

THE EFFECTS OF STRUCTURAL DETERIORATION IN BUILDING COMPONENTS (A CASE STUDY OF JMDB ESTATE HOUSING, TUDUN WADA ROAD, JOS PLATEAU STATE)

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ABSTRACT

Structural deterioration of building is an action that can occur spontaneously which can affect the individual building components and to the general structure. Deterioration can begin to present itself in form of cracked wall, foundations or floors, moisture penetration, leakages of roofs decomposition or rust of roof members etc. since the building is exposed to so many factors such as natural (weather) elements, it is bound to deteriorate even when not occupied. There are many reasons why building lie fallow and untreated, however the dangers are enormous. Maintenance of buildings appears to be the dominating factor that checks the deteriorative nature of the building, averting hazards posed by deterioration in buildings. Deterioration has strong effects on the structural stability of the building, as well as the comfort/health or safety of occupants and finally the life-span of the building. Although the building is a capital asset of the organization, instead of building owners assume maintenance of the building as a vain liability and not a priority.

Keywords: Corrective Maintenance, Planned Maintenance, Structural Deterioration

INTRODUCTION

Building maintenance may be defined as works undertaken in order to ensure that the aesthetics, value, safety, quality, reliability, life span and functional performance of a building does not fall below acceptable standards (Olanrewaju. 2010). These standards have been regarded as relating to user needs, the responsibility of the maintenance personnel for safety and the owner's interest in

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reserving his assets. Maintenance is also defined as the combination of any action carried out to retain an item in, or restore it to, an acceptable condition. The action referred to are those associated with initiation, organization and implementation. Retaining, i.e. work carried out before any damage occurs which can be seen as preventive maintenance; while Restoring, i.e. work carried out after damage has occurred is seen as corrective maintenance (Adejimi, 2005; Adenuga 1999).

Corrective maintenance is means of addressing deterioration in buildings to acceptable standards. This is meant to correct all the defects that have been discussed earlier involving the roof, walls, floors, materials and even the techniques involved. The dangers of water leaks and seepage, cracks and dampness etc. will be averted in the process of embarking on the process of corrective maintenance(Olanrewaju, 2010). The outcome of a building as a finished product, having passed through various processes and consisting of several components is that expected to last its lifetime through routine maintenance . It begins to perform its duty of providing the occupants with the necessary comfort and protection needed. Housing estate or low-cost units are erected by government or other bodies as societal contributions to addressing the housing problem. The durability and sustainability of these building becomes important in the quest and for investigating the causes and solutions to some of these major problems of deterioration on buildings. The important of this cannot be over emphasised, as such solution would improve the quality of lifestyle, the value for money, the life span of building, the orderliness research in order to safe guard the lives of people which is irreplaceable and many be jeopardised in a building during or after construction.

The structural stability of the building is its backbone and should possess integrity. When the structural design is faulty or left to deteriorate, the result will definitely be detrimental leading to loss of lives and resources. It is more advantageous to avoid buildings reaching unserviceable state or collapsing by maintaining and preserving them. After all, prevention is highly better than cure. Deterioration in a building is the situation where the components begin to depreciate in its original quality. The primary source and

causes of deterioration in structures and buildings are human, faulty construction, chemical, faulty materials, atmospheric, faulty systems, structural defects, faulty design, moisture, cleaning, fire and vandalism.

Repairs and maintenance include both the process of retaining and restoring the components. However, these deterioration factors lead to structural failure. Hence, structural failure can be seen as the conditions at which a structure reaches its limit state. It does not always imply total collapse, but some structures are considered unsafe before they even collapse hence, the condition of a structure when it becomes unserviceable is called a "limit state".

When buildings are designed, maintenance should be put into consideration before the building is erected in respect to the life cycle of the building)(Assaf et al, 2010). If not so such buildings are bound to create problems to the users in respect to their value for money and or optimum usage of the building. This problem most at times lead to quick obsolesce and failure of the building. For this reason the present study will investigate the cause and effect of deterioration on building components. Proper building maintenance should be considered during planning, design, construction and maintenance stages. Effective building maintenance requires the correct diagnosis of defect and implementation of the correct remedial all based on sound technical knowledge, otherwise waste of capital resources have to be done again. Evidence from observed buildings reveals the stage of progressive deterioration of these building components affecting the building itself. The research aims at exposing factors responsible for the deterioration of buildings as well as those necessary measures to be taken.

A careful study reveals how deterioration would affect a building and its cost, under different circumstances and reasons(Talib, Ahmad, Zakaria, &Sulieman, 2014; Odediran, Opatunji,& Eghenure, 2012; Siu, Bridge &Skitmore, 2010). However, maintenance policy has proven to be at the rescue of these agents. Lists of the agents that act upon and erode buildings' initial standards according to Lee (1981), include:

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- a. Climatic conditions which vary in severity according to the location and orientation of the building.
- b. User activities which include both human and mechanical agents as well as authorised and unauthorised usage.
- c. Changing standards and tastes.

The extent to which these agents cause deterioration and thus create a need for remedial treatment will depend upon;

- a. The frequency of the design and the suitability of the materials specified
- b. The standard of workmanship in the initial construction and subsequent maintenance.
- c. The extent to which the designer has anticipated future needs. There are three categories of maintenance, namely:
 - a. Major Repair or Restoration: This is work such as re-roofing or rebuilding walls. Work which frequently incorporates improvement to bring a building up to modern standards.
 - b. Periodic Maintenance: Work undertaken by; say annual contracts and including external repainting, internal redecoration, etc.
 - c. Routine or Day-to-Day Maintenance: This is largely of the preventive type, Such as checking the efficiency of rainwater gutters and servicing mechanical and electrical installations.

Due to the present condition of the estate, the type or form of corrective maintenance that will adequate can be seen as the "major repair or restoration." As seen above, there will be a great need to change the roof coverings replacing them with new ones/by so doing, the height of the roof can be raised in order to increase the slope for an easier flow of water. This includes the fascia boards and the ceiling boards as well. The walls of the building will have to undergo some sort of major repair such as re-plastering and re-enforcement to bond the cracks existing on the walls. This is also applicable to note the floor area of the buildings.

It is important to note that, the other categories of maintenance (i.e. periodic and routine maintenance) will have to be incorporated in order to maintain the corrections done. By checking the maintenance) will have to be incorporated in order

to maintain the corrections done (Olanrewaju, Babatunde, & Anifowose, 2015). By checking the presence and efficiency of rain water gutters, mechanical and electrical fittings, replacing broken door/window glasses and fittings and refuse disposal, the desired and acceptable aesthetics, values, safety, quality, reliability, long life span and functional performance of the other hand, the economic value of the estate will be boosted (Usman, Gambo & Chen, 2012; Waziri, & Vanduhe, 2013).

This achievement in the estate entails precisely the correction work on several parts of the buildings. These are the walls (i.e. plastering), floor and stair ways. These are parts that have been highly defected, some due to either obsolesce or poor construction. Defects due to civil construction; inaccurate measurement, damaged from work, inadequate water proofing, premature formwork removal etc. as earlier stated by Assaf, Al-Hammad & Al-Shihah (2007) can be responsible for the poor structural strength of the stairways and slabs. The stairways have some steps broken and railings very fragile, not underestimating the vibration it possess even under the minimum pressure. Other defects present in the estate buildings are constituted basically by natural deterioration due to age, environment and miss use by occupants and rented houses (such as Jos Metropolitan Development Board (JMDB) Housing estate) are more liable to abuse than owner occupied houses (Olagunju, 2012).

Another important issue is the roofing component which exposed the most to the effects of weather. Therefore, roof system will soon cause defects in other components. A critical direct case in the estate is the issue of reroofing. Though reroofing can constitute a high cost, Griffin (2000) has it that reroofing saves the perennially troublesome roof leaking which later becomes more difficult to repair, replace or recover during winter. Hence a recovered roof has less chances of lasting out a 20 year service life than a new roof build with comparable care and skill. Finally, the easiest and best way in respect to minimum cost is the raising of the roof pitch to better drain water by increasing the steepness of the slope. After all, the basic reason why you should drain the roof is the superiority of water shedding over water resistance (Seely, 1987; Wall, 2006).

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RESEARCH METHODOLOGY

This study adopted a case study methodology to determine the extent of Structural deterioration of buildings identified in the estate. This research design was used because it sheds light on the unique characteristics of the structural defects. Research of this nature relies on buildings and buildings under several forms of deterioration due to one reason or the other. As such a presented/peculiar case would be studied on buildings that would enhance and illustrate points to achieve the aim of the research. A case study of an estate housing unit, which is the Jos Metropolitan Development Board (JMDB), was used to carry out the necessary field study. This is located at Tudun Wada Jos, Plateau State. The case study presented the kind of features (in respect to the deterioration and failure of buildings) needed for the study. Photographs were also used for illustrative purposes.

Study Area

The area of study this research is Jos Metropolitan Development Board (JMDB) Housing Estate, Tudun Wada, Jos North Plateau State featured in Plate i.



Plate i: Aerial View of study area
Source: Google Earth (2018)

The buildings consist of semi-detached buildings containing three bedrooms of four flats in one storey buildings, two bedrooms bungalow, one bedroom block of four flats and boy's quarters.

The poor level of functionality can be seen even without entering the building. This can be revealed by the stairway above the main entrance doors, and the entrance doors of some of the buildings are placed diagonally opposite the exit doors. The orientation of the buildings is also not appealing as unsightly deposits from the rear of some building settle at the approach of others.

FINDINGS

The problems are outlined as observed of the building components in the following order of roofing systems; wall systems and floor/foundation systems.

a. Roofing Systems

The roofs happen to be the most affected part of the buildings. Most of the houses have their roof sheeting's opened at certain places due to wind pressure. This in turn makes the roof members vibrate excessively and become weak with time, thereby causing leakages into the ceiling system as well. The exposure of these wooden roof members to rain/moisture bring about the fast decaying of the roof and enhances the deterioration that is being experienced as seen in plate vii.

Rotted eave boards were present as a result of water issues that have been present for some time. These rooted areas are due to the failure of proper constructed drip edges. The crumbled and discoloured wood must have been caused by mold, mildew, or even dry rot. These are extremely damaging causing structural failure like the roof collapsing. Apart from this moisture that aids the survival of these fungi, poor ventilation is also a contributive factor to deterioration and failure in the roof system.

b. Wall Systems

The walls of buildings in the area are cracked at joints between them and at other points which shows faulty foundation detailing. They are also corroded at those points of damp which gives the wall a spongy look. Dampening can be noticed on the walls which is mostly just a little above ground level. This is shown by the black discoloration which can be about 300mm or more. This shows a problem in detailing of the foundation system in the area of moisture protection which arises from the presence of

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surface and underground water. Deterioration in walls can be as a result of poor roof, windows or door construction/installation as shown in plates ii, iii and vi.

The cracks further allow the penetration of moisture which led to the growth of dry rot and mildew. Most of the exterior walls have their paints peeled off. Treated cracks (using cement and water mix) can also be noticed on the exterior of many buildings located in this area.

c. Floor/Foundation Systems

The floors of the buildings are covered by too many cracks and holes. These can be experience mere at the entrance and verandas of the buildings. These cracks can be attributed to the foundation and also the obsolesce of the buildings. Cracks are also seen on the foundation of the buildings. These cracks are responsible for some of those cracks existing on the walls of some of the buildings. The foundation is also responsible for the dampness experience at some parts of the buildings. This shows a problem in detailing of foundation system in the area of moisture protection.

The inter connections existing amongst these components can be considered as the interface detailing of the components i.e the foundation, walls and roof. This means that, any construction defect on a particular component can be as a result of the other components(s) or perhaps, the techniques involved in their interface detailing. A practical illustration can be related to the cracks on the foundation which leads to those on the walls. Another can be related to poor roof construction in terms of roof gradient and edge drip which enhances leakage into the ceiling, eave boards, roofing members and possibly the walls.

The effects of these studied problems are numerous affecting both the buildings and the users. The main concern however is the effect the occupants. The deteriorations have made the environment unpleasant and unhygienic. Deterioration is as a result of design and also construction errors. Rain water is left to flow at random and most at times, it is being trapped and remains stagnant. The waste discharged from kitchens and some baths. This uncontrolled deterioration has adversely affected the

buildings, and this can be attributed to the reason(s) why a few of these buildings have been left unoccupied as seen in Table 1.

Table 1: Showing problems of unoccupied flats in Jos Metropolitan Development Board (JMDB)

BUILDING TYPES	NO	PROBLEM(S)
3 bedroom semi-detached	1	Floor has been badly damaged due to long time and perhaps careless usage
1 bedroom flat	2	Experience a high amount of leakage from the roof which has led to rotten and falling ceiling members. Also leakages in roof (due to raised roofing). Too many cracks existing on the deck, walls and floors with very rough holes on the floors as well.



Plate ii: Walls with plaster falling off



Plate iii: Walls with cracks

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Plate iv: Broken and overflowing septic tank



Plate v: Broken floor at threshold



Plate vi: Concrete spalling on walls



Plate vii: Exposed roofing sheets



Plate viii: Stair ways without railings



Plate ix: spiral stairs without handrails

CONCLUSION

In the present living condition, the situation has not changed from the initial time of occupancy. The research showed that since the completion the estate, security and adequate maintenance have not been provided, maintenance and repairs and have not been carried out as well. This includes works and equipment. Refuse disposal in the estate has none of the modern methods of disposal. When house hold waste accumulates, it is being disposed on an open site close to the estate. This could cause ill health to the closest occupants. The defects as observed in the Jos Metropolitan Development Board (JMDB) occurred as a result of the following reasons:

- a. Poor maintenance organization
- b. Poor operational services
- c. Poor specification and choice of materials
- d. Incorrect detailing
- e. Rough usage by tenants.

One of the major factors responsible for these poor building conditions has been identified as lack of maintenance policies and management functions. There is also high level of redundancy on the part of the estate owner as well. Therefore, these buildings

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will have to undergo some form of maintenance management processes that can better be feasible if taken over by a (new) maintenance body that would be ready to take adequate measures in order to achieve positive restoration and maintenance of these buildings. Also, detailing is a term that deals with the nitty-gritty of the assembly of a building based on preparation (design by the architect) and construction. Also as a positive step towards maintenance and cost management, it therefore has to be generally taken into consideration right from the beginning that is, design and construction stages because it involves proper planning and preparation of the total assembly of the different building components.

RECOMMENDATIONS

It will be in order to recommend more on the issue of maintenance since this research has been motivated by the deteriorative conditions of buildings. As critical as the issues of the defects may be (and several factors can be traced to be the reasons for such) maintenance remains the only and best way to the restoration of the situation. A stitch in time saves nine, applicable it is here, where maintenance is the key to restoration. Indeed, maintenance will be able to avert the destructive and dangerous results of building deterioration, such as loss of assets/resources and lives due to the collapse of such buildings.

A Maintenance programme is necessary here as the remedy and can be operated over a five year period. It is normal to carry out all foreseeable remedial and decorating work in order to achieve the required standard in the first year, which entails high cost maintenance though. In the remaining four years, expenses should be much lesser as the only work necessary will be emergency work and annual servicing. It is also advisable to carry out any necessary alteration(s) and improvement to the buildings during this first year of the cycle. This will also help in providing some form of modern appearance to the estate. It can be seen therefore, that by adopting a planned maintenance policy, the client is able to budget his finances in a realistic manner. These eliminating the need for the occasional large maintenance bill at regular intervals this is highly advantageous as a lot of money can be saved, being sufficient and enough to employ the services of

maintenance contractors. However as stated earlier, these buildings seem to be abandoned by the owner. And so, it is advisable to have them being sold and taken over by committed owners or estate managers, this will reform the entire estate to the benefit of both the owners and the tenants.

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