

Building Condition Survey and Systematic Defects Diagnosis on Library Building in Nigeria

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Abstract

The building under investigation is at Mai Idris Aloomo Polytechnic Geidam library situated in Yobe State North Eastern, Nigeria. The building is being occupied by large number of people many defects propelled were associated with cracks, discoloration, settlement, dampness, peeling, moisture and mold grow on the buildings besides environmental factors. These compelled the researcher to conduct the investigation to look into possible remedies in line with the bulk stage defects diagnostic that will be useful in identifying the aspect. The information gathered through survey of the affected building under investigation based on spatial severity degree of damages suffered on the buildings. Moreover; the analysis for the investigation is based on Assessment Rating system (BARIS) that provide very high-resolution to process the interferometric techniques. However, after a critical survey of the building facades from each side the researcher explore the major defects found on the building that are mostly attributed due to poor workmanship, general climatic conditions and practical inadequacy during construction. Therefore, the diagnosis will predict the overall judgement for the type of repair required.

Keywords: *Building defects, Investigation, Maintenance, Remedies, Building survey, Diagnosis condition.*

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Background to the Study

A defect is a shortfall in performance occurring at any time in the life of the building, its components, and other important element. A defect shall be interpreted as a fault in an element or component of a building. For example, leaks at joints or tiles loose or collapsed suspended timber floor etc. Moreover, building diagnostics is the process of determining the causes and solution to the problems in building. More specifically building diagnostic are holistic process of data collection methods and techniques regarding inspection and analysis of future prediction.

A lot of defects propelled were associated with cracks, poor workmanship, settlement, dampness, peeling, and moisture and mold growth on the buildings besides environmental factors. Consequently, in controlling the defect that will make the building to improve its functionality. The major building components to identify are floor, ceiling, walls and roof that requires bulk stage of diagnosis. The detailed investigation will be analyse for further suggestion and recommendations that are applicable. Othman et al (2015) identified the building defect as a problem that may lead to other defects that can penetrate to other place in the building from either side of the facades of the building because of climatic condition and other environmental factors.

Chong (2006) in his work investigates groups of defects through physical survey conducted. However, critically the building facades from each side surveyed the major defects found were attributed to poor workmanship and general climatic conditions and practical inadequacy during construction. Peduto, *et al*, (2017) outline that, research requires deep knowledge on the different types of defect that deteriorates the structural surface based on physical and mechanical attributes. Furthermore, the information gathered on building through the survey process, on the spatial severity for the degree of damages suffered on the buildings. The diagnostic models use for this research is use based on the Building Assessment Rating System (BARIS) which, provide very high-resolution to process the interferometric techniques. The objectives of the research are therefore;

1. To investigate the physical severity of building defects minor and visible defects
2. To look for the possible remedies that result from survey findings.
3. To prepare the schedule of building condition SBC
4. To inspect the failure of the building that ruined the building condition

Statement of Problem

Mai Idris Aloomaa polytechnic Library is associated with many defects that were being associated with various inadequacies which lead to poor user satisfaction. The inadequacies required extensive investigation. Essentially, there is need to provide accurate analysis of the defects report for proper maintainability. Therefore, the development of the investigation is expected to improve the current state of the building condition as seen in Fig: 1.



Main entrance

Left side elevation

Figure 1: Showing main entrance and left side of the library building

Literature Review

Building diagnosis has to be performed to make a judgment on the overall structural condition in terms of expected residual life and the repair needed. Kwan (2016) explain that, good knowledge of structural engineering, materials and testing. Hence, building diagnosticians should be recognised as professionals of a special discipline. It considers how the structure and equipment of a building relate to its environment, its occupants and the way the building is used, so as to develop a better understanding of building defects. According to International Council for Research and Innovation in Building and Construction (CIB) 1993, defects as the systematic study or treatment of building defects, their causes, their consequences and their remedies.

It requires a deep knowledge on the damage components in both visual and physical identification. Furthermore, gathering information and severity of damages and acquiring very high resolution images that will further supplement techniques in evaluation the severity of damages of building.

Once there is a crack, it is weaker than the surrounding wall and that leads to the possibility that pressures from outside will begin to bow that wall. Later shrinkage is caused by continuing hydration and carbonation (Rollings., 1993). Poor construction methods and workmanship is responsible for the failure of buildings and structure. The poor construction methods and workmanship is caused due to negligence and inadequate quality control at construction site (Ali et al 2011).

A diagnostic is the converse of a fault. It is a procedural guide leading from failure to error. According to Justin (2015) a diagnostic is the reasoning process an expert uses by attempting to ascertain the error that caused it. Thus, it relies more on the experience of the expert than the fault.

Methodology

The methodology developed for this study aims to provide an objective and systematic method for the examination and evaluation of buildings prior to the execution of maintenance and rehabilitation activities. The data were collected from the survey and visual inspection from the main library building of Mai Idris Aloomaa Polytechnic, Geidam in Yobe State Nigeria. The methodologies developed were based on the investigative process as indicated Fig 2,

before applying the diagnostic approach. However, targeting the real defect that were associated with the building facades, floor, wall, slab and the roof. The investigation indicates, systematic execution of the investigation that gives the background for the data required for the final evaluation analysis. The data was collected on inspection sheet from 01-06 to give out the preliminary results. The interpretation evidences of the defect presented on defect sheet respectively for the analysis.

Investigation Process

The investigator must make every effort to include all pertinent observations in reports to avoid an accusation of subjectivity as shown in Fig 2. An investigator's background and area of expertise may skew his or her observations. For example, a ceramicist or brick expert may survey a problem building. Diagnostic sheets and checklists can be helpful in this effort. We acquire information by looking for evidence of high degree of deterioration, such as the presence of cracks, displacement, visible water, stains, rot, odours, and mold. Then we determine if the evidence is measurable and recordable (Justin 2015).

It involves the systematic examination of a component, element or system that is faulty or not performing adequately to determine its diagnosis and prognosis. Investigation methodology is the practices, procedures and techniques used to collect, store, analyse and present information and evidence that is obtained through a pathology investigation. The individual steps to perform these tasks may vary from case to case and depend on the types of defect and equipment used.

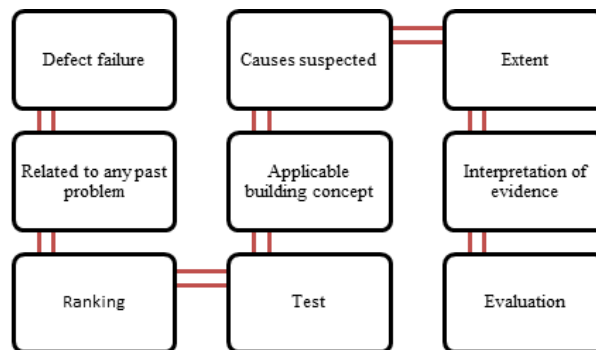


Figure 2: Investigative process

Result and Discussion

With the complexity of technical issues in construction, the analysis suggests causes of the internal and external problem associated with the building. This analysis confirms the defects severity degree of the problem in the building. After successful building diagnostic, to find out the likely causes for the defect and fault in the building as shown Table 2 before suggesting appropriate remedial measures Peduto *et al*, 2017.

Defect description as indicated on defect sheet 1 shows vertical, horizontal & diagonal cracks in the wall & expansion cracks in the pavement around the building possible causes is due to loading problems, faulty construction method, thermal expansion and poor workmanship.

The analysis of the result has in line with (Bucx et al, 2015) in (Dario et al, 2017). The analysis of damages of building components and subsidence risk is that particular that are concern analysis is a difficult task. However, the defect description in 2 indicated the presence of brownish and blackish stains on the wall and the possible causes may be due to alkalis effect on plastering of wall, moisture effect on paint as pointed out in the study of (Othman., 2018). Moreover, defect description in sheet 3 shows significant voids at the joint between building wall and pavement around the building and the possible causes resulted from soil movement beneath the pavement aided by water seepage was in conformity with Peduto, *et al*, (2017). With the complexity in construction the defects severity degree in the building after a successful building diagnostic, find out the likely causes of the defect and fault in the building before suggesting appropriate remedial measures

Subsequently, defect description in sheet 4 indicate defect of paint peel off and the plaster peel off due to lack of adhesion between its material and the wall with possible causes. Thus, indicate the presence of so much moisture in the wall due to seepage and dampness. However, Igal (2003) emphasize that, diagnosis will provide grounds for the prioritization of maintenance activities that will focus on the investigative systems. Rehabilitation of the major failure in the building that require to be restored to its normal condition of the entire building to acceptable condition. This can be remedied by scrapping of the wall, treat dampness and re-plastered the wall.

Defect description in sheet 5 weeds and moulds grows in cracks and damp area. The possible causes resulted from dampness in wall and wind pollination. Othman et al (2015), Identified the defect areas where one problem may lead to other defects that can penetrate to other place in the building from either side of the facades of the building as a result of climatic condition. Moreover, this can be remedied by scraping the surface that is affected, treatment of the dampness, application of anti-moulds and anti-fungi on walls and Plastered the area that were affected by the defects.

Defect description in sheet 6 Paints and plaster swells up and detached from the wall as a result of dampness in wall the remedied should include scrapping of wall, treat dampness and re-plaster the wall. Critical thinking is Effective and efficient problem solving and professional judgment requires critical thinking. It's the cognitive link between diagnostics and best practice.

The overall judgement for the diagnostic approach in Table.1 showing the scheduling of the building condition (SBC) in the table summarises the defect, condition assessment (a), priority assessment (b), matrix annalistic (a x b), defect sheet and defect indication code respectively. Moreover, if the condition assessment range from 1-4 plain monitoring is required while if the condition assessment range from 5-12 condition monitoring is required and in the other hand if it ranges of the score is between 13-20 the building condition is red serious attention is needed to overhaul the whole building.

From table 1 the total marks (d) = sum of (c) 45 and number of defect (e) 11
 Total score (d/e) is 4.09 and the overall building rating is FAIR this is the clear indication that with proper maintenance the building can still be use by the occupants but is subject to routine maintenance.

Table 1: Building Assessment Rating System (BARIS) For Mai Idris Aloomaa Polytechnic Geidam and Scheduling of Building Condition (SBC).

Defects	Condition Assessment (a)	Priority Assessment (b)	Matrix Analysis(c) [a x b]	Defect Sheet	Defect Indication Code
Minor defect but can lead to serious defect if left unattended	3	2	6	001	U6
Functional, only cosmetic defects			12		
Serious defect cannot function to an acceptable standard			12		
Minor defect but can lead to serious defect if left unattended			2		
Serious defect cannot function to an acceptable standard			9		
Minor defect but can lead to serious defect if left unattended			4		
Total marks (d) = sum of (c)			45		
Number of defect (e)			11		
Total score (d/e)			4.09		
Overall building rating			FAIR		

Table 2: Inspection sheet for the Library building of Mai Idris Alooma Polytechnic Geidam

S/N	Defect/failure	Causes suspected	Extent	Related to any past problem	Applicable building concept	Interpretation of evidence	Ranking	Test	Evaluation
1	Crack vertical horizontal on the wall. There are also crack on the pavement of the buildings	Loading, faulty construction, thermal expansion and poor workmanship	Minor visible on the facades but few inside	Extension/ conversion of the building	Crack treatment	The slab and the beam at the external wall are disjointed some walls not tie together during construction	1	Physical observation	The depth are not wide nor deep
2	Discoloration of wall	Alkalis effect & moisture effect on paint	Minor visible coloured stains on walls	Not known	Alkali treatment	There are blackish and brownish on the wall	6	Physical observation	It effect some areas usually touched by rain
3	Settlement in pavement around the building	Slight soil movement beneath the pavement	Medium	Not known	Reconstruction of pavement	The voids allow water to penetrate to the substructure and rise in the wall.it also aid the growth of vegetation in the joint between wall and pavement	3	Physical observation	There are voids at the joint between building walls and pavement but the foundation is not physically affected
4	Mold growth of vegetation	Dampness and presence of moisture in cracks	Medium	Not known	Crack treatment	Mold and weed growths in the crack that are moist	4	Physical observation	The weeds and mold growth in the areas that are moist
5	dampness	Water seeping in to the substructure from faulty pavement	Medium	Not known	Repair in plumbing work.Re-plaster of affected walls	The wall are wet, traces of water was seen and this allows the growth of vegetation the areas affected	2	Physical observation	
6	Peeling of paint and plastering	Dampness	Minor	Not known	Blocking of seepage to substructure, repair of leaking pipe, replastering and repainting	The paints are peeling off from the wall and the plastering are also peeling off from the wall	5	Physical observation	Defects only occur where the dampness is much

Conclusion

A survey was conducted to quantify the relative effectiveness of external preview and internal inspection that are associated with defects. The method enables the determination of priorities based upon the performance of the entire building the assessment. The efficiency of maintenance operations requires deep diagnosis procedure of the surveyors with regard to the scales used for each building component.

The building is currently in use, although it has defects ranging from cracks, settlement, dampness, growth of vegetation, stains on wall due to moisture presence, Peeling of paint and plaster. The rating of the building using BARIS shows that the building condition is fair. Majority of the defects detected from the building does not threaten the life of the building at present but if left unattended to for a long time; it could have degenerated into structural defects and failure. Expert input and supervision is highly essential whenever the remedies are to be carried out.

Recommendations

1. Some non-destructive test methods may be used for a quick and preliminary appraisal. These include: cover meter survey of concrete cover to steel rebar's, ultrasonic pulse

velocity tests for detecting voids and defects in concrete, rebound hammer tests for rough estimation of concrete strength, impact echo test for detecting delamination, infrared thermography for remote detection of delamination and/or water leakage, and surface penetration radar for detecting internal cracks and defects.

2. Inadequacies in the design does not mean only errors of computation, but a failure to take into account the loads the structure will carry, erroneous theories, reliance on inaccurate data, ignorance of the effect of repeated impulsive stresses, and improper choice of material or understanding of their properties.
3. Poor workmanship this includes substitution of inferior steel for specified one; bad riveting or even improper lightening torque of nuts, excessive use of the drift pin to make holes line up, bad welds, and other practices well known to the construction worker. This has been the most important cause of structural failures; the engineer is also at fault. Here, if inspection is not strict, severe or careful enough about work, rules or standard of behaviour should be maintain.

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