a quality policy statement (vision and mission).

Quality control management at the construction stage will require that concrete materials be checked, tested and inspected, and that the project as a whole should meet the needs of the client.

RECOMMENDATIONS

1. Government at all levels including private sector operators should urgently enforce the implementation of quality in system, controlling, management, standards and planning of all building works to ensure collapse free buildings.
2. Professional and regulatory bodies should acquaint themselves with the knowledge and application of all relevant standards, rules and regulations as enshrined in local and international quality control regulatory authorities and affiliate agencies; some of the regulatory authorities include; Nigerian National Building Code, SON, NIS-ISO Quality among others.
3. Government agencies, professionals and other key stakeholders that determine the success of building projects need to implement regular inspections of stages of works at building sites in accordance with their inputs as specified by the National Building Code.
4. It is imperative to continuously survey and monitor concrete elements as to detect impending failure and monitor the performance of the concrete works in order to save lives and properties, as the investigation will show the performance of the structural elements and suggest measures for their maintenance in order to sustain structural stability.
5. Professionals in the industry should make it mandatory for them to certify the successful completion of concrete works at every stage of construction.
6. Government agencies, professionals and other key stakeholders that determine the success of concrete production need to implement regular inspections and testing of concrete elements during and after constructions.

7. Ensure that every quality control strategy should be covered in the aspect of concrete, provide effective guidance on the project to achieve quality concrete works, provide documentation of materials, installations and tests, avoid duplication of effort and lastly provide a clear delineation of responsibility.

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