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NIGERIAN NATIONAL BUILDING CODE AS IT RELATES TO MATERIAL SPECIFICATIONS AND QUALITY CONTROL

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ABSTRACT

Buildings are generally assessed using the criteria of firmness, utility and beauty, to determine the degree to which they are fit for purpose. The Nigerian National Building Code provides broad guides on general specifications and quality control, to ensure that materials used to execute building projects meet minimum standards. This paper examines the different materials captured in the Code, in terms of their special characteristics and in-depth aspects of quality, for best practice. The study addresses certain identified shortcomings in the relevant parts of the Code that deal with material specification and quality control.
Key words: Building Code, Material Specification, Quality Control

INTRODUCTION

The evolution of the Nigerian National Building Code was spurred by the recognition that there are six areas where Architects, Urban Designers, Engineers and Construction Professionals have hitherto not adequately provided infrastructural facilities that completely satisfy the requirements of the citizenry. These areas are:

a) Planlessness of our towns and cities;
b) Incessant collapse of our buildings, fire infernos, built environment abuses and other disasters;
c) Dearth of referenced design standards for professionals;
d) Use of non-professionals (quacks);
e) Use of un-tested products and materials;
f) Lack of adequate regulations and sanctions against offenders.

Apart from (a) above, all the other four conditions are linked to material specifications and quality control, either directly or otherwise. The National Building Code provides the necessary guides on general specifications for materials and quality control to ensure that the materials meet minimum standards. The code provides minimum standards to safeguard life and property and further guarantees public health and safety for different building types. Building Material is any material which is used for construction purposes in an attempt by man to provide shelter to protect him from adverse environmental conditions. Building materials and construction industry constitute one of the most important sectors of a nation's economy. At the close-out stage of construction of a reasonably well-finished dwelling, it is generally assumed that building materials represent 45-65 percent of total cost; while Labour, equipment and overhead account for the rest. The materials that are used to varying degrees in construction of buildings are broadly classified into non-metallic (earth or soil, clay bricks, lime, stones, glass, ceramic and concrete), metallic (structural steel, reinforcing steel, metal sheets and aluminium) and organic (leaves, grasses, reeds, bamboo, timber, plastic and paints). These materials are converted to useable materials, for example, natural stone, clay and soil blocks, burnt clay bricks, tiles, thatched, cement and cement products including asbestos cement sheets, corrugated iron sheet, long span aluminium, structural steel, sheet glass and ceramics (sanitary ware, tiles and pipes). The choice of materials is determined by the particular environment of their utilization (rural or urban), exposure conditions (mild, moderate or adverse), functional considerations, their availability and cost. This paper focuses on the broader issues which apply to the choice and use of materials, based on the guidelines given by the National Building Code. The different materials captured in the Code are identified in terms of their special characteristics and essential qualities. Emphasis is also laid on human and non-human aspects of quality control for best practice and sustenance of the industry.

MATERIALS CAPTURED IN THE BUILDING CODE

Section 10 of the National Building Code stipulates that materials and components to be used in the construction of buildings should meet the requirements of aesthetics, durability, functionality, character and affordability. Materials and components recognized in the Code are contained in section 10.1,1 to 10.26.6.11. Some of the materials can be categorized as factory-based e.g. plumbing and electrical fittings,

Other considerations that guide material specification

The underlisted factors also guide material specifications:

- Transport and handling – It is necessary to consider the problem of loading, unloading and getting into position on the site. There is a need to further consider whether a material is likely to be damaged.
- Relationship between type of labour and type of material of construction – There are occasions when a choice of material or method of construction will be influenced by the type of labour likely to be available.

The national building code as it relates to quality control

The idea of quality control in the Building Code is to achieve the "Total Performance Concept" for buildings. The purpose of Quality Control is to ensure compliance to standards, guidelines, specifications, procedures, plans, and best practices recognized in the industry. The Code addresses the issue of workmanship by specifying performance requirements. Cristofolini et al (2000) reported that quality measurement is critical in quality system to evaluate production process reliability, defectiveness and non-quality cost. Quality control can be achieved by effectively controlling both human and non-human factors. The construction industry interprets quality as a measure of standard or requirement. The final quality of a new building, its materials and its component parts depends on some factors, which Fletcher and Seivyer (1988) outlined as follows:

- The product standard and specification properly defines the fitness for purpose
- The product accurately represents the specification
- The product is delivered and stored on site so as to avoid damage and hence reduced performance
- The product is correctly installed

The code as it relates to human aspects of quality control

The human factors centre on supervisions and workmanship. This approach to quality control is based on the conviction that it is possible to achieve defect-free work most of the time if emphasis is placed on prevention. Inference from the code shows professional competence as being at the core of quality control. The code advocates non-involvement of charlatans or quacks in the performance of tasks at any level of project delivery. The implication is that the recruitment, selection and placement of personnel at all stages of building and construction processes are critical to quality enhancement and control. This human management aspect of quality control is highly desirable for the design process, construction process, and products. Quality of the design process includes reliability of the brief and the reliability of the information used as the basis for the design and product specification. Quality of the construction process requires the reliability of the procedures and skills of the builder to provide the end product on site. Quality of the products needs reliability in all the materials/products/components incorporated in the building. These requirements place responsibility upon four main parties: the client, the designer, the manufacturers, and the contractors.

The code as it relates to non-human aspects of quality control

Non-human aspects relate to the Materials, Plants and Equipments used in building production. There is now in existence a series of codes of Practice and Standards from internationally recognized institutions. These are referred to as third party quality control stakeholders. These institutions stipulate standards of materials, components and equipments used by the building industry. Some are concerned with dimensional standardization, others with quality standardization or both. In majority of cases, precise methods of tests for conformity to standards are a major consideration. The advantage of this feature is that manufacturers will tend to check their products, and second, that the user has a precise definition of standard which he can check if he wishes. This aspect of quality control is well acknowledged in process engineering and manufacturing.

Application to building: The overall aim of third-party quality control organizations is to set recognized standards for all building operations and to obviate the occurrence of major deficiency and defects in the design and construction. Practices and procedures are aimed at ensuring that building production conforms to established functional and technical schedules in a consistent, predictable and reliable manner. The performance and compliance criteria should hence clearly specify three things. These are: the form or contents of the expected output; the process by which the output shall be produced; and how compliance to standards shall be measured.

paints and paint materials, reinforcement and structural steel. They are supposed to comply with the relevant minimum standards whereas products like sandcrete blocks and timber boards are produced and cured/seasoned on/off sites. Concrete and allied products are most of the time prepared in-situ on site. The component materials are mixed in a definite proportion depending on the expected strength. The component materials especially fine and coarse aggregate often fail to conform to recognized standards thereby affecting the quality and durability of building and necessitating early building repairs and expenditure.

Suitability of materials for specific projects, operations or building types

The properties of construction materials vary with different combinations of their sourced constituents. The choice of materials is determined by such factors as:

- Functional considerations
- The particular environment of their utilization (urban or rural)
- Exposure conditions (mild, moderate, adverse)
- Their availability
- Cost
- The service life for which the material could be used.
- The maintenance and operational implications of using the materials (assumptions about building use).
- Variance of service life for the same material in different building contexts.

Technical issues in material performance and specification

Buildings and Constructed assets generally have a long service life. Considerations for material specification are usually based on product application context. Such considerations should also be drawn from scenarios concerning technical and economic performance, as well as user-related aspects. Oftentimes, material specification only reflects today's information or today's expectation of the future, predicted with the hope that it will give the same result when a post-completion retrospective performance evaluation is carried out. Decisions on specifications of building materials and components need to address how each component will be manufactured, transported and assembled to complete the facility.

Specifications occasioned by mechanical properties of materials

It is difficult to classify the different mechanical properties that need consideration. The following may, however, serve as a basis for examination:

Strength in relation to general construction: The essential requirement for the main structural parts of a building is safety. The designer is expected to have knowledge of the safety limit and how near it can reasonably be approached. This raises three challenges:

- The challenge of knowing as accurately as possible the properties of the materials being used, including whether changes may occur with age and exposure.
- The challenge of having a material of regular qualities.
- The challenge of knowing the way the material can be affected by quality of workmanship.

Strength as it affects local damage: The emphasis is on damage that is likely to be caused by wear and tear from normal occupation of a building. Materials applicable under this category are usually referred to as hard, soft, resilient or plastic. Hard materials are more suitable to resist local damage than soft materials. A resilient material is more resistant to local damage than a plastic one.

Specifications Occasioned by Fire Considerations

The whole subject of fire hazard is an extremely complicated one. In practice the choice of material has to be considered from the following points of view: Danger to the people especially the occupants of the building, danger to structure and its contents, and danger of spread to adjacent or adjoining building.

Various properties of building materials may affect their choice in relation to fire hazard.

Will the material burn or not? If it burns, does it readily ignite or spread flame? If it burns, what is its behaviour in burning? If it does not burn, how is it affected by nearby burning material?

Specifications Occasioned by Acoustic Considerations

Materials to be considered in relation to sound should have two distinct aspects namely absorption and transmission. Absorption refers to the way in which materials absorb or reflect sound, and therefore how they affect the sound conditions within a room. Transmission on the other hand refers to the way in which noise is transmitted through materials and therefore how the choice of materials can influence the amount of sound penetration from one room to another.

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The case of selected materials in quality control of building

The importance of concrete and allied materials in the construction of buildings has necessitated the need to examine the products more closely.

The properties of construction materials

The properties of construction materials vary with variation in the combination of their sourced constituents. The quality of some of the materials cannot be controlled on site except that appropriate selections are made during their procurement. In this category are reinforcement steel, electrical and plumbing materials. The strength of reinforcement can be assessed in the laboratory using tensile strength test. But materials such as concrete, blocks, and timbers require adequate quality control for them to meet the required specifications.

Concrete

In building works, concrete (cement, fine and coarse aggregates, atimes admixture) constitutes 60 – 70 percent of construction work. Concrete is also said to surpass other construction materials in terms of flexibility, strength and durability. The constituents of concrete are mixed in definite proportion depending on the required strength.

- A change in their proportion will cause a change of some or all of the construction properties of concrete.
- Different methods of testing, storage and control are available for each of the constituents of concrete, to meet established standards.

Falade (2000) outlined the characteristics of concrete mixtures with inappropriate content of constituents. He concluded that the inevitable variations in the quality of concrete cast on job sites can be reduced by adequately monitoring the conditions of the concrete constituents.

Future challenges

Building and Construction projects are generally unique and temporary in nature. This makes it difficult to develop a perfect approach across projects. Therefore there is need for flexibility in the administration of the code. Most clients do not know many of their specific needs at inception, hence cannot communicate these unambiguously to the designer and other professionals. Not all institutions or manufacturers have current Codes of Practice and Standards that comply with what is stipulated in the National Building code. The National Building Code has provided general guidelines on building materials usage. However, the stakeholders in building industry, especially engineers, will still need to come together to formulate necessary experimental procedures to assess the characteristics of construction materials that are widely used locally. The manufacturers need to provide data on their products. The responsibility of developing Codes and Standard lies with the professional bodies, in collaboration with Standards Organization of Nigeria (SON).

CONCLUSION

From the foregoing, the following conclusions are made:

1) The National Building Code provides the necessary guide on general specifications for materials and quality control.
2) Choice of materials is guided majorly by fitness for purpose. It is also determined by technical considerations of properties such as mechanical, fire resistance, acoustic/sound, and availability of skill to handle them.
3) Quality control in the Building Code addresses "the concept of total performance" through the application of human and non-human factors.
4) The challenge of the future is on the need to encourage more third party institutions and stakeholders to produce or review their Codes of Practice and Standards, using the National Building Code as a springboard.

RECOMMENDATIONS

1. All the foreign codes cited in the National Building Codes must be properly referenced.
2. NCP1 and NCP2, 1973 are widely referenced in the National Building Codes. Copies of these should be produced and made available to the relevant professionals
3. Updating the National Building code should be given adequate priority.
4. It is necessary to develop Codes and Standards for other engineering materials and facilities.

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