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THE EFFECT OF CHOICE OF CONSTRUCTION MATERIALS ON THE URBAN ENVIRONMENT.

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Abstract:

Construction Materials are one of the determinants of the quality and strength of a building. The types of buildings coupled with other factors determine the condition of the environment, while the condition of the environment determines the health condition of people in that area. Therefore, wrong choice of material can be hazardous to health. Research has shown that choice of asbestos material for instance, as a roof covering over some years exposes the fibre to dust and as a result causes Asbestosis – a disease of the lungs which develops to cancer. This paper attempts to discuss and proffer ways of reducing the effect of construction activities on the environment through the right choice of materials specification by the architect. It also highlights the effects of wrong choice and its implication. It concludes by advocating that clients should not insist on the use of certain materials of which they have little or no knowledge about.

Keywords: choice, construction, effect, environment, material.

INTRODUCTION

Throughout the history of architecture, there has always been correspondence / connection between the architects' attitude to space and choice of materials used to define and articulate the space. Since the beginning of civilization, man has been an architect, devoting creative energies to the construction of buildings in which to live, works and worship. And it is owing to the high service properties of materials used that his works, embodied in wood and stone, survived in many parts of the world.

In addition to natural materials, architects and builders have been using man – made materials for three millennia now. These have not only added spice and character to the modest choice of materials, but also immensely influenced the development of structural

elements and architectural forms. The advancement of construction material will be adequately utilized to shape the environment.

Architecture is dynamic. New developments in construction methods, technology and building materials are constantly evolving (Anunobi A. 2006). Modern building materials should ideally contribute to making construction energy efficient, comfortable, and healthy to live or work in. An architect must therefore become a central figure who can influence and direct the entire industry of building materials, for no creative freedom is feasible in architectural design unless he can dictate his will to the manufacturer and even the client.

For instance, the use of Asbestos materials for roof covering over about thirty years exposes the fibre to dust and as a result causes asbestosis – a disease of the lungs which further develops to cancer (Encarta 2005). Not only that, the use of grasses, shrubs and trees as landscaping materials instead of concrete paving round the compound are matter of choice. The first provides cool air and conducive environment due to the ability of the grasses, shrubs and trees to absorb the glare from the sun; while the later reflects the radiation from the sun and makes the environment unconducive for the inhabitant.

Our urban environments are fast growing with constructed buildings which are constantly facing problems caused as a result of carelessly or ignorantly choice of construction materials. The problems are more rampant in our developed/developing cities like Lagos and Abuja. The researcher of this work coined that “ignorance is an environmental disease in the choice of construction materials”, since wrong choice of construction materials can result to health hazard which may discomfort the inhabitant in such environment.

This paper therefore, discusses and proffers ways of reducing the effect of construction activities on the environment through the right choice of material specification by the architect. It also highlights the effect and the implication of wrong choice of construction materials.

HISTORICAL PERSPECTIVE

Materials are probably more deep – seated in our culture than most of us realize. Transportation, housing, clothing, communication, recreation and food production – virtually every segment of our everyday lives is influenced to one degree or another by materials. William D., (1997). Historically, the development and advancement of societies have been intimately tied to the members' ability to produce and manipulate materials to fill their needs. In fact, early civilizations have designated by the level of their materials development (i.e. Stone Age, Bronze Age).

The earliest human had access to only a very limited number of construction materials, those that occur naturally: stone, wood, clay and so on. With time, they discovered techniques for producing materials that had properties superior to those of the natural ones; these new materials included pottery and various metals. Furthermore, it was discovered that the properties of a materials could be altered by heat treatments and by the addition of other substances. At this point, materials utilization was totally a selection process that is deciding from a given, rather than limited set of materials the one that was best suited for an application by virtue of its characteristics.

It was not until relatively recent times that scientist come to understand the relationship between the structural elements of materials and their properties. This knowledge acquired in the past sixty years or so, has empowered them to fashion, to a large

degree, the characteristics of materials. Thus, tens of thousands of different materials have evolved with rather specialized characteristics which meet the needs of our modern and complex society; these materials include metals, plastics, glasses and fibre etc.

Therefore, the development of many technologies that make our existence so comfortable has been intimately associated with the choice of suitable materials.

CLASSIFICATION OF CONSTRUCTION MATERIALS

According to Don A. Watson, construction materials can be classified according to their trade as follows:

1. Soil: e.g. sand, clay.
2. Concrete: e.g. Cement, Aggregate, Admixtures, Reinforced Concrete, Precast and Pre-Stressed Concrete.
3. Masonry: e.g. Stone, Brick, Clay Tile, Block, Glass Block etc.
4. Wood and Related Products: e.g. Lumber, Soft And Hardwood, Laminated Timber, Plywood, Pressed Boards, Composite Boards etc.
5. Ferrous Metal and Steel: e.g. Iron, Cast Iron, Wrought Iron, Steel, Steel Alloys etc.
6. Non – Ferrous Metal and Alloys: e.g. Aluminum, Lead Zinc, Zinc Coatings, Copper and Copper Alloys, Nickel, Chromium, Cadium and Titanium etc.
7. Lath, Plaster, and Acoustical Materials: e.g. Plaster, Gypsum Plaster, Portland Cement Plasters, Lath, Acoustical Tiles And Boards.
8. Roofing Materials: e.g. Zinc, Aluminum, Bituminous Roofing Materials, Shingles, Tiles and Slate, Wood Shingles and Shakes, Metals, Membrane – Roofing Materials, Concrete Roofing Materials etc.

9. Floor and Wall Coverings: e.g. Terrazzo, Tile, Stone Floor, Asphalt, Marble, Glass Mosaics, Soft and Hardwood Flooring Material, Vinyl Tile Floor – Covering, Asphalt Tile, Rubber Tile, Cork Tile, Ceramic Tiles etc.
10. Doors, Windows and Hardware: eg. (May be Timber Or Metal) Panel Door, Flush, Solid or Hollow Core doors, Sliding Doors and Window Folding Door, (Hardware eg. Nail, Bolts, Anchor Bolts) etc.
11. Glass: e.g. Sheet Glass, Plate Glass, Safety Glass, Synthetic Resins, Bituminous Paint etc.
12. Paints and finishes: e.g. Emulsion, Text coat, Gloss, Synthetic Resins, Bituminous Paint, etc.
13. Mechanical Trades: e.g. Water Supply Pipes, Fuel Gas Pipe, Air Condition, Drainage Pipe etc.
14. Electrical Equipment: e.g. Distribution Board, Electrical Wires etc.

WHO DETERMINES THE CHOICE OF CONSTRUCTION MATERIALS TO BE USED – ARCHITECT / DESIGNER, CLIENT OR USERS

Choices of construction materials are quite different from choice of a design. The **architect/designer** is the one who plans and designs a project to satisfy the owner's (client's) particular needs. The **client** is the buildings owner (employer) or sometimes called the **developer**, who sponsors the financial aspect of a project; while the **user** is the person who may rent or live in such accommodation. Some may argue that since the client sponsors a project, the client has the right to choose what types of materials to be used. This is not far from the truth, but the question is "where a client is just a developer and not the user of such project will the choice of the construction materials favour the

users/occupants"?. This therefore, calls for participatory choice of construction materials especially at the design stage.

Findley, (2001) as quoted in Zubairu S. (2006) that the process of design has also undergone changes over the years. The brief stage, which involved mainly the architect and client, has now changed. The number of people involved in initial imput before an architect can decide on the main attributes of the sketch design, has increased. Depending on the nature of the project, the number of people involve in the briefing stage may be ten or twenty, or it may be several thousand or more. These people are stake – holders and potential users of the proposed building. In some western countries like Germany, Holland and Sweden, it is now mandatory that workers in any organization, whether private or public, be consulted in any proposal building development that will house them, such as new offices, factories or residential buildings.

Therefore, architect as the master builder in the participatory choice of construction materials and design will advice the client on the best use of materials for construction with the acquired wide skill and knowledge of materials and their properties.

FACTORS THAT DETERMINE PROPER CHOICE OF CONSTRUCTION MATERIALS.

A good knowledge of the mentioned properties below gives room for making a proper choice of construction materials. This can be treated under five broad headings namely:

i. Physical properties

ii. Mechanical properties

iii. Chemical properties

iv. Biological properties and

v. The complex properties

Physical Properties: They are essentially structural and mass characteristics (such as density, porosity, voids ratio, and the like) and properties describing the response of a material to water, vapour gases (examples are hygroscopicity, water absorption, water permeability, moisture resistance, water vapour and gases), heat, fire, cold, electric current, acoustic waves, radiation (thermal conductivity, heat resistance, fire resistance, refractoriness, cold resistance, electrical conductivity, sound – proofing and sound – absorbing capacity, resistance to radiation, etc.), and other attacks by the environment (for example, frost resistance characterizes the materials response to water and cold acting at the same time).

Some physical properties become apparent in manufacture and processing (these are fusibility, malleability, weldability, ability to cake, mouldability, solubility, and so on). Others show in service either directly or through their effect on other functional and aesthetical properties. To demonstrate, the density and porosity of a material have an effect on its weight and thermal performance, surface water absorption influences its frost resistance and dirt retention, permeability to air affects its sound absorption, etc. Moreover, some physical properties are closely associated with the ease of application or erection, which forms an important aspect of functionality. Examples are the workability (consistence and harshness) of concrete mix, the viscosity, hiding power, and drying or film – formation speed of paints, the elasticity and flexibility of finishing and roofing materials coming in rolls, the setting time of grout and mortar etc.

Nevertheless, no less important to the architect are the colour, lustre, face finish, texture, and similar physical properties of a material.

Mechanical Properities: This is another important factor to be considered for in the choice of construction materials. The mechanical properties have to do with the ability of a material to resist deformation and breakdown under the action of external forces. They include various kinds of strength, hardness, elasticity, brittleness, ductility, yield, creep, abrasion resistance, and the like.

Chemical Properties: The chemical properties are also important because they characterize the ability of a material to withstand attacks by corrosive environments which can give rise to exchange reactions and eventually destroy the materials. Among these are acid resistance, alkali resistance, and resistance to the simultaneous action of several corrosive agents.

Biological Properties: The biological properties of materials are another important factor to be considered in the choice of construction materials. These have to do with response to fungi, micro organisms, insects and their larvae etc. In service, building materials and product are generally exposed to physical, mechanical, biological, physico – chemical, Biochemical, and other factors acting in combination or even all at the same time. For example, the exterior filler elements of a building are subject to various mechanical loads, water, heat, cold, ultra-violet radiation, etc.

The Complex Properties: These refer to the resistance offered by a material to the simultaneous or cyclic action of corrosive and destructive factors which include durability, reliability, compatibility, long – term strength, refractoriness, cavitations resistance, corrosion resistance, and erosion resistance. Airapetov D. (1986).

Adequate knowledge of these properties of materials will enhance proper choice of a better material to be used during construction.

EFFECTS OF WRONG CHOICE OF CONSTRUCTION MATERIALS

1. Building Failure/Collapse: According to Onolaja O.A et.al (2007) quoting Bamidele and Iyagba (2000), posited that the non – involvement of professionals in the design and construction process, poor workmanship, lack of proper supervision and monitoring by the development control regulatory agencies, as well as the wrong choice of building materials and methods are responsible for the causes of the reported cases of building collapse. Bamgbopa (1999) as quoted in Onolaja O.A, et.al (2007), added that the incidence of collapsed buildings are due to poor construction work, use of sub – standard materials and disregard to the structural requirements and faulty sequence of operation by the contractor/builder.

2. Poor Aesthetics: Aesthetics an important objective of design is a way of securing attractive solution by the choice of materials, size and other relevant factors.

Adedayo O.F, et.al (2007). Therefore, wrong choice of construction material, invariably leads to some ugly aesthetical view of some buildings/structures. This as well defaces the overall look of the environment.

3. Environmental Disease/Health Hazards: Wrong choice of material can be hazardous to health for instance, the use of asbestos roof as a covering material. Exposure to asbestos fibres and dust, however, can cause asbestosis – a disease of the lungs caused by the inhalation of asbestos particles which develop to cancer especially lung cancer and mesothelioma after a latent period of up to 30 years. This disease can also be called occupational and environmental disease. Encarta (2005).

4. Fire Out – break: Fire resistance is the ability of a material to retain its physico – mechanical properties when it is subjected to fire or an elevated temperature (up to 1000^0C) Airapetov D. (1986)

Since some materials can easily be ignited and / or loss strength on exposure to fire, care should be taken to consider material resistance to fire. According to resistance to fire, construction materials are customarily classed as combustible (e.g. Wood, Tar, Bitumen) and non – combustible (e.g. both natural and man – made inorganic materials and metals), while some group of materials lie midway between the two above. Therefore, wrong choice of construction material can easily lead to fire out – break, when the place it should be used is not also considered.

5. Unconducive /Uncomfortable Environment: Choice of certain construction material makes the environment unconducive and uncomfortable to the inhabitant. For instance, the use of dark coloured, gloss and other paints which may be toxic and uncomfortable to the inhabitant should be carefully selected. Care should be taken in making choice of paints for a particular place or for specific purpose. Use of oil paint inside the interior of a house produces and radiates heat; use of light paint externally radiates or reflects light rays; while the use of dark coloured paints absorbs heat from the sun. Another instance is the use of concrete paving round the entire compound which exposes the environment to harsh weather of the sun, instead of using soft landscape material like trees, grasses and shrubs, which rather makes the environment more conducive and comfortable for the inhabitant.

IMPLICATION

Sequel to the rapid growth of construction activities in the urban environment, construction material has also constituted to one of the determinants of the condition of the environment. Therefore, care should be taken in proper choice of construction material, since wrong choice of material if not properly handled will eventually lead to environmental degradation such as: building collapse which may destroy lives and

properties and health hazard which may sustain little or no life for the future generation of a particular environment.

RECOMMENDATIONS

This paper having highlighted the dangers of wrong choice of construction materials to the environment, therefore recommends the following:

1. **In-depth Knowledge of Construction Materials:** Innovation and advancement in materials has jeopardized the environment as a result of wrong choice of these materials. Therefore, architects and other designers who specify should follow the new trend in development in studying the Biological, Mechanical, Chemical and Physical properties of these materials to minimize these limitation and improve efficiency in the use of these materials.

2. **The Public:** The public especially the client, to take heed to the advice of an architect and others trained to specify construction materials as regards to choice of material, since they have little or no knowledge of such materials.

3. **Proper Specification Writing:** Architects as initiators, originator of projects and one who specifies construction materials should learn the proper ways of specification writing. According to Arc. Haruna I.A. in his paper titled "Specification writing" presented at Abuja during the N.I.A Abuja Chapter Seminar/General Meeting on 27th September; 2006, pointed out that the style of writing is technical in approach. This means it should be devoid of long paragraphs in display of good literature. It should be short phrases with figures and good punctuations to make technical sense. One of the CSI's (Construction Specifications Institute) tenets of writing specifications demands that "you say it once and clear, concise, complete and correct". This is because wrong, unclear or improper specification can mislead the builder or the contractor from carrying out what (exact

material) the designer has in mind. The architect or engineer has the duty to see that the products furnished in compliance with his drawings and specifications are actually suitable for the particular uses intended.

4. Contractor's Attitude to Substitute Materials: Contractor should desist from the attitude of substituting cheaper material for the specified material by architect. According to Edward R.F (1982), one of the most common occurrences during construction is the constant search by the contractor to obtain products that cost less than these actually specified, and offer them to the architect/engineer as substitutes (sometimes without offering a share of the savings to the owner). The ever – present desire to use cheaper materials that frequently have not had the test to show that they will perform as well as a specified product frequently leads to claims against the architect or engineer for negligence if it is determined later that the product did not perform as required. Great care must be used in the approval of new, substitute products as well as in the application of some established ones.

5. Professionals, Regulatory Agencies and the Government: They should individually and collectively educate the public about the role and the importance of engaging and / or involving qualified and competent professionals in the design, choice of material and construction processes of the building. Such enlightenment should highlight the implications of the patronage of quackery, as well as the legal implications of contravention of the design and construction processes viz, building codes, building bylaws and regulations.

CONCLUSION

This paper has elaborated well on the choice of construction materials, and its effect on the urban environment. In-depth knowledge of various construction materials and its

properties are necessary as this may lead to right choice of construction materials. Wrong choice of materials for construction due to ignorance, wrong specification by architect or contractor's attitude to substitute materials specified by an architect will be dangerous; since this may cause building failure, poor aesthetics, environmental disease/health hazard, fire out–break and un-conducive environment. Therefore, participatory action in the choice of material is necessary whereby the client/developer, architect/designer, and users will be involved. Professionals are expected to advice and specify accordingly, while the contractors are expected to carry out the construction work without substitution of cheaper materials but according to architect's specification.

REFERENCES

Adedayo O.F., Ayuba P., Isah A.D and Yelwa M.U.K (2007), Improving the Aesthetics of Residential Areas in Nigeria Urban Centre, 1st Annual National Conference SET, FUT, Minna Page 117.

Airapetov D. (1986), Architectural Materials Science Pages 22 – 23.

Anunobi A.I. (2006), Training of Architects to Meet the Challenges of the 21st Century. AARCHES Journal, Nigeria vol. 5 No. 1, Page 4.

Don A. Watson (1972), Construction Materials and Processes. New York, Mc Graw-Hill Book Company Page 1 – 5.

Edward R. Fisk, P.E (1982), Construction Project Administration. Second Edition, New York Chichester Brisbane Toronto Singapore, John Wiley and Sons. Page 103.

Encarta (2005), Encyclopedia.

Onolaja O.A., Kilasho O.M, and Bello O.A. (2007), Collapse of Building 1st Annual National conference SET, FUT, Minna.

William D., (1997), An introduction to Material Science and Engineering, New York, Chichester Brisbane Toronto Singapore Weinheim, John Wiley and Sons, Inc. Pages 1– 5.

Zubairu S.N. (2006) Participatory Design – Community and Users\Input in Design. AARCHES Journal, Nigeria Vol. 5 No 1, Pages 55 – 58

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