

## Assessment of Defects Associated with Altered and Converted Institutional Buildings in Gombe State, Nigeria

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### Abstract

*Many buildings have been altered and converted for use in various tertiary institutions in Gombe state. It was however, observed that most of those converted and altered buildings are characterized by some common defects. The aim of this study is to examine the common types of defects associated with altered and converted buildings in some selected tertiary institutions in Gombe state with a view to making recommendations for improvements. A mixed method approach involving the use of quantitative and qualitative methods was employed in collecting data for the study. A questionnaire survey strategy was employed in the quantitative stage of the study to collect data from construction professionals involved in the supervision of altered and converted buildings in three selected tertiary institutions in Gombe state (Gombe State University (GSU), Federal University Kashere (FUK) and College of Nursing and Midwifery (CNM)). In the qualitative phase of the study, a checklist and physical field observation was employed to collect data from fifteen (15) identified altered and converted buildings in the selected tertiary institutions. Findings reveal that most alteration and conversion works are carried out through manual methods. It was discovered that cracks, defective plasters, dampness and peeling of paints were the most common types of defects associated with altered and converted buildings. Based on the physical examinations of the buildings, it was revealed that most buildings altered and converted using predominantly manual methods do develop severe defects compared to those altered and converted using mechanical techniques. The study concludes that the techniques adopted in alteration and conversion work significantly affect the quality of the resulting building. It was recommended that more use of mechanical aids should be adopted in carrying out alteration and conversion to minimize defects and ensure quality outputs from buildings.*

**Keywords:** Alteration and Conversion of Buildings, Common Building Defects, Methods, Gombe, Institutions.

### INTRODUCTION

Building alteration and conversion are two different things but they are inter-related in many ways. Andrew (2007) defines conversion of building as a change in function which involves change in forms, while alteration refers to the process of adjustment and adaptation of a building to meet new requirements. Generally, conversion of Buildings is part of maintenance work undertaken in order to maintain the performance of a building (Paul, 2009). Remoy and VanderVoodt (2014) observed that alteration and conversion of any type of building is unique, due to the sheer number of parameters that govern the two processes. Alteration and conversion involves cutting, breaking, hacking, chiseling, boring, retrofitting and other similar operations. Therefore, the techniques and tools used in carrying out these set of activities will have significant effect on the quality of the

final altered and converted buildings. Inappropriate handling and execution of alteration and conversion works among others have been identified as an important cause of building defects in many buildings (Chendo and Obi, 2015). According to Nurul and Azree (2013) building defect is one of the most common problems associated with altered and converted building structures. Defect can occur in both new and old buildings when the building fails to perform its function in accordance to its original design. Hence, there is need for careful planning and execution using appropriate techniques. Poor planning and use of inappropriate techniques can lead to unsuccessful alteration and conversion works (Craig *et al*, 2007).

According to Abdullah and Anumba (2012), alteration and conversion require experience, skills and thorough knowledge in the field of building maintenance. This is so, because a thorough understanding of both structural and building materials properties are required for undertaking alteration and conversion (Remoy, *at, al.*, 2014). The choice of technique adopted in carrying out alteration and conversion work have been identified by ISSA (2009) as one of the major factors in achieving a successful alteration and conversion work. According to ISSA (2009) there are two major techniques for alteration and conversion works: the manual and mechanical techniques. The manual technique is a labour intensive method that involves the use of tools such as: pickaxes, club hammer, chisel, and digger etc. to carry out alteration and conversion work. The mechanical method on the other hand entails the extensive use of machines and other aids to execute alteration and conversion works. The use of mechanical techniques usually comes with more efficiency and accuracy when compared to manual techniques (Vienn, 2004; Noha, 2010).

Many buildings have been altered and converted for use in various tertiary institutions in Gombe State. It was however, observed that most of the converted and altered buildings are characterized by many common defects which has become a source of worry to many concerned stakeholders. It was in this respect that the current paper seeks to examine the common types of defects associated with altered and converted buildings in some selected tertiary institutions in Gombe state with a view to making recommendations for improvements. To achieve this overall aim, the study sets out the following objectives: (i) to examine the methods used in carrying out conversion and alteration works in the selected institutions (ii) to assess the perception of stakeholder on the effectiveness of the chosen methods (iii) identify the most common defects associated with altered and converted buildings and to make recommendations for future improvements.

### **Conversion and Alteration of Building**

Conversion is the process of subjecting a building to a change in occupation or from one form to another or to a new plan while alterations refers to works carried out on an existing building in order to meet new requirements (Hilde and Sara, 2012). Alterations are however, most often, part of conversion works. According to Nurul and Azree (2013), due to its delicate nature, careful investigation is needed whenever alteration and conversion of buildings is to be carried out. This is so because in most circumstances conversion and alterations becomes an alternative when a building has reached the end of its service life, or when it fails to perform its required functions (Umi *et al*, 2018). Conversion and alteration is generally considered as part of maintenance work in order to uphold the performance of buildings to a standard that allows them serves and fulfils the purpose for which they were built (Dennis, 2007). Building alteration and conversion sector is fast becoming one of the most important sectors in most construction industries the world over. This is due to the presence of a high number of ageing buildings and rapid changes of technology

(Azree, 2015). It is also generally accepted that conversion and alteration works are more difficult to handle and manage compared to new buildings. Design for alteration and conversion works requires the designers to gather information from existing building as much as they can to ensure that their design suit the existing condition of the building as against new building designs (Azlan *et al.*, 2005). A study by Anker *et al* (2018) observed that conversion of an existing building is a successful branch of the construction industry because it provides financial diversification for construction. Building owners are often challenged with deciding between new constructions and renovating an existing building to achieve their desired scope (Umi *et al.*, 2018).

### **Alteration and conversions Methods**

They are two major techniques for carrying out alteration and conversion of buildings. These techniques are 1) Manual and 2) Mechanical method. Manual method according to ISSA (2009) involves the use manual techniques using simple hand tools to carry out the necessary activities involved in conversion and alteration work. It is a very labour intensive and time consuming method especially for large projects. The mechanical technique on the other hand, refers to the use of machines to undertake alteration and conversion works. This method reduces labour requirement and allow one person to do work that several people can do manually.

The use of mechanical method enhances the precision, and quality control of the process. Thus, mechanical method is much faster than and optimizes human resources at the project site compared to the manual technique. The method also ensures that the structural integrity of the existing structure is maintained without serious disturbances. Hence, the choice of an appropriate technique in carrying out alteration and conversion is of significant importance in averting the likelihood of defects in the building elements in future.

### **Building Defects**

Building defects refer to any problem that reduces the value of a building. According to Benarroche (2021), defects are deficiencies in a building, be it as a result of design, poor choice of materials or workmanship which leads to a failure in some aspect of the building and that can cause damage to the property or its inhabitants. Defects occur for a vast range of reasons such as poor workmanship, defective designs, natural deterioration and inappropriate selection or use of materials. Other factors include: lack of maintenance culture, ageing of building, poor quality control and negligence (Subhi *et al*, 2017). Building defects requires significant attention because they can have serious negative impacts on a building and its users (Nurul, *et al.* 2013; Syamilah *et al*, 2019). According to Subhi *et al* (2017), some of the most common types of building defects include: cracks, deformation of walls, columns and beams, leakages, dampness on walls, roof defects, peeling of paint, defective plasters, timber decay, felt failure, sealant failures, blemishes, corrosion, damage of exterior surfaces, discoloration, etc. The problem of building defects have been observed in many altered and converted buildings due to the precarious nature of these activities.

### **METHODOLOGY**

The study adopted a mixed method approach where both quantitative and qualitative data were collected in order to achieve the aim of the study. A semi-structured questionnaire was used for data collection in the quantitative phase of the study while checklist and field observation strategy

was adopted in collecting and analyzing qualitative data in the second phase of the study. The targeted populations in the quantitative survey were construction professionals working in tertiary institutions in Gombe state. Three institutions comprising of Federal University Kashere (FUK), Gombe State University (GSU) and College of Nursing and Midwifery (CNM) Gombe were selected. The samples of respondents were selected using the non-probability purposive sampling technique. A total of 22 construction professionals (consisting of 11 from FUK, 6 from GSU and 5 from CNM Gombe) were conveniently selected to participate in the questionnaire survey. The questionnaire sought for the respondent’s opinions on the methods of carrying out alteration and conversion as well as the level of severity of defects commonly associated with altered and converted buildings in their various institutions. All the 22 questionnaires distributed to the respondents was returned and used for analysis in this study. The quantitative data was analyzed using descriptive statistics including frequency, percentages, means and standard deviation with the aid of SPSS software.

In the qualitative phase of the study, a checklist and field observation strategy was adopted to examine and check the level of severity of some common defects in fifteen (15) selected altered and converted buildings in the tertiary institutions in the study. Seven (7) buildings were identified in GSU, five (5) in FUK and three (3) buildings in CNM Gombe. The level of severity of the defects was assessed based on Pedro, *et al.* (2007) criteria for classification of defects. Pedro, *et al.* (2007) classified defects (table 1) based on their level of severity into four groups: 1) very slight defects 2) minor defects, 3) medium defects and 4) severe defects.

- a) Very slight: As a result of no defects found will be neglected on the severity impact, this is due to the fact that the defect is insignificance.
- b) Minor severity: Minor defects were found with average condition affecting the functional element, with a minor extension.
- c) Medium severity: Buildings have deteriorated with major defects found, defects affecting limited areas of the functional element, and with major extension of the total area.
- d) Severe: Buildings have failed. This is unfit for occupancy or normal use. Defects affect large areas or almost all of the functional element, and with extension beyond expectation of the total area.

Table 1 Classification of defects based on severity

Very slight	Minor	Medium	Severe
Absence of defects or defects with no Expression	Defects prejudicial to aesthetic	Defects prejudicial to use or comfort	Defects that endanger health or safety

Source: Pedro *et al.*(2007)

**RESULTS AND DISCUSSION**

Demographic characteristic of respondents and the first section shows the profession of the respondents (table 2). The result shows that 32% of respondents are Architects, 22% are engineers, 22% are quantity surveyors, and 18% are Builders. The result indicated that majority of the respondents are professionals in construction field. This implies that 95% of the respondents are knowledgeable to be responsible in carrying out alteration and conversion of buildings. However, the second phase shows years of experienced of the respondents; the results revealed that 82%

majority of the respondents had at least ten years of working experiences, also were quite knowledgeable and experienced in the built environment. Philippe *et al.*(2013) ascertained that working experience of the professionals is an important consideration in undertaking alteration and conversion of building works respectively. Therefore, with this educational qualification of respondents is very vital in supervising altered and converted buildings, while most of the respondents are BSc and PGD/MSc holders with highest percentage of 50% and 27% respectively. The last phase shows gender differences of the respondents; the results revealed that 91% were male, while female represented 9% of the sampled population. This also implies that female participation in the field of built environment were negligible to make positive contribution in the study area.

**Techniques adopted in carrying out alteration and conversion work**

Table 2 shows the views of respondents on the most adopted method as well as the effectiveness of the methods used in carrying out alteration and conversion works respectively. The result in table 3 indicates that manual techniques is the most frequently adopted method with a mean value of 4.32 and ranked first while mechanical technique was ranked second with a mean value of 2.70. It was however agreed among the respondents that mechanical method is the most effective method of undertaking alteration and conversion works as shown in table 4.

Table 2: Methods Used in carrying out Alteration and Conversion

S/N	Methods	Frequency of response					Σf	Σfx	Mean	S.D	RII	RANK
		1	2	3	4	5						
1	Manual	0	1	4	34	27	66	285	4.32	0.66	0.86	1 <sup>st</sup>
2	Mechanical	1	24	37	2	2	66	178	2.70	0.70	0.54	2 <sup>nd</sup>

(1 = Never, 2 = Rarely, 3 = Often, 4 = Very Often, 5 = Always)

These results suggest that manual method is predominantly used in undertaking alteration and conversion works in the study area. It was however evidently clear that the respondents believe that mechanical techniques are the most efficient techniques as against the most preferred manual method. This finding reinforces the position of ISSA (2009) who advocated for the use of mechanical method as the most efficient method of achieving quality in alteration and conversion works. According to ISSA (2009) the use of mechanical method is associated with the following benefits: increase in the efficiency of work, improvement in quality, savings in time and cost as well as minimizing the likelihood of future defects in altered and converted buildings.

Table 3: Perceptions on the Effectiveness of Alteration and Conversion Techniques.

Effectiveness of the methods	Frequency of response					Σf	Σfx	Mean	SD	RII	Rank
	1	2	3	4	5						
1 Mechanical	0	0	5	29	32	66	291	4.41	0.632	0.88	1 <sup>st</sup>
2 Manual	8	9	11	25	13	66	224	3.40	0.558	0.68	2 <sup>nd</sup>

(1 = Very-Ineffective, 2 = Ineffective, 3 = Not Sure, 4 = Effective, 5 = Very- Effective)

**Severity of common defects**

The perception of the respondents in the study was investigated with respect to the level of severity of the most common types of defects in the various altered and converted buildings and structures

in their institutions. Table 4 present the views of the respondent's on this issue. The table shows that physical appearance of cracks on altered and converted walls (mean=3.14), defective plasters (mean=3.04) and Peeling of paints (mean=2.90) are the most commonly recurring identifiable defects on altered and converted buildings in the study area. The problem of Sagging of beams and slabs was however identified as the least recurring defect in most altered and converted buildings.

Table 4: Perception of respondents of the severity of some common defects in altered and converted Buildings in their institutions

S/N	Common defects in altered and converted buildings	Frequency of response on severity				$\Sigma f$	$\Sigma fx$	Mean	Rank
		1	2	3	4				
1	Cracks on walls	2	3	7	10	22	69	3.14	1 <sup>st</sup>
2	Leakages on Roofs	6	9	4	3	22	48	2.18	7 <sup>th</sup>
3	Defective plasters	3	2	8	9	22	67	3.04	2 <sup>nd</sup>
4	Sagging of beams & slabs	10	8	2	2	22	40	1.81	8 <sup>th</sup>
5	Peeling of paints	3	4	7	8	22	64	2.90	3 <sup>rd</sup>
6	Dampness	2	5	9	6	22	63	2.86	4 <sup>th</sup>
7	Decay of timber components	6	3	7	6	22	57	2.59	5 <sup>th</sup>
8	Failure of felting works	6	8	5	3	22	49	2.22	6 <sup>th</sup>

(1 = Slight severity, 2 = Minor severity, 3 = Medium severity, 4 = High severity)

### Physical field observation of defects

The result of qualitative investigation which was obtained through checklist and physical field examination of some altered and converted buildings in the study is presented in table 5.0. The defects in the buildings were physically examined and analyzed based on Pedro *et al.*(2007) classification of defect based on their level of severity. The result shows that the defect in four (4) out of the 15 selected and examined buildings falls within the severe category on Pedro *et al.*(2007) scale. These indicate that such buildings present danger to the health and safety of occupants, while (5) buildings falls within the medium severity level of defects. These results revealed that major defects found on building elements with a high deterioration of the functional elements which is affecting the comfort and user satisfaction respectively.

In addition, (5) buildings examined to fall on Pedro *et al.* (2007) classification of defects based on their level of severity. These results indicated that such buildings falls within minor severity of defects which will affect the aesthetics of the buildings. Therefore, (1) building out of (15) selected and inspected buildings falls within insignificant of defects, this shows there is no defects found on building elements or defects with no expression.

Table 5: Checklist and Physical Examination of Defects

S/N	Previous bldg.	Present bldg.	Components Altered	Method used in A&C	Defects Found	Defects Severity	Remark
<u>GSU</u>							
1	Hostel	Classroom	Walls, roof beams ceiling	Manual	Crk,Lkg,Tbd, Sag, Ffl,	4	severe
2	Classroom	Admin Building	Walls, roof, ceiling	Manual	Dtp,Ppt, Tbd, Crk	4	severe
3	Office	Admin Building	Walls, Roofs ceilings	Manual	Ppt,Dtp, Crk	3	medium severity
4	Classroom	Admin Building	Walls, Roof, beams ceilings	Mechanical	Ppt,Crk, Tbd,	3	medium severity
5	Hostel	Academic Office	Walls, plaster and Ceilings	Manual	Crk,Lkg, Sag,Dtp, Ppt	4	severe
6	Classroom	Admin Building	Walls, Roof, beams	Mechanical	Ffl,Dpt, Tbd,	2	minor severity
7	Hostel	Classes	Roof and walls ceilings	Mechanical	Tbd,Dpn, Ppt,	2	minor severity
<u>FUK</u>							
8	Hall	Admin Building	Walls, beams, roofs, ceilings	Mechanical	Lkg,Tbd, Crk, Ppt	3	medium severity
9	Classroom	Store room	Walls, Roof, Floors	Manual	Crk,Lkg,Ffl,ppt,Dpn	3	medium severity
10	Classroom	Lecture Hall	Walls, Roof, Ceiling	Manual	Crk,sag, Tbd	4	severe
11	Classroom	Offices	Roof, wall, Ceilings	Manual	Sag,,Ppt, Crk,	3	medium severity
12	Admin Building	Admin Building	Walls, Beams & Roofs	Manual	Ppt,Dpt,Dpn & Sag	2	minor severity
<u>CNM</u>							
13	Classroom	Hall	Walls, Roofs & ceiling	Mechanical	Lkg, Ppt,Dpt	2	minor severity
14	Classroom	Admin Building	Roofs, walls &ceilings	Manual	Sag,Dpt.Ppt & Lkg	2	minor severity
15	Classroom	Hall	Walls& Floors	Mechanical	Ppt Dpt	1	insignificant

Source: *Tertiary Institutions in Gombe State 2018*. Adapted from Chendo and Obi (2015).

Crk: Cracks, Lkg: Leakages, Ppt: Peeling paints, Tbd: Timber decay, Dtp: Defective plaster, Ffl: felt failure, Sag: Sagging, Dpn: Dampness.

In summary, the study observed that there are defects on building elements of the converted buildings in both (GSU) and (FUK). The identified defects were found to be related to the manual techniques used in carrying out alteration and conversion of buildings. On the other hand, the findings of this study support previous works of Vienn (2004) and Noha (2010) who identified mechanical techniques as one of the most effective in carrying out alteration and conversion buildings. However, in some buildings elements defects were found with minor problems due to its partial conformity with the used of mechanical techniques in carrying out alteration and conversion of buildings when compared with others element.

## CONCLUSION

Findings from this study reveals that manual technique was the most frequently adopted method of undertaking alterations and conversions in the tertiary institutions investigated. Appearance of cracks of various degrees on walls, peeling of paints, dampness and defective plasters were identified as the most common defects associated with most altered and converted buildings in the study. It was concluded from this study that the technique used in carrying out alteration and conversion has significant effect on the future performance and quality of affected buildings. It is therefore, recommended that extensive use of mechanical inputs be adopted in carrying out alteration and conversion works to enhance the quality and performance of buildings in the study area.

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