

Defects in Buildings: A Study of the Twin Theatre, Federal Polytechnic Bauchi.

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Abstract

As days go by new buildings are erected and as such new construction defects are discovered. As defects are discovered, some defects are obvious while some others remain hidden within the building erected and eventually manifest themselves after a long time. Since materials used in constructing buildings depreciate in quality at a very unpredictable rate, the rate at which any defect visualizes itself in a building façade is likely to vary according to the nature and tempo of the attacks on the building components. Usually, during the erection of buildings, several determinants are put into consideration to secure the strength and integrity of buildings but defects will still manage to surface. This research is based on the causes and remedies of defects in lecture theatres, by using the case study method. The case study used is the twin theatre, Federal Polytechnic Bauchi. This paper concludes that the recognized defects can have a great impact on buildings.

Introduction

Regardless of the rate of housing development, new buildings are constructed and new construction faults are uncovered. Design defects encompass a wide range of difficulties that affect people in varying degrees of severity. The definition of design faults varies depending on the type of structure under investigation, as well as the use and amount to which the design contributed to the defect's severity. So, in general, we'll be looking at design defects, and according to design defect research, design defects are the leading cause of latent defects. According to study, design defects do not manifest until after the building has been completed, unless the defect is severe enough to induce a rapid

rate of degradation. Architectural finishes were shown to have less major latent problems, however, this study also discovered some structural defects. As a result, the focus of this research is on finding design techniques and failure reasons in order to prevent hidden faults at the design stage of a building.

Buildings are enclosures with walls, floors, roofs and other fittings and components like doors and windows. They are made for a variety of functions or uses. Buildings can be utilized for a variety of reasons, including industrial, commercial, religious, educational, and service. Residential development is the process of erecting and constructing structures for the purpose of habitation. The construction of structures for structured economic activities associated with the production, construction, and manufacturing of specific items is referred to as industrial/commercial applications. (2005, Carillion) stated that *'Buildings are considered to be incredibly durable commodities,'* Religious structures are built for devotional and worship purposes.

While educational usage refers to the use of buildings for the aim of distributing information or acquiring knowledge.

Buildings are made up of a variety of components that make them convenient for people to use. Windows, doors, ceilings, and other elements may be included. Concrete (mass or reinforced), steel, metals, polymers, wood, and glass are among the materials used to construct these components. Buildings become prone to faults when materials begin to degrade in quality (as a result of temperature fluctuations, expansion, humidity, and other factors), function, and efficiency. (Blake-Turner & Co Solicitors, 1995) *Defects will arise in buildings. It's one of life's big certainties, comparable to death and taxes in other aspects of existence.* Defects are physical defects in a system that prohibit it from performing as intended. Inadequacies, defects, faults, and defects in a system or structure and its components are called defects. Deterioration or weakness in the strength and value of structural systems and components that make up the structure are referred to as structural faults. Beams, columns, slabs, arches, and other structural elements make up a building's structure. In general, building faults are caused by the age of building materials, the number of people and the amount of load supplied by buildings, and climate effects (such as temperature, humidity). The three most important design-related failure scenarios, according to (Sui-pheng low & Wai-kiong 2006), *Weather, occupant impacts, and load and moisture from damp areas are the three most critical design-related failure scenarios.* The defects could arise from the building's design to the materials utilized in its construction. According to (Allen & Maggs 2011) *'Purchasers of old property should be aware that building components require more regular upkeep and attention as they become older'*. Cracks in walls, excessive drooping of roofs and ceilings, roof leaks, plumbing issues, termite penetration into timber components such as doors and cupboards, rotted floorboards, mold, electrical system, landscaping, and improper drainages are all instances of evident construction problems. These defects could be structural or non-structural. (Watt, 1999) *suggested that building faults can be caused by the use of improper building materials and bad expert decision-making.* While (Carillion, 2005) *the vast majority of these defects in structures, according to the author, are caused by the following factors: Use of a component or material that isn't appropriate, the usage of one material next to or in*

conjunction with another that has a negative impact on it. The designer's lack of understanding of the materials' potential for degradation, the structure has been subjected to external forces or agents that were not considered in the design. Mechanical, electromagnetic, thermal, chemical, and biological agents are examples of such agents. Manufacturers' inaccurate information, Poor manufacturing quality, and workmanship, as well as a lack of competent oversight during the construction phase, and the failure to perform necessary routine maintenance on schedule.

LITERATURE REVIEW

Because defects are highly technical and specialized in nature, a great deal of precision and accuracy is required in establishing their origins, effects, solutions, and impact. Many investigations have proven that many errors and defects in the undue designs that appreciation of buildings. Building defects can occur for a variety of reasons, including insufficient site investigation, weather, and others. However, it is critical to comprehend what constitutes a design defect and what steps should be taken to address it.

Even yet, there are rules, codes, and other measures in place to guarantee that structures have a time of low exposure to construction material failures and product failures.

The reality is that to make more money, builders and developers frequently take corners, which includes the decisions they make when purchasing building materials or installing a certain product. Builders frequently have a large array of construction materials from which to choose, and in the interest of saving money, they may use materials that are regarded inferior. Because of the low quality of the material, the rate of wear and tear may be high, affecting other components of the building.

The problems may appear to be easy or only top surface defects at first glance, but they are frequently a lot more complicated than they appear, with extra concerns to deal with beneath the surface. Now, to save traders strive to choose less expensive products, but their cost-cutting strategy may appear to be quality at first, but over time, the poor material quality utilized on the roof, within the walls, or under the foundation can cause noticeable problems within the building. Dealing with construction material and product failures and their causes may be devastating; not only is it difficult to identify the source of the problem but there is also the cost associated with the process. The ultimate goal is to keep buildings safe to use, and many building owners go to great lengths to guarantee that problems are immediately and accurately resolved.

On a more positive side, the numerous possible design defects with condominium and town projects require architects to make efforts to eliminate or at least reduce these types of designs in order to order to and safety of the buildings they create.

CAUSES OF DEFECTS

The causes and responsibility of faults are determined using contractual concepts such as specifications. Contractors and designers share responsibility for faults caused by inadequate requirements. Poor specifications are usually the fault of designers, although contractors are responsible for not following specifications. According to (Low and Chong, 2004), *design is*

the most important driver of latent defects in buildings, since the condition survey revealed that design could have prevented at least 66% of all latent faults discovered during the early phases of the tenancy.

Atkinson (2003) discovered that managerial errors account for around 82 percent of all errors made or constructed in structures and that managerial faults have hidden or latent characteristics, implying that these errors are not observable throughout the building's construction stage.

'The distress on the spall brick wall all that produced vapor intrusion was attributable to craftsmanship, materials, and design defects, according to Anderson (1999). Controlling humidity and air movement, which reduces the influence on vapor infiltration, was recommended by adjusting the interior environment, i.e. the ventilation system.

Watt (1999) proposed that building faults were helped by the use of improper materials and a lack of knowledge in decision-making. Better designs, according to (Anand et al, 2003), could aid in the rectification of various workmanship-related problems in masonry works.

Designers' can contribute to the reduction of defects with their designs, and by doing so, they will help reduce many types of latent defects. The garden roof alternative design proposal in (Wong et al. 2002) can help with the reduction of roof defects by reducing the possibility of roof leakage and increasing the lifespan of the roof.

Poorly specified materials and confusing designs, according to Calder (1997), frequently result in worse construction quality. In a study, (Seeley 1987) found that faulty design accounted for about 58 percent of defects, 35 percent from operation and installation, 12 percent from poor materials and systems, and 11 percent from unexpected user's requirements, while (Ransom, 1981) found that wear and tear accounted for about 56 percent of all defects found, while poor design decisions accounted for 20%, and materials and work accounted for 20%.

Inadequate information, unawareness, incorrect assumptions, and a lack of knowledge, among other organizational and motivational factors, were identified by Andi and Minato (2003) as contributory factors to defects caused by a variety of other defects, and preventing those defects could eliminate a variety of other defects.

Foundational flaws, according to Ajayi (1998), can be caused by one or more of the following factors:

- *A lack of thorough site inspection or a misinterpretation of the results of such an examination.*
- *Foundation design flaws.*
- *Poor craftsmanship in the foundation construction*
- *Due to financial constraints, construction materials were used sparingly during the foundation's construction.*
- *Other causes of defects include defective/ substandard building materials or components-materials, such as inferior building bricks, cement, roofing materials, and badly constructed windows, as well as violations of building codes at the time of construction.*
- *Failure to fulfill professional design standards at the time the plans were approved;*

- Failure to construct in accordance with recognized trace standards for excellent and workmanlike workmanship.

COMMON DEFECTS IN THE BUILDING

There are various forms of defects that occur in building parts these include Roofs, walls, floors, ceilings, toilets, doors, and windows. The following section will discuss common building difficulties and defects, such as wall cracks, peeling paint, dampness, timber decay, fungi, and small plant attack, sagging or deformation, erosion of mortar joints, defective plaster rendering, insect or termite attack, roof defect, and also unstable foundation, and services.

OBSERVATION REPORT:

LOCATION: Twin theater, Federal Polytechnic Bauchi, Nigeria.

A huge amount of the defects discovered in this building was due to water or moisture challenges, involving plumbing, method of material installation and maintenance culture. The defected areas where the floors, walls (interior and exterior), ceilings, architraves, sanitary appliances and so on.

WALLS

Defects found on the walls in the lecture theatre were cracks on the walls, peeling of paints, moisture build up in slabs flowing to the walls.

FLOOR

The defects found on the floors were majorly broken floor finishes; the lecture theatre is fully finished with terrazzo floor, starting from the floors at the corridors to the interior spaces.

FURNITURES AND DOORS

Defects found on the furniture's was that some of the woods on the chairs in the lecture theatre were broken, and some others had their steel frames detached from the floor, due to poor flooring and floor finish.

The entrance doors were found to be completely damaged and in some areas totally nonexistence, this was due to the type of door used for the building, due to the traffic through the door and constant use, the doors experience a life span below the estimated time.

CEILING, SLAB AND ROOFS

The defects found on the ceiling where majorly due to the fact that they were not fixed well and when there was reverberation from sound from public address system, some of the ceiling boards fell down. Some others ceiling boards fell after being soaked with water, which is due to leaking roofing sheets.

Roof slabs in some areas of the building especially the entrance of the theater have the paint pilling from the decking and usually after rains, we have slab wet and at times dripping water.

From the picture we could also see that some of the aluminum coping cover are pulling off due to the strong winds experienced in this area from time to time.

RECOMEDATIONS

WEATHER

Weather associated defects were caused by: Heat and ultraviolet rays from the sun, Rain or moisture, Humid air, wind loads.

Sun is the largest source heat. Heat usually causes expansion, but when moisture is introduced to cool materials or heat source removed contraction occurs. When expansion and contraction continue on a material increase in stress in materials occur, without defense systems, cracks may set in or fractures at the weakest spots on the material. The usual defense system used against expansion and contraction is the expansion joint. It is a very effective method.

Wind is also believed to have effects on buildings especially when the openings are not closeable, examples will be doors windows and so on. It's believed that when winds gain access to the inner part of a building, the roof and ceiling could easily be blown off especially when the amount of wind entering the building is much.

MOISTURE FROM WET AREAS

The existence of moisture in areas in a building may also trigger several moisture related problems or challenges. An intermediate zone can be placed between the wet and dry area, this is to form a moisture trapping zone, in this way moisture travelling from wet to dry areas can be controlled, especially looking at the wet slabs, various methods of moisture control have been designed over time, one of the most effective methods is the used of felting material over moisture exposed surfaces especially roofs that are concrete slabs, its believed to be more effective especially when the surface of the felt is painted silver, which helps to reduce heat absorbed, and ultimately increase the life span of the felt.

IMPACTS FROM OCCUPANTS AND LOADS

Defects that occur due to impacts from occupants and loading are usually caused by inadequate design provisions. For example, edges of walls were found to be chipped due to impacts of loads and occupants. So it is advised that metals or rubber protections are used at the edges of walls in places where there are high human and load traffic so as to prevent such defects, with time it will be discovered that the cost of such edges may be lower than the cost of repair of damaged edge.

As seen in the building we had walkway between a roll of chairs and the wall, to reduce damages on walls it's advised we have a sizable space for walkway between two rolls of chairs, that way if there is need to carry large objects, it could be carried over the rolls of chairs.

VANDALISM AND ACCIDENT

Areas where soft materials are used, are easily vandalized by people. Woods, gypsum boards, resin, partition walls are usually targets to scratches, cracks, and holes. Usually these defects

occur on wall surfaces, installing harder materials and designing such areas to be away from occupants will reduce their tendencies of vandalism and accidents.

Another way of preserving such buildings is by ensuring that they are on lock and keep, when not in use, it will reduce the number of careless users coming in to the building.

MATERIAL QUALITY NOT UPTO EXPECTATIONS

Finishes used in the case study was found to be deteriorating faster than anticipated. Some of this finishes failed before their estimated lifespan where reached. Although most of the failures where due to poor workmanship, some of this defect would have been avoided with better design details, specifications and by using more appropriate materials for such a public building.

BUILDING MAINTENANCE CULTURE

Maintenance is the process of restoring, maintaining, and managing a structure in order to assure its long-term viability, stability, and lifespan. Some of the defect found in the case study, such as the bad ceilings due to moisture from leaking roof, would have been reduced if the leaking roof was resolved immediately it was discovered. Ibrahim Y.S. (2010) Building maintenance is an important part of design, after construction. This is due to the fact that buildings are rarely maintained. Although there is plenty that can be done during the design phase to limit the amount of future maintenance labor. Every component of a structure deteriorates at a different rate depending on the materials used, and an estimated 30% of all maintenance work performed on a building could have been avoided if proper design and construction had been followed. Bokini's S.K. (2007). In a case of fast deterioration its advised to ensure a constant renovation in a lecture building, to avoid a total failure in use.

CONCLUSION

Buildings are subjected to a variety of defects, failures, deterioration, and variation. Several architectural defects and their contributing causes have been studied in the literature, and they can be linked to the main title of this paper. It is critical to assess each defect and failure in every section of the structure and determine the root causes of each defect and failure. After that, make the necessary corrections. The elements that contribute to the effects and failures must be thoroughly examined. After determining the various causes of defects and failures, it is critical to determine how to avoid them in the future and decrease the impact to the bare minimum.

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