Global Scientific JOURNALS

GSJ: Volume 9, Issue 5, May 2021, Online: ISSN 2320-9186
www.globalscientificjournal.com

MATERIAL SELECTION: MAJOR CRITERIA FOR OPTIMISING BUILDING MAINTAINABILITY

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Abstract

The Maintainability of buildings somewhat depend on the determination of the materials used and their capability to oppose defects from crumbling, ease of care, and limited support cost needed to improve it through its planned life. Subsequently, it is profoundly important that during the planning stage, multiple material alternatives are recognized and analysed for their appropriateness to accomplish practicality during post-development inhabitance. The information contained in this paper were mostly obtained from secondary sources of data collection such as books, articles, magazines, slides, journals and other related literature, and from personal observations. This article utilizes a collection of parameters to assess materials concerning their expected diligence to material sustainability before and after construction. Some material parameters such as cleanability, material maintainability, health and safety, material economy, material availability, thermal execution, and acoustic properties have been well discussed in this article, and designers are encouraged to always design with material choice in mind to avoid high maintenance cost throughout the lifespan of the building.

Keywords: *Cleanability, Maintenance, Material Maintainability, Post-Occupancy Development, Sustainability*

1.0 BACKGROUND OF STUDY

The idea of maintainability was officially started by the military administration of the United States in 1954. The problem of building maintainability has become increasingly relevant in recent years, as it has a direct effect on the long-term sustainability of building facilities. Maintainability has a broader meaning, encompassing not only reparability but also the ease with which an item can be restored to meet its original purpose. As a result, maintainability should be considered from the beginning of the design process.

Buildings deteriorate over time due to age, environmental conditions, usage of the building, method of construction, materials used for construction, the tactic and quality of construction,

and also the maintenance management of the buildings (Zubairu, 2001, Olotuah,2006, Cheng, Tsai, Lien & subgenus Chen, 2007). Work should be allotted to confirm that the building area is in safe, healthy condition in accordance with a specific standard.

Building maintenance may be outlined as "practices undertaken so as to preserve, restore or improve a facility, i.e. each part of a building, its services and surroundings, to presently accepted levels and to sustain the utility and worth of the facility" (Dept. of setting, 1972). This definition could be a modification of the B.S.3811 definition. The extra phrase is "currently accepted standard". This was enclosed considering, over time, it had been ascertained that standards amendment are different from country to country. It is thus important that minimum standards area unit are established by each country as a basis for the minimum acceptable level of maintenance of buildings.

The primary aim of a minimum standard is to protect the general public's health and safety. There are two types of maintenance standards that must be created: Standards of quality and quantity (Habitat, 1993) - Quality requirements define the activities that must be completed and the frequency at which they must be completed, thus determining the level of maintenance service that will be provided. The resources required to complete each task are described by quantity standards. The sum of labor, materials, and equipment that should be used to complete the job are among these tools. Depending on the image and roles of the company, as well as economic considerations, various organizations have different requirements.

A change in the use of a building could result in a reduction in the building's standards. A company can, for example, take over an office building and turn it into a warehouse; on the other hand, higher standards may be needed as a result of a new use for the building. However, it is the responsibility of the country's government to develop minimum maintenance requirements that should be followed by all building owners.

2.0 METHODOLOGY

This paper explored secondary sources for data collection which entails the study of existing literature and data relating to issues on material maintainability. A thorough literature search was carried out both online and offline to understand the experiences and limitations faced by not choosing the materials alongside the design process.

3.0 DISCUSSION

3.1. Building Material and Maintainability

Building materials are items or components used for construction. Several presently used materials, like clay, rocks, sand, and wood, even twigs and leaves, are typically used to construct buildings. The production of building materials is a longtime business in several countries and therefore the use of those materials is usually segmented into specific specialty trades like woodwork, insulation, plumbing, and roofing work. They constitute the make-up of buildings and other structures.

Any material used in construction is referred to as a building material. Building materials normally account for 30-60% of the total cost of a construction project. The materials chosen during the design stage of a building would have a direct effect on its long-term maintainability. Building materials are critical for growing building maintainability and leading to economic growth. The choice of construction materials has a major effect on the building's upkeep. Furthermore, if materials are not chosen according to the maintainability principles, it might lead to unpleasant circumstances later because all building materials have an effect on the building's maintainability during its life cycle. The use of faulty, low-quality materials and/or design specifics is a common occurrence in many projects, resulting in significant failures during operation and, as a result, shortening the service lives of many structures.

3.2. The Related Issues

A significant factor to remember when attempting to achieve design maintainability involves choosing appropriate building materials during the design stage of a project. Using faulty, low-quality materials and/or design specifics is a common occurrence in many construction projects, resulting in difficulty in use and even defects during the post-construction phase. Planners and architects frequently ignore this very significant factor, which can possibly do future support maintenance. Building maintenance and support costs that are somewhat disregarded at the planning and development stages brings about troubles and are expensive in maintaining after construction. The expenses, brought about by the viability issues, have caused critical issues in numerous nations throughout the planet. A deficient material choice would monetarily affect the structure's all-out support cost.

An important issue to be thought of in achieving style maintainability during the design stage of a building project is choosing an appropriate material. During the planning stage, the planner ought to consistently distinguish materials that can withstand current environmental conditions. Study the forceful ecological and environmental conditions that could lead to early decay of building materials and using alternative materials that can mitigate against such conditions. Planners ought to research the properties of the materials before specifying them.

It is significant for designers to consider the determinations, data, and information about the performance of materials. Nonetheless, such action would be complicated if there is an absence of information on the elements of the materials. Further, (Silva et al 2004) clarifies that the choice of materials, in a specific area, is influenced by the environment, accessibility, building method, and economy. Consequently, material accessibility should be considered at the development stage and when substitutions are required.

3.3. Maintenance Consideration at Design Stage

It is an age-old architectural tradition that the architect is expected to consider maintenance choices and costs from the beginning of the design process (Seeley 1987; Mills 1994; Lush 1994); however, this remains more of a hypothesis than a reality. According to Dunston and Williamson (1999) on facility maintenance issues, style flaws, among other things, have been blamed heavily. “Failure to gain and communicate professional knowledge on design specifications, systems/components incompatibilities, and product performance limitations is a widely cited cause of subsequent problems for maintenance personnel,” they added. The manufacturer or specifier must have a thorough understanding of the available materials, their properties, and their maintenance specifications in order to properly consider maintainability (Zubairu 2010; Dunston and Williamson 1999). Designers must ask themselves these four questions when they design each feature or part of a building, according to Seeley (1987).

- How do you get there?
- What is the best way to clean it?
- How long is it going to last?
- How would it be replaced?

Unfortunately, architects in Nigeria are often more concerned with the material's aesthetics than with their maintenance requirements (Zubairu 2010). In a survey of 211 major building design firms in the United States, the relationship between design practices and maintenance was investigated, according to the findings (Arditi and Nawakorawit 1999), the following design were deduced:

- Ease of repair and replacement, access to cleaning area, and ease of cleaning were among the least important design factors considered by designers during design;
- Maintenance-related complaints ranked far higher among the complaints designers reported receiving from clients and tenants.

As a result, it should come as no surprise that designers are primarily responsible for the high costs of building operation and repair, and should be held accountable for seeking a long-term solution. According to the English tort law principle of "Duty of Care", a designer must take good care to ensure that his client or third-party customers do not suffer any foreseeable economic damage as a result of his omissions or negligence (Speaight and Stone 2010). As a result, it is critical to put in place policies that make it easier to adhere to maintainability requirements.

3.4. Material Selection Criteria

There are certain maintainability qualities that should be considered when selecting materials for construction; they are:

3.4.1 Durability

Durability is the capacity of structures and their components to execute their essential capacities for the duration of their life cycle with little or no additional effort.

The ability of a material to perform its required functions without having to be replaced with a new material during its life cycle is referred to as longevity of materials. These considerations are important in the selection of maintainable materials because durable materials need less maintenance over their lifetime and, as a result, have a lower maintenance cost. Therefore, the quality of materials is an important factor to consider when selecting facade materials to increase the building's maintainability.

.3.4.2 Availability

Availability of material can be defined as a proportion of the level of the complete stock of a material that is operationally equipped for playing out an allocated purpose at an inconclusive arbitrary point on the schedule.

The term "material availability" refers to materials being readily available and accessible during repair and replacement work. Since long delivery times for materials may cause the project to be delayed and costs to rise, material availability can influence the decisions made on facade material choices. Locally available materials are easier to obtain and less expensive than materials obtained over long distances. The preceding discussion suggests that when selecting products, availability requirements must be considered.

3.4.3 Economy

Material economy refers to products that provide optimum output at the lowest initial and life cycle costs. Most designers and customers, according to Chew (1987), will use the initial cost to determine the project's economic acceptability; however, it has been shown that the initial cost might not be the most cost-effective option, as low-cost materials also necessitate more frequent maintenance.

In the other hand, to obtain a fairer value, economic considerations must be included in the initial cost of purchase and the life costs of products. Shortlisting materials that provide the best value at the lowest cost is a good way to start. It goes without saying that during the material selection process, materials economics requirements must be considered.

3.4.4 Thermal performance

Thermal Performance describes how well a structure responds to changes in outer temperature during the everyday and occasional cycles.

Thermal properties of a facade system are related to a specific material regardless of its dimensions or position, as well as properties that are related to the material in a specific design as it is used in a building The temperature is higher in the tropics, and the facade is subjected to higher heat loads and thermal shocks. As a result, their overall performance and rate of decline can differ tremendously under the temperate circumstances. The aim of thermal facade design is to manage and monitor heat gain and loss. As a result, the facades must be carefully constructed to minimize solar heat gains. Improving the thermal efficiency of building facades is critical for

reducing energy consumption, improving thermal resistance, reducing thermal breaches, and improving air tightness. As a result of the preceding discussion, it is clear that thermal efficiency requirements are essential factors to consider when choosing a facade material.

3.4.5 Health and Safety

The Health and safety parts of a material can be defined as the sum and mix of constituents in a material that are purposed to forfend any injury, illness, harm, or pharmacological impact in individuals.

When it comes to quantifying and rating the maintainability criteria in material selection process, health and safety are two of the most important considerations. However, today's residential buildings contain a significant amount of heavy metals and chemicals, which can cause nose and throat irritation, asthma, headaches, nausea, cancer, and immune system suppression, among other health issues. According to a report conducted in the United Kingdom, the relative humidity of indoor air should be between 40% and 60%, which is the most appropriate range for human health. When the relative humidity falls below 40%, it is referred to as the "sick building" syndrome. As a consequence of the preceding debate, health and safety requirements must be considered during the material selection process.

3.4.6 Functional Performance

Functional performance can be defined as the effectiveness of a material to level up to the best of their ability which will result in low maintenance cost

Functional performance of the material is the conduct of materials to accomplish up to the best of their ability with the lowest deficiencies. It is essential to write down the performances of different materials so as to develop or avoid using materials that are found not performing satisfactorily. Nevertheless, selecting materials with the best performances might not basically follow-on in the most active building, since the productivity of such constructions relies on how the materials are placed together to form a building. On the other hand, Soronis, stated that most maintainability failures rely on the real fact that knowledge of the performance of certain elements or materials is merely available in the literature. In certainty, designers do not have the time needed to review these documents. It is vital that the professionals within the field of maintainability support designers by providing information on the behaviour of materials and on their interaction with the surroundings. Thus, an inspection of defects of building material that

are capable of meeting functional performance at regular intervals could also be considered as "maintainable"

3.4.7 Acoustic property

The recent environmental sound pollution raises concern about the construction of buildings in noisy urban areas. Acoustic standards should be more widely used in the design of building envelopes, according to experts. In urbanized areas, noise pollution from traffic is a major concern. The fundamental key to determining the interior sound pressure levels is the acoustical facade load, which concerns the sound pressure level at the outside of the building and the facade insulation. Using high-performance elements or customizing the shape of the facade may enhance sound insulation. The preceding discussion suggests that acoustical parameters must be considered during the design process.

3.4.8 Material Sustainability

Material Sustainability can be described as the use of those materials that are drawn from inexhaustible sources that don't unfavorably influence the environment, as well as both the actual materials and their environmental factors.

Sustainable components and materials conserve energy during production and are efficient, reduce health risks for all consumers, reduce global environmental hazards, and are recyclable. The designer should always look for materials that can withstand the weather in the region since adverse environmental and weather conditions cause products to deteriorate prematurely. According to previous studies, one of the most significant fundamental parameters in managing building maintainability is sustainable content. As a result, it is evident that sustainability is an important criterion in material selection in order to improve building maintainability.

3.4.9 Cleanability

The cleanability of material is the capacity to clean effectively the materials or its neighboring segments so it will actually meet aesthetical and practical operation requirements. The cleanability standards highlight the recurrence and the technique for cleaning and maintenance of various sorts of materials which attribute to the longer life expectancy of a structure. Consequently, the more prominent the sustainability, the lower the cleaning needed to keep the material useful. Cleanability is one of the most important factors that should be assessed while choosing building materials for construction.

4.0 CONCLUSION AND RECOMMENDATIONS

The utilization of materials for accomplishing future viability relies upon choosing materials that can possibly oppose defect from regular deterioration so they would keep on accomplishing their expected capacity all through their life expectancy. The choice of materials for building development is quite important and should be done from the planning stage of the project. To an extent, building defects generate from the wrong selection of materials in regards to maintainability during the planning stage. It is crucial to realize the preventive measures to be taken to improve the viability of the structures. This article has introduced the implications of material selection and the measures for choosing viable maintainable materials during the planning stage from a broad outlook.

The discoveries in this paper recommend that Durability, Material economy and Thermal Performance are some of the crucial standards that require consideration for the effective choice of sustainable material for streamlining building sustainability. The disappointment of ignoring maintainability attributes in material determination in the past had prompted led to maintenance issues in the post-inhabitance stage; this may be curbed if appropriate sustainable material choice standards are considered in future structure projects.

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