APPRAISAL OF THE CONDUCT OF QUALITY CONTROL TEST OF BUILDING MATERIALS BY CONSTRUCTION INDUSTRIES IN LAGOS STATE, NIGERIA.

BY

MUHAMMAD HAUWA OYINOZA

2016/1/63759TI

DEPARTMENT OF INDUSTRIAL AND TECHNOLOGY EDUCATION

SCHOOLOF SCIENCE AND TECHNOLOGY EDUCATION

FEDERAL UNIVERSITY OF TECHNOLOGY MINNA, NIGER STATE

APRIL, 2023

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A PROJECT SUBMITTED TO THE DEPARTMENT OF INDUSTRIAL AND TECHNOLOGY, SCHOOL OF SCIENCE AND TECHNOLOGY, FEDERAL UNIVERSITY OF TECHNOLOGY MINNA

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APRIL, 2023

CEFTIFICATION

I, Muhammad Hauwa Oyinoza, with the matriculation number 2016/1/63759TI an undergraduate student of the Department of industrial and technology education, Federal university of technology Minna certify that the research project is original and has not been submitted in any form for the award of degree, diploma, or NCE in any other institution.

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Muhammad Hauwa Oyinoza Date

2016/1/63759TI

APPROVAL PAGE

This project has been read and approved as meeting the requirements for the award of Bachelor of technology (B.Tech) in Industrial And Technology Education, School of Science And Technology Education, Federal University of Technology, Minna.

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DEDICATION

This study is dedicate to Almighty Allah for making it a success, to my parents the person of Mallam Muhammad Zubair Ohueyi and Mrs. Abdulmalik wasilah and to my family and friends.

ACKNOWLEDGEMENT

I thank God Almighty, the originator, the mighty for his mercies and grace that kept me all through my undergraduate program. My sincere appreciation goes to my supervisor Dr. A.B. kagara for all his sincere efforts, guidance, knowledge he impact in me and support he gives me, and for his resourcefulness towards the realization of this research work. I also want to acknowledge Project Coordinator, Dr. A.M Hassan, the Head of the Department, Industrial and Technology Education, Dr. T.M Saba, the Exam Officer, Dr. D. Ibrahim, and also to my level adviser Dr. A. M. Abdulkadir, to my father in the department Dr. G. A Usman and also to all others lecturers in the department of Industrial and Technology Education.

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ABSTRACT

This study was designed to assess quality control test conducted by construction industries on building materials in Lagos State. Four research questions and four hypotheses guided the study. The study adopted survey research design. The target of this population consists of 100 subjects, comprising of 20 consultants and 80 site engineers in construction industries in Lagos State. A 42 items questionnaire was used to collect data from the respondents. The data collected was analyzed using mean, standard deviation, and t-test at 0.05 level of significance. The findings of the study revealed that specific gravity test, water absorption test, moisture content determination test, compressive strength and others are test conducted on building materials by construction industries, findings on the extent at which the QC test are been carried out on the materials was 75%, findings on challenges encounters greedy contractor (corruption), Inadequate regulatory framework, lack of sanctions for offenders, Inadequate budgetary allocation for quality control test, lack of proper usage of quality contest equipment, complexity of designs, last-minute changes, subcontractor mishandling, findings on strategies for improving QC test on building material can be achieved by enforcement of quality control clauses by authorized agencies, designers, contractors and approving agencies should be reprimanded for defects and violation of building regulations, withdrawal of licenses of professionals for any defects in construction, provision of adequate budgetary allocation, carrying out laboratory test on materials, general awareness, training and change in attitude of workers, continually seeking better ways of doing things. Based on the findings it was recommended that all team members comprising of site engineers, laboratory technicians and consultants should collaborate with each other in order to ensure all necessary building materials tests are conducted before putting to use in order to improve the life of building structures.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background of the Study

Ibrahim and Kasim (2017) affirmed that construction is the bedrock of development and no country can think, dream and experience development without an efficient and effective construction industries. Therefore, without construction industry there will be no construction activities that will be carried out. Kaiser *et al.* (2015) asserted that construction projects and their success are highly dependent on contractors. Hence, contractors' role in the construction industry cannot be overemphasized; their competence and capability is a function of performance and output in the construction industry (Makarfi, 2017) .That is, construction cannot take placed without the present of contractors.

Construction contractors are entrepreneurs involved in the management of construction projects (Inuwa *et al.,* 2015). Their role in the management of modern construction projects is circumscribed within design and management decisions, direct physical production of the facility on site, project closeout/ final accounting, and rehabilitation and maintenance of existing facilities (Adiansyah *et al.*, 2015).

Construction Contracting is a high risk business that entails a complex interplay of client, consultants, contractors, tools, equipment's and materials (Behera *et al.,* 2015). Consequently, it is a terrain that calls for high specialization (Irl *et al.,* 2015). Therefore, it is practically impossible to diligently run a construction firm without the requisite project management knowledge (Yu, 2018). Hence, contractors require project management techniques to successfully accomplish their construction project tasks (Kabwe, 2022). Construction activities in Nigeria represent 70% of the capital base of the national economy and generate about 65% of

her employment opportunities; this is an indication of the significance of the industry within the economy (Jin & Cho, 2015). Luyckx *et al.* (2021) stressed that the growth of a nation and its development status is generally determined by the quality of its infrastructure and construction projects.

However, despite its significant position within the national economy, its performance, in terms of quality, within the economy has been very poor (Farhana *et al.,* 2015). Baulant (2015) stressed that quality has become an important means of competition in the world market and a strategic weapon in the fight for market shares, thereby improving profitability. Alajoutsijärvi *et al.* (2018) observed that aggressive competition, both at the regional and international levels, has imposed higher standard levels in almost all business activities and sectors. Construction industry through ISO 9000 and ISO 14000 are also actively engaged in achieving international standard level.

The construction industry contributes 1% employment opportunities to Nigerians (Stanitsas *et al.,* 2021). According to the World Bank, an active industry should contribute at least 3.2% of the employment opportunities in the country (Okoye *et al.,* 2022). According to Nwinyokpugi and Okere, (2019), the construction industry in Nigeria can create more jobs if itupholds quality. Despite overall growth and good performance, Shittu, Idiake, and Akanmu, (2015) in Okoye *et al.* (2022) observed that the last decade was characterized by declining level of clients' satisfaction with the built facilities due to perceived poor quality. In addition to quality, other major problems affecting the clients' perception and overall performance of the industry include time and cost overruns (Oladinrin & Ho, 2015) in (Okoye *et al.,* 2022).

In this regard, it is imperative for leaders in the construction industry in Nigeria, including financiers of construction projects and government agencies responsible for overseeing and monitoring these projects to introduce radical change in industry practice in order to guarantee

quality (Ho, 2017). This can be done through the development of a quality evaluation methodology to analyze, gauge and rate the performance of different contractors. A house cannot be built without the knowledge of building materials and construction (Nitelik Gelirli & Arpacıoğlu, 2022). Therefore, the knowledge of building materials, constructind building has become very easy as services providers and suppliers of quality materials. Basic building materials which are also known as “star” building materials are the very important constituents of building elements most especially the structural members of a building. A structural element carry the load on it to an adjoining structural element by a system of bending moment, shear force and axial forces acting in one, two or three directions depending on the nature of the structural elements (Bandgar & Kumthekar, 2016).

Quality is a universal phenomenon that has been a matter of great concern throughout recorded history. It was always the determination of builders and makers of products to ensure that their products meet the customer's desire. (Bitew, 2019). The international organization for standardization (ISO), defines quality as the totality of characteristics of an entity that bears on its ability to satisfy stated or implied needs". Hence quality is a distinguishing characteristic of products or services, which satisfy the customer. Olanrewaju and Lee (2022) stressed that most of the construction firms in Nigeria are aware of the benefits of total quality management, though most of them are yet to fully adopt its usage.

According to Hanna (2016), it became important that construction project be more qualitative, competitive and economical to meet owner's expectation. Rees *et al.* (2019) stressed that of a total utility of 100%, the client places the following importance upon the three functional aspects as follows: Quality - 45%, Price - 35% and Time – 20%.

Quality can be defined as “the total conformance of a product to standard and specification i.e.

the product must be able to meet client's requirements and specification and must be fit for its purpose. The absence or lack of quality is easily recognized in faulty product that creates problems for users and generally fail to achieve user's satisfaction. There are varieties of definition of quality of which the following are common: the achievement of excellence, fitness for purpose and conformance with requirements. It is therefore better for one to be concerned with quality assurance, quality control and quality management, which are terms used in explaining the word quality and they are much easier to handle .Quality control (QC) is defined as "the sum of all the operational techniques and activities that are adopted to fulfill requirements for quality. They are those quality assurance actions that provide a means to control and measure the characteristics of a material, structure, components, or system to establish requirements" (Olusola *et al*, 2016). It is a system of routine technical activities, to measure and control the quality of a product, system or components as it is being developed. Traditionally, finished product is inspected for defects or a completed service is reviewed for satisfactory performance, which is part of quality control (Jochelson *et al.*, 2017). Quality control therefore called for monitoring of materials quality in order to achieve the main goal of any building project i.e. satisfying the need of the client.

Quality control is critically important to a successful construction project and should be adhered to throughout a project from conception and design to construction and installation. Inspection during construction will prevent costly repairs after the project is completed. The inspector, engineer, contractor, funding agency, permit agency, and system personnel must work together to inspect, document, and correct deficiencies. The need for "Quality Assurance procedures" cannot be over emphasized, as quality is as much of importance to client as cost and construction duration. Quality control in a building construction project is of utmost importance to; upgrade

the architectural appearance, improve safety and durability of the building (reduce faults), ensure user compatibility and fulfill the needs and aspirations of the user to occupy the building without any difficulty.

Building materials is any material which is used for a construction purpose. Many naturally occurring substances, such as clay, sand wood and rocks even twigs and leaves have been used to construction buildings. Apart from naturally occurring materials, many man-made products are in use, some more and some less Synthetic (Wei *et al.,* 2022). The manufacture of building materials is an established industry in many countries and the use of materials is typically segmented into specific specially trades, such as carpentry, plumber, roofing, masonry and insulation work (Gabriel & Muazu, 2022). Building materials account for approximately 60% of the total cost of building projects. Building materials are produced, imported and distributed in general by another sector of the industry that is not immune to the ills of the society (Oboirien & Windapo, 2020).

According to Lawson *et al.,* (2015), housing is globally acknowledged as the second most basic essential need of man after food and is a major economic asset in every nation. Housing for residential purposes is the most and major need for the average citizenry. The provision of affordable and decent housing is a major challenge faced by most developing nations and the rural-urban migration has worsen the situation resulting in the widening the gap of housing deficit in a nation (Ogunbayo *et al.,* 2018).

Consequently, Ede *et al.* (2018) concluded that concrete has a very good compressive strength but poor tensile strength. As there has not been a better alternative over the years, modern structures in developed and developing nations are mostly built in concrete. It is a composite

material of aggregates (fine and coarse) embedded in a Portland cement matrix (Ogundipe *et al.*, 2021). Concrete is a mixture of fine and coarse aggregates (sand and granite or gravel) and a controlled amount of entrained air, held together by a binding material such as Portland cement (Ede *et al.*, 2021). The study further stressed concrete is commonly used worldwide because of the availability of its strength, economy related to availability and sustainability of its constituent materials. The availability of both fine and coarse material required for the production of concrete makes it an important method of production. In Nigeria, over ninety percent (90%) of building structural components that is responsible for the strength and stability of the building is made from reinforced concrete (Nduka *et al.*, 2018). Tasevsk *et al.* (2018) maintained that compressive strength being the maximum stress sustained by concrete, is the maximum load registered on the testing machine divided by the cross sectional area of the concrete cube.

According to Coffie *et al.* (2019), sandcrete blocks can only be acceptable for construction only when they are properly manufactured with good compressive strength and high bulk density. Studies on the compressive strength of sandcrete blocks are numerous; their findings suggest that sandcrete blocks are not meeting their expected strengths (Hedidor & Bondinuba, 2017). Coffie *et al.* (2019) explored the magnitude of the effects of the continuous usage of constituents of sandcrete and concrete blocks on the environment and recommended the need for alternative materials or reduction in the use of them to safe guard the environment.

1.2 Statement of Research Problem

As a result of great urge for development, the construction industry in Nigeria is rapidly developing in handling simple to complex building construction projects; there have been observations from various sites (within Lagos State), where construction activities are going on, that selection of building materials are not properly enhanced to their maximum potentials. As a

result of this, the study of appraisal of construction industries in quality control testing of building materials in this area becomes necessary.

However, the quality of a building material to be used in construction industries depends on the decisions taken by a number of stakeholders in the construction process: owners, managers, designers, firms, contractors, engineers, construction industries and investors. The pace of actions towards the type of quality test that is applicable to each building material depends on the awareness, techniques, knowledge as well as an understanding of the consequences of individual actions. Among these is the environmentally responsible approach to the selection of building materials (Giannaki & Papadopoulos, 2016).

The selection of building materials is one of several factors that can impact the reliability of a building is the materials used in its construction in a project; an appropriate choice of material selection in a design process plays an important role during the life cycle of a building (Wong & Zhou, 2015). Understanding the environmental issues surrounding the extraction of raw materials, the manufacture of construction materials, and their effects in use, is important to ensure sustainability and maximize the potentials of these materials. Structural designers identify selection of sustainable building materials as the basis for incorporating sustainable principles in building projects (Jimoh *et al.,* 2020).

1.3 Purpose of the Study

The purpose of the study is to assess quality control test conducted by construction industries in building materials. Specifically, the objectives are:

1. Determining the types of quality control test conducted on building materials by construction industries in Lagos State.
2. Assessing to what extent are these quality control test conducted on building materials by

construction industries in Lagos State.

3. Finding out the challenges encounter in the conduct of quality control test on building materials by construction industries in Lagos State.
4. The strategies to be employed for improving the quality control test of building materials by construction industries in Lagos State?

1.4 Significance of the Study

In the fact that construction in the building industry is a dynamic process, the quality control testing on building materials will assist the various participants of building projects within the construction industry in terms of the likely effects and consequences of materials quality and methods of carrying out the test. The study will provide information and reveal various constraints to be considered and how to proffer solutions to them.

It is very important to point out the fact that a lot of challenges are involved in carrying out quality control test on building materials by construction industries for any construction project; it becomes more effective in terms of time, cost and quality. Also, material selection in the construction industry is considered right from the inception to completion of a project. According to Akintoye, (2001), Projects are not devoid of challenges of selecting appropriate materials. Hence this research was effectively carried out so as to let the professionals in the construction industry be more sensitive to the criteria of material selection for any construction projects and how best to manage them as possible in other to achieve the required structure. Thus, this study is of importance to both the owner and the end users.

The importance of quality control test of building materials to the environment at large cannot be over-emphasized. Analysis of building production, from the gathering of raw materials to their ultimate disposal, provides a better understanding of the long-term costs of materials. These

excess cost can be critically control by the principles of Life Cycle Analysis which provides important guidelines for the selection of quality building materials.

1.5 Scope and Limitation of the Study

The scope of this study is to evaluate the appraisal of the conduct of quality control test of building materials by construction industries in Lagos State, Nigeria. Therefore, the study will focus on what are the types of quality control test on building materials conducted by construction industries, To assess the extent are these quality control test conducted on building materials by construction industries, To find out the challenges encounter in the conduct of quality control test on building materials by construction industries and what are the strategies for improving the quality control test of building materials by construction industries in any building projects.

Hence, the scope of this research will be restricted to building construction projects that are carried out within Lagos State. The research study will be centered on the appraisal of construction industries on quality control testing of building material.

1.6 Research Questions

The following are the research questions as related to this study:

1. What are the types of quality control tests conducted on building materials by construction industries in Lagos State?
2. To what extent are the quality control test conducted on building materials by construction industries in Lagos State.
3. What are the challenges encounters in the conduct of quality control test on building materials by construction industries in Lagos State.
4. What are the strategies needed to improve quality control test on building materials by

construction industries in Lagos State.

1.7 Hypothesis of the Study

1. There is no significant difference between the mean responses from site engineers and consultants on quality control test of building materials conducted by construction industries in Lagos State.
2. There is no significant difference between the mean responses site engineers and consultants regarding to what extent are these quality control tests conducted on building materials from construction industries in Lagos State.
3. There is no significant difference between the mean responses from site engineers and consultants regarding the challenges encountered in the conduct of quality control test on building materials by construction industries in Lagos State.
4. There is no significant difference between the mean responses site engineers and consultants regarding the strategies they use in improving the quality control test on building materials by construction industries in Lagos State.

CHAPTER TWO

2.0 RELATED LITERATURE REVIEW

This chapter present provides an overview of the literature conducted during the research using the research questions as a guide, previous knowledge and development carried out by various researchers and their findings on research related to this study.

2.1 QUALITY

Quality is concerned with the totality of the attributes of a building which enables it to satisfy needs. According to Arowolo *et al.* (2019), any client would want to construct a facility of the highest quality and it is the goal of the design team to maximize quality while minimizing cost and time. There is a need for structural and formal systems of construction management to address the aspect of performance, workmanship and quality. Construction projects have the involvement of many participants including the owner, designer, contractor and many other professionals from construction-related industries. Each of these participants is involved in implementing quality in construction projects. These participants are both influenced by and depend on each other in addition to other players.

Rehren and Brüggler (2020) assert that it has been estimated that as many as one in four workers produce nothing at all because they spend their entire day rectifying the mistakes made by others. 6-15% of construction cost is found to be wasted due to rework of defective components detected late during construction and 5% of construction cost is wasted due to rework of defective components detected during maintenance (Kimeria *et al.,* 2019). Ashworth and Downe (2020) stressed that defects in construction projects are a persistently worrying problem despite continually improving technology and education. The construction industry has too often in the

past been discredited by bad publicity resulting from sometimes dramatic features of both the design and the construction of its products.

According to Adekeye *et al.* (2017), the major problems identified in their research are inadequate budgetary allocation for quality control, non-conformance to quality control clauses by authorized agencies, insufficient quality control laboratory and personnel. Rumane (2017) asserts that quality concepts, principles, methods and processes, along with quality systems, environmental systems and health and safety provisions are integrated to create a new quality concept known as the integrated quality management systems. In their research, Owusu-Manu *et al.* (2022) found out that a significant positive relationship exists between the extents to which companies implement process management practice on site and the performance of the project in terms of customer satisfaction and, reduction in costs of defects and rework.

Similarly, Ololade and Rametse, (2018) observed that previous researches indicated that total quality management has been in use since the 1980s in Nigeria, despite its potential benefits to the industry, there is little usage of Total Quality Management (TQM). It is evident that researches in the construction industry has proved that utilization of quality management concept has a great influence on the cost-effectiveness results of construction projects and achieving successful project performance.

(Rumane, 2017). In their findings, Oni *et al.* (2019) indicated that most of the firms are aware of the benefits of total quality management and the factors enhancing its implementation, however the level of adopting the total quality management principles are very low in Nigeria. The analysis further showed that there is no prevalence of total quality management principle among indigenous construction firms in Nigeria while there is a high correlation between the implementation of total quality management principles and organizational performances. It is

now recognized that in the construction industry, that the lowest price can cost more in the long run. There is often poor management and supervision which indicated that about 50% of faults originate in the design in office, 30% on site, 20% in the manufacture of materials and components. Building clients are becoming more conscious and are insisting on quality construction from the contractors.

Kamal *et al.* (2022), study was on Identification of the Factors Affecting Quality in Building Construction Projects in Gaza Strip of Palestine. The aim of the research was to provide clients, project managers, designers and contractors with the necessary information needed to better manage the quality of building construction projects in Gaza Strip. To accomplish the aim, questionnaires were administered to contracting companies, who were registered by contracting union in Gaza Strip and Engineering consulting offices that were also registered by the Engineering Association in Gaza Strip. Data were analyzed using descriptive statistics. Findings show that project owner, site layout, equipment, environment, site staff, design, financial issues, subcontractors, materials, labor, systems and execution are the main factors influencing quality of building construction projects in Gaza Strip. The research recommended the need for improvements in the aspect of work related to these factors in order to improve quality in Gaza Strip of Palestine.

Consequently, Ede and Aina (2015) concluded that concrete has a very good compressive strength but poor tensile strength. As there has not been a better alternative over the years, modern structures in developed and developing nations are mostly built in concrete. It is a composite material of aggregates (fine and coarse) embedded in a Portland cement matrix (Bamigboye *et al.,* 2021). Concrete is a mixture of fine and coarse aggregates (sand and granite or gravel) and a controlled amount of entrained air, held together by a binding material such as

Portland cement (Ede, Olofinnade, Bamigboye, Shittu, & Ugwu, 2017). The study further stressed concrete is commonly used worldwide because of the availability of its strength, economy related to availability and sustainability of its constituent materials. The availability of both fine and coarse material required for the production of concrete makes it an important method of production. In Nigeria, over ninety percent (90%) of building structural components that is responsible for the strength and stability of the building is made from reinforced concrete (Joshua et al., 2015). Prasanth *et al.* (2021) maintained that compressive strength being the maximum stress sustained by concrete, is the maximum load registered on the testing machine divided by the cross sectional area of the concrete cube.

2.2 Quality Control Tests 0n Building Materials Conducted By Construction Industries in Lagos

The success of any construction project, especially in terms of safety and integrity, relies heavily on material testing and site inspections (Yang *et al.,* 2016). Material testing puts resources like soil, concrete, rebar, structural steel, and masonry through a series of assessments that examine and analyze performance prior to and during construction. It doesn't matter if the project is new construction, additions to existing construction, or renovations and upgrades to older construction. Material testing and site inspections are necessary throughout the construction process to ensure a quality project upon completion.

While not all tests are necessary for every project, there are some key tests that can prove to be vital to most. The required services are determined by the type of project, the land and location being built upon, and the services available for testing.

Types of Construction Material Testing

Construction material testing can be divided into two categories: field testing, which occurs at the project site, and laboratory testing, which involves taking samples from the project site back to an off-site location for further analysis. The outcome of each is to ensure construction materials are safe and reliable, easily maintained and sustainable, do not damage the building or project site, nor endanger anyone or anything within the perimeter of the project. In both instances, repeated testing with inspections is recommended throughout the construction process. These can be done at regular intervals, at any time from beginning to project completion and will help avoid potential risks later on.

Field Testing

Field testing is done at the project site. Certified professionals carry out field testing services for various construction projects that can include roadways, bridges, utility projects, airports, and building developments. Typically, soil sampling is a method of removing sub-surface earth materials. These soil samples can be evaluated in the field or taken back to the lab for further testing. The technicians check for moisture and compaction, which will affect the building's foundation.

It seems obvious, but it is critical to have a strong foundation, without issues, before construction begins. This includes the ground to be built upon and the materials used to build the structure. Material testing ensures that the project will be successful before the foundation is laid. Without this testing, builders and engineers will not be aware of the quality of the sub-surface and materials and whether they will meet the project's requirements (Yang *et al.*, 2016).

Other types of field testing include: Soil and Aggregate Sampling and Testing, Compaction and Density, Bearing Ratio, Permeability Testing, Concrete Sampling and Testing, Air Entrainment

Testing, Slump Testing, Temperatures, Unit Weight.

On-site inspections are necessary to ensure compliance with the requirements of the project documents and building code. For example, an inspector can review rebar, structural steel, and the bolts and welding that hold these materials together. Site inspection ensures that any failures are detected and fixed properly prior to project completion.

There are many tests that can be performed prior to, during, or after construction to assist in the conformity of the project. For example, floor moisture analysis and floor flatness testing define the safety and longevity of a concrete slab foundation. Floor moisture analysis detects any wetness or moisture within the concrete slab, eliminating future flooring issues. Floor flatness testing measures how close the concrete slab is to planar, detecting any waves that move across the top.

Laboratory Testing

Lab testing is when material samples are taken back to an off-site location or lab to review and analyze. Don't confuse this with product testing, which is also done in a lab and involves reviewing, testing, and providing reports on finished products, such as doors, windows, curtainwalls, and roofing products. Pre-testing finished products and how they perform in a lab does not guarantee how well they will perform in the field, especially if the construction materials that support the finished products have not been properly tested and inspected.

Lab testing on material samples such as soil, asphalt, aggregate, concrete, and masonry taken from the field site is a reliable method to provide detailed analysis on the materials, ensuring that the materials on a job site will not cause any project-related issues. Lab tests can also be performed if the field testing results prove inconclusive or a more detailed analysis is needed.

Other examples of lab testing include: Soil Testing, Moisture Content, Specific Gravity Test, Dry

Density Test, Atterberg Limits Test, Sieve Analysis, Modified/Standard Proctor, Bearing Ratios, Chloride/Sulfide Testing, pH Testing, Permeability Testing, Asphalt Testing, Mix Evaluation, Stability, Flow, Bulk Specific Gravity, Extraction, Masonry/Concrete Testing, Flex Strength Testing, Compression Strength Testing,Unit Weight, Tensile Testing, Absorption, Efflorescence Testing, Mix Design, Structural

Masonry Testing.

Whether field testing or laboratory testing, the key takeaway is that much of the testing is not done prior to construction, but duringand at intervals throughout construction. Both types of testing and regular inspections to monitor the construction progress ensures that quality control is maintained throughout the project. Many and assorted quality control tests are conducted regularly in the quality control laboratories at various construction sites. The types and quantum of tests conducted depend on factors like the type of project, size of the project, the degree of importance laid on the quality domain, budget for the project and so on. For example, the degree of quality control (QC) adopted for the construction of an ordinary road may be somewhat different from that of a highway project. In case of the later the quality procedures are expected to be more stringent as compared to the former for obvious reasons.

Accordingly, the types and frequency of QC tests may vary to some extent in spite of the fact that they are projects of similar nature. Similarly, the QC requirements for an ordinary waste water treatment project would presumably be more relaxed as compared to the same for a nuclear power project – again for obvious reasons. There can be many more examples like these.

A project on a healthy budget will have more space for the quality domain than one on a leaner budget. There can be a host of other factors too influencing the quality matters of a project. These are some of the reasons why the degree of QC or the extent of QC tests may vary from

project to project or place to place. Delving in textbooks or other related technical literature one might end up with a large number of quality tests suggested for every occasion. Yet, only a handful of them are actually conducted in project sites and one needs to be conversant with those relevant ones rather than getting lost in a sea of information. Mentioned below are some QC tests commonly conducted in quality control laboratories at various construction industries.

2.3 To What Extent Are the Quality Control Test Conducted On Building Materials by Construction Industries in Lagos

There is some equipment that every construction industry is likely to need. Along with considerations for specification compliance and quality, size, weight, power requirements, and cost influence the optimum choices for quality for building materials (Hebisch *et al.,* 2022). Quality control tools are important tools used widely in the manufacturing field to monitor continuous process improvement and overall operations in a construction industry. In every construction industry there must be some simple and essential tools and equipment needed for quality control test work and any construction industry without any of these instruments is not a construction industry, these are plum bob, thin strong string, vernier calipers, graduated cylinder, set of gauge rings, right angle scale, calculator, screw drivers, pair of pliers, steel scale, metallic tape, sharp knife, rebound hammer [Google scholar]. In essence, if there are available instrument for conducting quality control test in the construction industries in Lagos and they readily available for conducting test o n building materials.

2.4 Challenges Encounter in the Conduct of Quality Control Test by Construction Industries in Lagos, Nigeria.

According to Self *et al.* (2020) there is often poor management and supervision and that studies in U.k. indicated that about: 50% of faults originate in the design in office, 30% on site, 20% in

the manufacture of materials and components. Taingson *et al.* (2017) observed that price is no longer the determinant factor, building clients are becoming more conscious and are insisting on quality construction from the contractors.

Agyekum *et al.* (2018) stressed that project quality is the most important yardstick for patronage by clients, it is an indication that delays in project delivery and increases in project final costs are not as important as project quality to clients. Despite the significance of quality in the construction industry, there are some factors that affect quality which Self *et al.* (2020) classified as "M" factors affecting quality:

a. Market: Compatibility between standards provided by different firms.

b. Men: This is perhaps the single most important factor in achieving quality, having the right people to do the job which is required.

c. Money: Quality costs money. If an inadequate amount of money is included in a budget, then the required quality will be difficult to obtain.

d. Management: It is the function of management to set a company's quality policy, and this will in turn form the basis of the company's reputation in this respect.

2.5 Strategies for Improving Quality Control Test On Building Materials by Construction Industries in Lagos state.

We have listed five tips that can help improve a construction firm’s focus on quality control while carrying out test.

1. Establish Standards
2. Control the Workflow
3. Implement Independent Audits
4. Embrace Construction Technology

5. Seek or Create Skilled Labor

Establish Standards

Every project is unique and requires different quality standards based on the contractual stipulations and the type of construction. Being able to measure and assess the quality of work done is a step towards enhanced quality. For this to happen, it is essential to set standards in an easily understandable and feasible way. Quality standards generally involve the combination of information from sources such as: international, national, and local building codes, third-party testing and auditing standards such as iso: 9000, the newest lawsuits and lawsuits related to the quality of various building materials and recommendations and requirements from the manufacturers of all products and equipment used in a project.

Control the Workflow

A variety of quality control inspections and tests are required before, during, and after every construction phase. Shifting the onus towards the later stages of construction and considering all the QC checks can be performed just before the final permitting inspection, will result in overlooked issues. For instance, problems related to electrical and wiring systems need to be identified during and right after the installation. While the subcontractors are still engaged and available for rework, recognizing these issues would prevent any significant design changes or demolition for the repairs. Besides, a number of QC planning software are available that facilitate easy identification of the vulnerable areas to test and put a focus on quality control.

Implement Independent Audits

Tests and audits conducted by independent third-party players are considered the best option for maintaining high-quality standards. Any project manager or skilled builder, irrespective of their prowess, may overlook certain questionable matters. A third-party provider equipped with all the

advanced testing tools will allow the contractor to double-check every work after completion. Contractors undertaking government and infrastructure projects are required to submit these tests by any means, so putting in some capital to keep the quality under check for other industrial and commercial projects is considered a wise investment.

Embrace Construction Technology

Different construction productivity software tools are available to tackle the common causes encountered during the quality control process. Seamless communication between the various parties involved in the same project reduces the chances of miscommunication, outdated documents, and other similar problems. Bringing all the project documents, drawings, and relevant reports to a single software platform for collaboration and viewing can help eliminate conflicts and disagreements to smoothen the execution. Also, using software tools that allow planning of quality control audits to ensure the construction team hits every milestone within the specified time.

Seek or Create Skilled Labor

The skill of the workers involved directly affects the quality of construction. Even the best firm won't be able to stick to its quality standards with an inexperienced workforce. When it comes to working on sophisticated infrastructure and commercial projects, one must have an on-site experience as intensive education programs contribute very little to the required skills. When a minute detail like the amount of air mixed into concrete or the depth of a weld can create a major difference between success and failure, construction firms should not dispel the idea of investing in extensive training courses to keep their workforce abreast with all the necessary skills.

2.6 Some Building Materials and the Kind of Quality Control Test Carried On Them

Cement: initial & final setting time, compressive strength test (3, 7 & 28 days strength using

mortar cubes), % passing through 75 micron IS sieve. These tests are routinely conducted in a site QC laboratory. Few more necessary tests which are not frequently performed are soundness test (Le chatelier or Autoclave expansion test), determination of specific surface (air permeability test), heat of hydration, chemical composition tests, etc. These tests are often conducted in professional off-site labs that are well equipped for all sorts of tests.

Fine aggregates (sand): particle size distribution (sieve analysis), specific gravity, water absorption, moisture content determination, etc. Zone of sand, fineness modulus, etc are determined from sieve analysis. Tests for determining clay or silt content and organic impurities are conducted occasionally, including during selection of source of sand. Bulking of sand is usually tested only when nominal concrete mixes are used for less important pours.

Coarse aggregate: sieve analysis, specific gravity, water absorption, moisture content determination, flakiness index, elongation index, aggregate impact value, aggregate crushing value, LA abrasion test, etc. Petro graphic examination of rock is done initially to ascertain the quality of the quarry material. Aggregate impact value is a more useful test as it indicates the quality of stone chips unlike the aggregates crushing value test which gives idea of the quality of the source material (rocks).

In any building production, some of the components that are important are aggregates and water (Bamigboye *et al.*, 2021). Ogunbayo *et al.* (2018) opined that good aggregate is characterized by shape, toughness, grain sizes, bleeding, pumpability, and segregation of fresh concrete, stiffness, shrinkage, creep, density, permeability and they determine the durability of hardened concrete. Ogunbayo *et al.* (2018) maintained that the quality of concrete is affected by the choice of coarse aggregate used in its production. Bamigboye et al., (2021) opined that aggregates account for about 60−75% of the total volume of concrete mix and 70–85% of weight with coarse aggregate

contributing to about 45–55% of the total mass.

Reinforcing steel: determination of yield & ultimate stresses, % elongation test, bend & rebend test, testing of nominal diameter and weight per unit length, etc. Tests like ultrasonic flaw detection, torsion test, fatigue test, chemical composition test, etc are also conducted (less frequently) usually in off-site approved labs in some projects.

Concrete: workability test (slump test, compaction factor test), compressive strength test (cube or cylinder), determination of total chloride and sulphate content in concrete, cement content in mix, temperature monitoring of concrete, especially for mass concreting work (using infrared digital thermometer or other device), etc. Trial mixes are prepared as per design calculations in the initial stage of designing a concrete mix in order to ascertain desired workability, strength, etc of the mix. Testing of accuracy of batching plant is done by routine calibration of the same (once in 2 or 3 months).

Common NDTs conducted at construction sites for testing quality of hardened concrete structures are core test, Schmidt hammer or rebound hammer test, ultrasonic pulse velocity test.

Bricks: compressive strength test, efflorescence test, dimensions test, water absorption test. Tests like soundness & warp age tests are also conducted sometimes.

Water: pH value, determination of chlorides, sulphides and sulphates content, iron and Mn content, turbidity test, hardness test, determination of solids, determination of alkalinity, BOD & DO, etc.

Walling elements in this infrastructure are mostly done using sandcrete blocks. Wallace and Wallin (2015) attest to the fact that sandcrete blocks are widely used as walling units in Ghana. Olawale and Tijani (2019) reinforce this assertion by stating that sandcrete blocks are used in over 90% of physical infrastructures in Nigeria. In Ghana, sandcrete blocks as masonry units in

assemblages of walls are used either as load bearing or non-load bearing walls. In most cases they are used in both the substructure and super structure of buildings especially in the urban centers or dwellings where demands for housing units are on the ascendancy. It is expected of these sandcrete blocks to perform their intended functions in structures whether they are serving as load bearing wall units or non-load bearing wall units.

Grout: compressive strength test (for 1, 3, 7 & 28-day cubes), fluidity test (immersion or cone method), expansion test, bleeding test, volume change test, etc. Trial mixes are also prepared at initial stage to ascertain desired workability, strength, etc. Mock tests can be conducted at site lab to ensure proper grouting operation before actual execution at site.

Soil tests: Standard Proctor test to determine maximum dry density & OMC, in situ bulk & dry densities & moisture content ((core cutter or sand replacement method for bulk density and oven drying or calcium carbide method for moisture content), determination of Atterberg limits by Casagrande apparatus (LL, PL & SL), plasticity index, grain size analysis (sieve analysis & pycnometer), CBR test, etc.

Some soil tests like the direct shear test, triaxial shear test, soil bearing capacity determination test (plate load test), unconfined compressive strength test, etc are occasionally conducted for mainly design purposes. These tests as well few other tests are usually conducted in well equipped off-site labs.

Roadwork: sieve analysis for coarse aggregates for pavement & selected fill materials, flakiness index, sodium & magnesium soundness tests for coarse aggregates, aggregate impact value, LA abrasion loss test, 10% fines value, water absorption by aggregates in bituminous base course, Marshall stability test, retained stability test, bitumen penetration test, flash & fire point test, viscosity of coal tar, ductility test, determination of sulphate, chloride & organic matter content

for selected fill materials, sand equivalent, det. of friable particles, bitumen stripping, extraction & grading analysis test for asphaltic mix, in situ bulk density & det. of degree of compaction for bituminous base course, modified Proctor test to determine maximum dry density & OMC of sub-grade soil and selected fill materials, in situ density & moisture content of compacted sub grade (core cutter or sand replacement method for bulk density and oven drying or calcium carbide method for moisture content), atterberg limits & CBR test for subgrade and selected fill, etc.

In fact, there are more tests for each of the above-mentioned categories or materials. Also, there are quality tests for other materials or other types of work. As already mentioned, depending on the importance laid on quality aspects and few other factors the types or quantum of tests performed may vary from laboratory to laboratory or place to place – even for projects that are quite similar in nature.

2.1.6 Importance of quality control test in construction industries

Quality control is important because it is the foundation of your project's success. We believe a robust quality plan inspires quality construction. Build it right from the first time. Everything that goes into a construction build is dependent on a contract's quality plan, which means from the beginning of the project until the end, quality always remains at the forefront of everyone's minds. Poor quality can lead to a variety of problems such as defects, builds that won't last, confusion between parties involved and a lot of construction changes. In addition, quality control goes hand in hand with cost control. When we provide advanced planning and set quality standards early on, we reduce the risk of making costly mistakes once construction begins

Focusing on quality control can also improve the safety of a project. Defects and failures not only cost a lot, they can become safety hazards because they may require trade partners going

back to redo work in non-ideal conditions. Oftentimes, accidents are preventable with an attention to detail and a dedication to completing work right the first time. When everyone involved is on the same page and works together to create a quality-driven environment from the start, it can lead to fewer accidents.

Lastly, quality control in construction gives you the best outcome possible. If you don’t want to go through a construction project only to end up with mediocre results, you need to take quality control measures that means carry out all necessary quality control tests on building materials.

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

This chapter describes the design of the study, area of the study, target population and sample, instrument for data collection, validation of the instrument and administration of the instrument, method of the analysis and decision rule respectively.

3.1 Research Design

The research design that was used in this study is the survey method, where questionnaires are used to evaluate and gathered information under this study. The study design makes use of questionnaires and interview , the interview was conducted because of some of the respondents are not Anglophones where there is a middlemen translating to them. The survey design is therefore considered suitable because the study will seek information from a sample that was drawn from a population using questionnaires.

3.2 Area of the Study

This study covers the entire Lagos state. Lagos is the former Federal Capital Territory on 27 May 1967. Location Coordinates 6°35′N 3°45′E ,Geopolitical Zone South West, Date created 27 May 1967,Capital Ikeja, Number of LGAs 20, Total area 3,577 km2 (1,381 sq mi), with the total population of 9,113,605 estimated in 2012 by LASG during the Population (2006 census). Lagos State is dominated by bodies of water with nearly a quarter of the state's area being lagoons, creeks, and rivers Rank 1st of 36, Density 2,500/km2 (6,600/sq mi), Time zone UTC+01 (WAT) ISO 3166 code NG-LA

3.3 Population of the Study

The population for this study is 100 subjects made up of 80 site engineers and 20 consultants from 10 construction companies in Lagos on quality control test conducted on building materials

by construction industries.

3.4 Sample of the Study

The entire population was used for the study therefore was no sampling.

3.5 Instrument for Data Collection

The instruments used for data collection was a structured questionnaires on the investigation on appraisal of quality control test on building materials by construction industries developed by the researcher for the study.

The questionnaire is then divided into two section “A” and “B”. Section “A” contains the personal data of the respondent and the introductory part of the study while section “B” contains the questionnaires items, which are divided into four sub-sections according to the research question, such as research question 1 which contains 11 items relating to types of quality control test conducted by construction industries, research question 2 contains 11 items relating to availability of instruments used in the conducting of quality control test, research question 3 which contains10 items relating to challenges encounter during quality control test on building materials and research question 4 which contains 10 items relating to strategies to employ for improving the quality control test of building materials. All items are to be responded to by indicating the appropriate respondent’s best perception using four point rating scale. Strongly Agreed(SA),Agreed(A), Disagreed (D), Strongly Disagreed(SD).

3.6 Validation of the Instrument

The instrument used for the study was first validated by the project supervisor and two other lectures in the department of industrial and technology education, Federal university of technology, Minna. All the necessary corrections observed were effected and finally draft was produced.

3.7 Administration of Instrument

The questionnaire design used for the study was administered by the researcher to all 10 construction companies in Lagos state. She visited some construction industries in the town of Lagos to distribute and collect questionnaires in order to interview and collect information based on the research study. A total of about 100 questionnaires were distributed.

3.8 Method of Data Analysis

The analysis of data for the research question and hypothesis were accomplished using the mean, standard deviation and t-test was used to test the hypothesis of two groups of respondents at 0.05 level of significance.

The four rating scale developed is as follows:

Strongly Agree SA=4

Agree A=3

Disagreed DS=2

Strongly Disagreed SD=1

$X= \frac{\sum fx}{N}$

Where: X = Mean

F = Frequencies of each response option

X = Weight of response option

N = Number of respondents to the items

The mean of the response option was computed with the formula

$X=\frac{\sum fx}{N}$

Where X=Mean

∑=Summation

Therefore the mean value of the 4 point scale is:

X=4+3+2+1/4=10/4=2.5

3.9 Decision rule

The mean of 2.5 was used as decision point for every questionnaire item consequently any item with mean respondent of 2.50 and above was considered to be agreed and any item with response below 2.50 was considered as disagreed in section A, B and C. An inferential t-test was used to test the hypothesis at 0.05 level of significance to compare the mean responses of the two groups.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Research Question 1

What are the types of quality control tests conducted on building materials by construction industries in Lagos state?

Table 4.1: mean responses from site engineers and consultants on quality control test of building materials conducted by construction industries in Lagos state.

N_1= 80 N_2=20

S/N	ITEMS	$\bar{X}$	SD	Remark
1	Specific Gravity test	3.68	.683	SA
2	Water absorption test	3.54	.676	SA
3	Moisture content determination test	3.72	.497	SA
4	Compressive strength test	3.44	.577	SA
5	Initial & final setting time test	3.26	.600	SA
6	Sieve analysis test	3.28	.607	SA
7	Particle size distribution test	3.36	.693	SA
8	Flakiness index test	3.56	.611	SA
9	Determination of yield & ultimate stresses	3.60	.571	SA
10	Slump test	3.50	.432	SA
11	Compacting factor test	3.21	.563	SA

Key:

N=100

$\bar{X}$= mean of the respondents

N_1 = No of site engineers

N_2= No of consultants

SD = standard deviation of the respondents

Table 4.1 showed that both site engineers and consultants agreed on all items. This is because none of the mean response was below 2.50 which was agreed on the 4-points response options. The standard deviation score ranged between 0.497 and 0.683. This showed that the responses of the site engineers and consultants on the items were not divergent.

4.2 Research Question 2

To what extent are quality control test conducted on building materials by construction industries in Lagos state?

Table 4.2: mean responses site engineers and consultants regarding what extent the quality control test are conducted on building materials by construction industries in Lagos State.

N_1= 80 N_2=20

S/N	ITEMS	$\bar{X}$	SD	Remark
1	Specific Gravity test	3.68	.683	HE
2	Water absorption test	3.54	.676	HE
3	Moisture content determination test	3.72	.497	HE
4	Compressive strength test	3.44	.577	HE
5	Initial & final setting time test	3.26	.600	HE
6	Sieve analysis test	3.28	.607	HE
7	Particle size distribution test	3.36	.693	HE
8	Flakiness index test	3.56	.611	HE
9	Determination of yield & ultimate stresses	3.60	.571	HE

10	Slump test	3.50	.432	HE
11	Compacting factor test	3.21	.563	HE

Key:

N=100

$\bar{X}$**=** mean of the respondents

N_1 = No of site engineers

N_2= No of consultants

SD = standard deviation of the respondents

Table 4.2 showed that both the site engineers and consultants agreed on all items from 1 to 11. This was because none of the mean response was below 2.50 which was agreed on the 4-point response options. The standard deviation score ranged between 0.544 and 0.762. This showed that the responses of the site engineers and consultants on the items were not divergent.

4.3 Research Question 3

What are the challenges encounters during quality control test on building materials by construction industries in Lagos state?

Table 4.3: mean responses from site engineers and consultants regarding the challenges encountered during quality control test on building materials by construction industries in Lagos state.

N_1= 80 N_2=20

S/N	ITEMS	$\bar{X}$	SD	Remark
1	Greedy contractor (corruption)	3.36	.598	Agreed

2	Inadequate regulatory framework	3.36	.563	Agreed
3	Quackery	3.34	.658	Agreed
4	Lack of sanctions for offenders	3.38	.667	Agreed
5	Inadequate budgetary allocation for quality control test	3.38	.602	Agreed
6	lack of proper usage of quality contest equipment	3.20	.991	Agreed
7	Failure to Document Changes and Practices.	3.30	.823	Agreed
8	Complexity of Designs	3.63	.672	Agreed
9	Last-Minute Changes	3.35	.701	Agreed
10	Subcontractor Mishandling	3.35	.740	Agreed

Key:

N=100

$\bar{X}$**=** mean of the respondents

N_1 = No of site engineers

N_2= No of consultants

SD = standard deviation of the respondents

Table 4.3 showed that both the site engineers and consultants agreed on all items from 1 to 10. This was because none of the mean response was below 2.50 which was agreed on the 4-point response options. The standard deviation score ranged between 0.563 and 0.991. This showed that the responses of the site engineers and consultants on the items were not divergent.

4.4 Research Question 4

What are the strategies needed to improve quality control test on building materials by construction industries in Lagos state?

Table 4.4: mean responses site engineers and consultants regarding the strategies they use in improving the quality control test on building materials by construction industries in Lagos state

N_1= 80 N_2=20

S/N	ITEMS	$\bar{X}$	SD	Remark
1	Enforcement of quality control clauses by authorized agencies	3.34	.501	Agreed
2	Designers, contractors and approving agencies should be reprimanded for defects and violation of building regulations	3.31	.543	Agreed
3	Withdrawal of licenses of professionals for any defects in construction	3.31	.525	Agreed
4	Provision of adequate budgetary allocation	3.28	.457	Agreed
5	Carrying out laboratory test on materials	3.24	.465	Agreed
6	General awareness, training and change in attitude of workers	3.29	.482	Agreed
7	Continually seeking better ways of doing things i.e.	3.29	.513	Agreed

	continual improvement			
8	Creating a unity of purpose and a quality culture	3.40	.611	Agreed
9	Enforcing quality control and assurance	3.35	.592	Agreed
10	Increasing communication between all of the various teams working together	3.34	.571	Agreed

Key:

N=100

$\bar{X}$**=** mean of the respondents

N_1 = No of site engineers

N_2= No of consultants

SD = standard deviation of the respondents

Table 4.4 showed that both the site engineers and consultants agreed on all items from 1 to 10. This was because none of the mean response was below 2.50 which was agreed on the 4-point response options. The standard deviation score ranged between 0.457 and 0.611. This showed that the responses of the site engineers and consultants on the items were not divergent.

4.5 Hypothesis I

There is no significant difference between the mean responses from site engineers and consultants on types of quality control test conducted on building materials conducted by construction industries in Lagos state.

Table 4.5: T-test on the types of quality control test conducted on building materials conducted on building materials by construction industries in Lagos state.

$N_1 = 80$ $N_2 = 20$

Respondents	N	X	SD	Df	Tcal	P-value	Remark
Site Engineers	80	3.59	0.52	98	0.446	0.06	NS
Consultants	20	3.50	0.59				

Key:

N=100

$\bar{X}_1$**=** mean of site engineer

$\bar{X}_2$ = mean of consultants

N_1 = No. of site engineer

N_2= No. of consultants

SD_1 = standard deviation of site engineer

SD_2 = standard deviation of consultants

NS=Not Significant

Table 4.5 showed that there was no significant difference in the responses of site engineers and consultants on all the items as quality control test of building materials conducted by construction industries in Lagos state; therefore the null hypothesis of no significant difference was upheld at 0.05 level of significance.

4.6 Hypothesis 2

There is no significant difference between the mean responses site engineers and consultants regarding to what extent the quality control test are conducted on building materials from construction industries in Lagos State

Table 4.6 T-test on what extent the quality control test are conducted on building materials from construction industries in Lagos State?

Respondents	N	X	SD	Df	Tcal	P-value	Remark
Site Engineers	80	3.42	0.52	98	0.625	0.10	NS
Consultants	20	3.48	0.68				

Key:

N=100

$\bar{X}_1$**=** mean of site engineer

$\bar{X}_2$ = mean of consultants

N_1 = No. of site engineer

N_2= No. of consultants

SD_1 = standard deviation of site engineer

SD_2 **=** standard deviation of consultants

NS=Not Significant

Table 4.6 showed that there was no significant difference in the responses of responses site engineers and consultants regarding to the extent the quality control test are conducted on building materials from construction industries in Lagos state; therefore the null hypothesis of no significant difference was upheld at 0.05 level of significance.

4.7 Hypothesis 3

There is no significant difference between the mean responses from site engineers and consultants regarding the challenges encountered in the conduct of quality control test on building materials by construction industries in Lagos state.

Table 4.7 T-test on the challenges encountered in the conduct of quality control test on building materials by construction industries in Lagos state.

Respondents	N	X	SD	Df	Tcal	P-value	Remark
Site Engineers	80	3.58	0.61	98	0.528	0.09	NS
Consultants	20	3.34	0.60				

Key:

N=100

$\bar{X}_1$**=** mean of site engineer

$\bar{X}_2$ = mean of consultants

N_1 = No. of site engineer

N_2= No. of consultants

SD_1 = standard deviation of site engineer

SD_2 **=** standard deviation of consultants

NS=Not Significant

Table 4.7 showed that there was no significant difference in the responses site engineers and consultants regarding the challenges encountered in the conduct of quality control test on building materials by construction industries in Lagos state; therefore the null hypothesis of no significant difference was upheld at 0.05 level of significance.

4.8 Hypothesis 4

There is no significant difference between the mean responses site engineers and consultants regarding the strategies needed to improve in the conduct of quality control test on building materials by construction industries in Lagos state.

Table 4.8 T-test on the strategies needed to improve the conduct of quality control test on

building materials by construction industries in Lagos state.

Respondents	N	X	SD	Df	Tcal	P-value	Remark
Site Engineers	80	3.48	0.61	98	0.512	0.07	NS
Consultants	20	3.54	0.60				

Key:

N=100

$\bar{X}_1$**=** mean of site engineer

$\bar{X}_2$ = mean of consultants

N_1 = No. of site engineer

N_2= No. of consultants

SD_1 = standard deviation of site engineer

SD_2 **=** standard deviation of consultants

NS=Not Significant

Table 4.8 showed that there was no significant difference in the responses strategies they use in improving the quality control test on building materials by construction industries in Lagos state; therefore the null hypothesis of no significant difference was upheld at 0.05 level of significance.

4.9.1 Findings of the study

The following are the main findings of the study; they are prepared based on the research questions and hypothesis tested.

The quality control tests conducted on building materials by construction industries in Lagos state

1. Specific Gravity test
2. Water absorption test

3. Moisture content determination test
4. Compressive strength test
5. Initial & final setting time test
6. Sieve analysis test
7. Particle size distribution test
8. Flakiness index test
9. Determination of yield & ultimate stresses
10. Slump test
11. Compacting factor test

what extent the quality control test above are being conducted on building materials by the construction industries in Lagos State by using these Instruments in the conducting of quality control test on building materials:- Rebound hammer, Pulse-velocity meter, Pull-off testing load cell, Metal detection equipment, Blaine Fineness, Hydraulic shrinkage mould, High pressure autoclave, Blaine fineness apparatus, Vibrating machine, Automatic and Manual Compression testing machine, Slump Cone is 75%.

Challenges encounters in the conduct of quality control test on building materials by construction industries in Lagos state

1. Greedy contractor (corruption)
2. Inadequate regulatory framework
3. Quackery
4. Lack of sanctions for offenders
5. Inadequate budgetary allocation for quality control test
6. lack of proper usage of quality contest equipment

7. Failure to Document Changes and Practices.
8. Complexity of Designs
9. Last-Minute Changes
10. Subcontractor Mishandling

Strategies needed to improve the conduct of quality control test on building materials by construction industries in Lagos State

1. Enforcement of quality control clauses by authorized agencies
2. Designers, contractors and approving agencies should be reprimanded for defects and violation of building regulations
3. Withdrawal of licenses of professionals for any defects in construction
4. Provision of adequate budgetary allocation
5. Carrying out laboratory test on materials
6. General awareness, training and change in attitude of workers
7. Continually seeking better ways of doing things i.e. continual improvement
8. Creating a unity of purpose and a quality culture
9. Enforcing quality control and assurance
10. Increasing communication between all of the various teams working together

4.9.2 Discussion of findings.

Table 4.1 shows the result on the findings on quality control tests conducted on building materials by construction industries in Lagos state. The findings among others reveal that

Specific Gravity test, Water absorption test, Moisture content determination test, Compressive strength test, Initial & final setting time test, Sieve analysis test, Particle size distribution test, Flakiness index test, Determination of yield & ultimate stresses, Slump test, Compacting factor test are test conducted by site engineers and contractor in order to ensure quality control on building materials. The findings of the study is in line with Longtau (2016) that quality control test is very necessary in order to have a clear information and knowledge about the building materials been use for building constructions. Meena (2020) also noted that Most of the contractors were not engaging qualified and experienced staff both to construct and to supervise construction works. In addition, very few contractors were performing quality control tests.

The result of the analysis of hypotheses 1 revealed that there was no significant difference in the mean responses from site engineers and consultants on quality control test of building materials conducted by construction industries in Lagos state. The null hypothesis of no significant difference was upheld for all items, the respondents agreed that on all the items with no significant difference in the mean responses from site engineers and consultants on quality control test of building materials conducted by construction industries in Lagos state.

The result from table 4.2 shows the extent at which those quality control test are been conducted by the construction industries in Lagos state. The findings among others reveal that Specific Gravity test, Water absorption test, Moisture content determination test, Compressive strength test, Initial & final setting time test, Sieve analysis test, Particle size distribution test, Flakiness index test, Determination of yield & ultimate stresses, Slump test, Compacting factor test are test conducted by site engineers and contractor in order to ensure quality control on building materials. The findings of the study is in line with Longtau (2016) that quality control test is very necessary in order to have a clear information and knowledge about the building materials been

use for building constructions. Meena (2020) also noted that Most of the contractors were not engaging qualified and experienced staff both to construct and to supervise construction works. In addition, very few contractors were performing quality control tests. .

The result of the analysis of hypotheses 2 revealed that there was no significant difference in the mean responses from site engineers and consultants on availability of instrument for conducting quality control test on building materials from construction industries in Lagos state. The null hypothesis of no significant difference was upheld for all items, the respondents agreed that on all the items with no significant difference in the mean responses from site engineers and consultants on availability of instrument for conducting quality control test on building materials from construction industries in Lagos state.

Table 4.3 show the result of the findings on Challenges encounters in the conduct of quality control test on building materials by construction industries in Lagos state. The findings among others revealed that, Greedy contractor (corruption), Inadequate regulatory framework, Quackery, Lack of sanctions for offenders, Inadequate budgetary allocation for quality control test, lack of proper usage of quality contest equipment , Failure to Document Changes and Practices, Complexity of Designs, Last-Minute Changes, Subcontractor Mishandling. The findings of the study is in line with Longtau (2016) that corruption in the part of the contractors is the most significant barrier for adhering to quality standards on building construction projects. Quackery and inadequate regulatory framework is the second most significant factor for not adhering to standards. Lack of sanctions to offenders and inadequate budgetary allocations is ranked third as a factor for non-adherence to quality on building construction projects. On the other hand, extra cost and shortage of quality management staff are the less significant factors militating against the adherence of quality control.

The result of the analysis of hypotheses 3 revealed that there was no significant difference in the mean responses from site engineers and consultants on Challenges encounters in the conduct of quality control test on building materials by construction industries in Lagos state. The null hypothesis of no significant difference was upheld for all items, the respondents agreed that on all the items with no significant difference in the mean responses from site engineers and consultants on Challenges encounters in the conduct of quality control test on building materials by construction industries in Lagos state.

The result on the findings on Strategies needed to improve the conduct of quality control test on building materials by construction industries in Lagos State is revealed in table 4.4. The findings revealed that: Enforcement of quality control clauses by authorized agencies, Designers, contractors and approving agencies should be reprimanded for defects and violation of building regulations, Withdrawal of licenses of professionals for any defects in construction, Provision of adequate budgetary allocation, Carrying out laboratory test on materials, General awareness, training and change in attitude of workers, Continually seeking better ways of doing things i.e. continual improvement, Creating a unity of purpose and a quality culture, Enforcing quality control and assurance, Increasing communication between all of the various teams working together. The findings of the study is in line with Arowolo (2019) who stated that Provision of adequate budgetary allocations establish more quality testing laboratories and to equip the existing once with modern equipment, e.g. NBRRI laboratory for Testing Materials.

The result of the analysis of hypotheses 4 revealed that there was no significant difference in the mean responses from site engineers and consultants on Strategies needed to improve the conduct of quality control test on building materials by construction industries in Lagos State. The null hypothesis of no significant difference was upheld for all items, the respondents agreed that on

all the items with no significant difference in the mean responses from site engineers and consultants on Strategies needed to improve the conduct of quality control test on building materials by construction industries in Lagos State.

CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary of the Study

The main focus of this research study was to identify of quality control test on building materials by construction industries in Lagos state, Nigeria.

Chapter 1 of the study discussed the background of the study, the statement of problem, purpose, significance, scope and the research questions were all stated and discussed for the conduct of this research.

The review of related literature looked into Quality Control Tests on Building Materials Conducted by Construction Industries in Lagos, Some Building Materials and the Kind of Test Carried On Them Cement, Importance of quality control test in construction industries, Factors Affecting Quality Control Test, Availability of Instrument for Conducting Quality Control Test on Building Materials by Construction Industries in Lagos, Strategies for Improving Quality Control Test On Building Materials by Construction Industries, Various views of different authors concerning the topic were harmonized in a comprehensive literature review and empirical studies.

A survey approach was used to developed instrument for the study; the respondents identified as the population of the study were the site engineers and consultants. The entire respondents were used. A number of 100 questionnaires were administered. The instrument used was analysed using mean and standard deviation. The research questions were discussed base on the findings from the responses and results of the instrument used.

Implication of the study and conclusions were also drawn from the findings discussed. Recommendations and suggestions for further study were formulated and stated according to the findings of the study.

5.2 Implication of the Study

The findings of the study had implications for government, construction industries and clients in Lagos state. From the outcome of the study, it implies that:

1. The findings of the study will have implication on the government as it will enable them to make policy on quality control test in construction in other to guide the construction processes in the construction industry.
2. As a result of the implication of the study construction industry will also be under strict regulation to conduct quality control test on construction materials and equipment before embarking on any construction project.
3. The findings of the study will have implication on the client as they also will be aware of necessary quality control test that is required in any construction projects.

5.3 Contribution of knowledge

QC test on building materials has to do with understanding the environmental issues surrounding the extraction of raw materials, the manufacture of construction materials, and their effects in use, it’s important to ensure sustainability and maximize the potentials of these materials.

5.4 Conclusion

Based on the findings of the study, the following conclusions were drawn:

1. Quality controls important to maintain both quality and the economy.
2. Both client and consultant have to conduct their work in accordance with professional ethics.

3. Quality management plan which include quality test control has to be prepared and properly implemented during concrete and material production processes that identifies the critical activities and helps in taking the appropriate measures at any stages during concrete and material production.
4. Systematic and Well-organized quality control test by an independent body is useful in improving concrete quality on construction projects.

5.5 Recommendations

Based on the findings of the study, the following recommendations were made:

1. Proper interpretation and use of quality control test should be enforced by the stakeholders in the building industry.
2. All team members should collaborate with each other to achieve the goal which is to have the best outcome.
3. Concerted efforts should be directed towards improving the use of quality management practices at the contract stage of construction work across the procurement methods used in the study area.

5.6 Suggestion for Further Study

The following are suggested for further studies:

1. Influence of the level of use of quality management practices on performance at post contract stage
2. Appraisal of quality control test on building materials by construction industries in other state.

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APPENDIX B

FEDERAL UNIVERSITY OF TECHNOLOGY MINNA, NIGER STATE

SCHOOL OF SCIENCE AND TECHNOLOGY EDUCATION

DEPARTMENT OF INDUSTRIAL AND TECHNOLOGY EDUCATION

A QUESTIONNAIRE FOR SITE ENGINEERS AND CONSULTANTS ON APPRAISAL OF THE CONDUCT OF QUALITY CONTROL TEST OF BUILDING MATERIALS BY CONSTRUCTION INDUSTRIES IN LAGOS STATE, NIGERIA

INTRODUCTION: Please kindly complete this questionnaire by ticking the column that best present your perception about the topic. The questionnaire is for research purpose and your view will be confidentially and strictly treated in response to the purpose of the research work.

SECTION A

PERSONAL DATA

Site Engineers: ☐

Consultants: ☐

Note: A four (4) point scale is used to indicate your opinion, tick the options which best describe your agreement as shown below:

Research Question1, 3 and 4

Strongly Agree	(SA)	=	4points
Agree	(A)	=	3points
Disagree	(D)	=	2points
Strongly Disagree	(SD)	=	1points

Research Question 2

Very High Extent (VHE) = 4points

High Extent (HE) = 3points

Low Extent (LE) = 2points

Not Available (NA) = 1points

SECTION B

Research Question one: What are the quality control tests conducted on building materials by construction industries in Lagos state?

S/N	Items	Scales			
		SA	A	D	SD
1	Specific Gravity test				
2	Water absorption test				
3	Moisture content determination test				
4	Compressive strength test				
5	Initial & final setting time test				
6	Sieve analysis test				
7	Particle size distribution test				
8	Flakiness index test				
9	Determination of yield & ultimate stresses				
10	Slump test				

11	Compacting factor test				

Research Question two: To what extent are the instruments used in the conduct of quality control test on building materials are available in construction industries in Lagos state?

S/N	Items	Scales			
		VHE	HE	LE	NA
1	Specific Gravity test				
2	Water absorption test				
3	Moisture content determination test				
4	Compressive strength test				
5	Initial & final setting time test				
6	Sieve analysis test				
7	Particle size distribution test				
8	Flakiness index test				
9	Determination of yield & ultimate stresses				
10	Slump test				
11	Compacting factor test				

Research Question three: What are the challenges encounters in the conduct of quality control test on building materials by construction industries in Lagos state?

S/N	Skill Items	Scale			
		SA	A	D	SD
1	Greedy contractor (corruption)				
2	Inadequate regulatory framework				
3	Quackery				
4	Lack of sanctions for offenders				
5	Inadequate budgetary allocation for quality control test				
6	lack of proper usage of quality contest equipment				
7	Failure to Document Changes and Practices.				
8	Complexity of Designs				
9	Last-Minute Changes				
10	Subcontractor Mishandling				

Research Question four: What are the strategies needed to improve the conduct of quality control test on building materials by construction industries in Lagos State?

S/N	Skill Items	Scale

		SA	A	D	SD
1	Enforcement of quality control clauses by authorized agencies				
2	Designers, contractors and approving agencies should be reprimanded for defects and violation of building regulations				
3	Withdrawal of licenses of professionals for any defects in construction				
4	Provision of adequate budgetary allocation				
5	Carrying out laboratory test on materials				
6	General awareness, training and change in attitude of workers				
7	Continually seeking better ways of doing things i.e. continual improvement				
8	Creating a unity of purpose and a quality culture				
9	Enforcing quality control and assurance				
10	Increasing communication between all of the various teams working together				