

Impact of Residential Building Decay on Indoor Space Optimization in Port Harcourt Municipality

Esau, James Esau^{1,*}, Ferdinand Frank Oko Daminabo²

Abstract

Residential buildings, when provided, are expected to satisfy design requirements and stay in a healthy, sustainable, and safe condition within their lifespan before the issue of decay sets in. But in recent times, the issues of early decay of residential building components and materials resulting in limitation in usable indoor spaces in residential buildings in Port Harcourt Municipality have become a source of concern to building owners, occupants, and the built environment professionals. The study is aimed at assessing the impact of building decay on indoor spaces and to prove an architectural solution that will ameliorate building decay and its impact on indoor spaces in the study area. The study adopted a mixed-methods research approach using a concurrent triangulation design for data collection. The study employed purposive and simple random sampling techniques to select two (2) neighborhoods (Port Harcourt Township and Elekahia) and respondents for the collection of data, with a total of 341 respondents sampled. Structured interview questionnaire and key informant methods were used to collect data from the respondents, including building occupants, professionals in the built environment, and MDAs. Physical observation and photography were also used to characterize building decay and indoor space in the buildings of the study area. The study found that early building decay amongst residential building has resulted to a reduction in the usable space, difficulty operating components, such as doors and windows, damp interior, reduced occupants satisfaction, increase risk of accident and reduction in the overall architectural values of the building. It was concluded that, the design approach and choice of materials, neglect and delay attitude of government, private owners and occupants in carrying-out maintenance, the impact of climatic elements and anthropogenic activities on the building component and materials are the major factors responsible for early building decay amongst residential buildings that resulted to limitation and unhealthy indoor spaces in residential buildings in the study area. The following recommendations are made are to trained artisans should be used during project execution, and finally all parties responsible for the building repairs and maintenance should be educated on the implication of neglect and delay attitude.

Keywords: Residential building, building decay, indoor space, optimization, Port Harcourt municipality

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INTRODUCTION

Affordable, adequate, and accessible housing and improved living conditions are important ingredients of sustainable housing provision to every human (UN-Habitat, 2012) [1]. According to Ogunoh (2008) [2], building is an integral part of the housing and one of the basic and essential elements needed by man for habitation and social-economic activities. It is described as an enclosure or “envelop” designed and constructed to give a satisfactory level of comfort and convenience for a human being. It provides both shelters for humans, animals, equipment, and materials from weather effects and gives internal

comfort that is governed by the climatic condition, choice of materials, and design approach (Ogunoh (2008) [2], Council of Registered Builders of Nigeria (CORBON) (2014) [3], and Odoanyanwu, Kosisochukwu & Emmanuel (2021) [4]).

In recent times, the construction industry is faced with numerous indoor envelope problems and material breakdown, resulting in serious adverse consequences to building value, operational costs, occupant comfort, and environmental impact (Peter O. A., Ezekiel A. C., & Paul O. O. (2012) [5], Robertsen (1999) [6]). To achieve a satisfactory level of comfort considering the increased level of industrial activities and climate change facing the world, building designers are tasked to create buildings that are sustainable and constructed to enhance the safety and comfort of the users. Other aspects of the building, such as building enclosure, indoor environmental quality, and environmental conditions, should be considered during design (Saranya & Akansha, 2017) [7].

According to Robertsen (1999) [6], building practice today has resulted in premature failure and lack of durability of the building envelopes, especially in modern buildings, with higher impact stresses on the service life and indoor spaces than those of earlier buildings. The environmental impact and higher demands impose limitations, combined with the influx of different materials, systems, and assemblies, make design, construction, and prediction of building performance and life span very complex. Furthermore, Andy et al. (2019) [8] posited that buildings should be designed and constructed to enhance the safety and comfort of the users, a sustainable approach should be adopted throughout the life cycle of a building, from design and construction to operation and maintenance, but it is glaringly apparent, according to Saranya (2017) [7]. The state of progressive decay and damage of infrastructures, especially indoor spaces in residential buildings, has impacted the health and usability of spaces in the buildings. This condition becomes imperative to investigate the impact of building decay in optimizing indoor space utilization for occupants of buildings in Port Harcourt municipality as to improve conditions through architectural solutions to enhance users' comfort and livability.

AIM AND OBJECTIVES OF THE STUDY

The study aimed at assessing the impact of building decay on indoor spaces optimization in selected neighborhoods of Port Harcourt Municipality.

The Objectives of the Study Are to

1. Examine the impacts of building decay on residential building components and the indoor spaces in the study area; and
2. Offer architectural measures to mitigate the impact of building decay on building components and indoor spaces in the study area.

Scope of the Study

The scope of this study is limited to residential buildings in selected neighborhoods in Port Harcourt Municipality of Rivers State, Nigeria. The buildings in the selected neighborhoods comprise single-family bungalows, semi-detached bungalows, and blocks of flats and are occupied by residents. It should have been ideal that the study covers all residential buildings in Rivers State, Nigeria but study opted to restrict the scope of the study to two (2) communities which includes Port Harcourt Township and Elekahia all in Port Harcourt Township, Rivers State which the findings will be used to better the conditions of the residential buildings in the country.

LITERATURES REVIEW

According to Charles (2022) [9], building as a source of happiness to the occupants, especially when the building and the urban environment are in harmony with the user, giving joy and a state of wellness, devoid of decay and an unhealthy built environment. Izomoh and Olomu (2005) [10] noted that most residential buildings are planned and designed with less attention to thermal comfort,

outdoor air quality, and reduction in the amount of rain and moisture in the building envelope. In line with advocate for the advocated need to ensure that recommended standards for housing conditions that allow a building or parts to be lawfully occupied as a dwelling should be obeyed. It is therefore imperative to obey laws governing zoning, setbacks, and proper ventilation. Cross or through ventilation, one of the recommended design approaches, helps to minimize the high interior temperature and thermal discomfort in buildings, eliminate wetness in the rooms, minimize the growth rate of fungi and bacteria that are dangerous to occupants' health, and decay of building materials and components. Sr Nor, Afaq, and Ahmad (2007) [11] posited that the resultant effect of poor design could be seen from the minimum level of maintenance, such as surface decay and indoor spaces, to the final level of collapse.

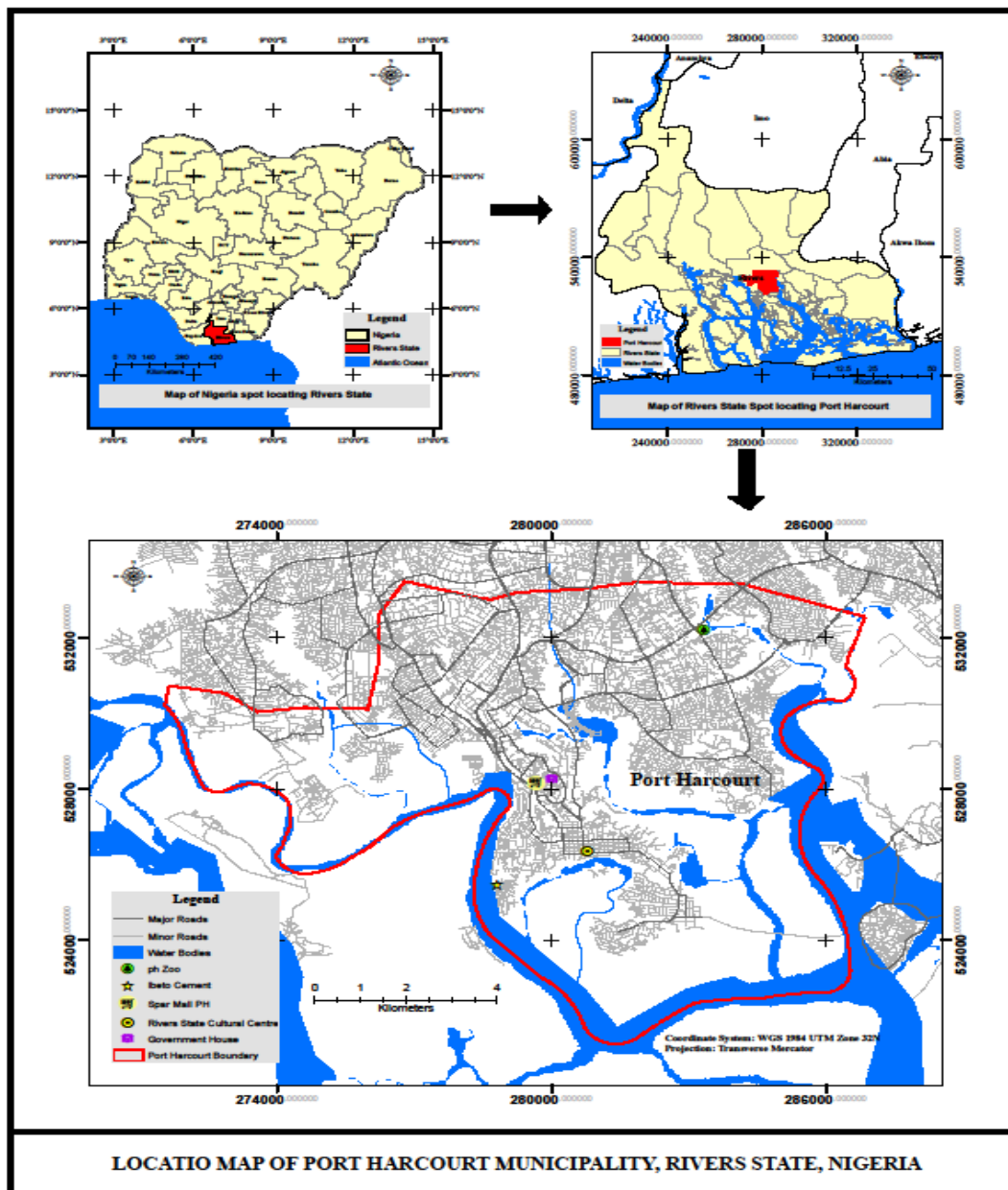


Figure 1. Location map of Port Harcourt Municipality, Rivers State, Nigeria.

Source: Department of Urban and Regional Planning GIS Lab, Rivers State University, 2024.

Changes in the properties of building materials and components, according to Maria–Margarita (2015) [12]. Sr Nor, Afaq, and Ahmad (2007) [11] could result from human neglect due to a lack of

proper material and maintenance, or insufficient restoration strategies, the multiplier effect and deterioration of the fabric has a turning effect on the architectural, historical, cultural sustainability of the building. More so, human actions resulting from neglect, the nature of construction materials and anthropogenic activities, and lack of adequate maintenance and restoration techniques cause complex degradation of the fabric with serious effects on the indoor spaces and the architecture of the environment and the individual building (Maria–Margarita, 2015) [10]. Temperature, solar radiation, and humidity are some of the factors that control the changes in the volume and physical appearance of materials. Climate with a high degree of temperature fluctuation could cause significant damage to the materials' surface (Moncmanova, 2007) [13]. The researcher added that degradation is also a factor of the degree of saturation with water and the pore structure of the materials. Other than wear and tear, building materials and components are also subjected to effects that negatively impact their durability and performance, which could later contribute to the possibility of premature failure of these building parts (Odoanyanwu et al., 2021) [4]. The entry of rain and moisture into the building fabric which results in high humidity levels, and a drop-in temperature causes dampness and encourages the breeding of fungi and other bio-agent which impair the strength of materials and components. Izomoh and Olomu (2005) [10] also stressed the frequent epidemic of chronic diseases faced in our society today, due to the negligence in the design of the built environment, which encompasses the places we live and work.

According to Stephen and Christopher (2010) [14], the external finishes are the determining factor in the aesthetic appearance of the building and the durability of the building fabric. The internal finishing helps create a feeling of place and encourages a healthy indoor environment. The current rate of material decay, which affects the aesthetic quality, durability, and indoor environment, also necessitates the study. Akansha and Saranya (2017) [7], in their conclusion, proposed that a regular dilapidation survey on residential buildings will educate occupants and governments, and professionals in the building industry on how to make informed decisions and provide a good design and management approach. According to Duncan, Derek, and Rogers (2003) [15], when the condition of a building is evaluated, it allows the professionals in the built environment to assess the risk level and ascertain those that require urgent attention and those that more time could be given before remedial work is initiated. This also necessitated this study.

METHODOLOGY

Consequently, to obtain pertinent information and data for the study, a mixed-methods research approach and concurrent triangulation research design were adopted. Purpose and simple random sampling techniques and key informant methods were adopted for the collection of field data. The study also carried out a reconnaissance survey to establish coordination and boundaries of each community under study, which were inputted into an ArcMap and digitalized information system (GIS) and (Open Street Map) to determine the total number of buildings (population) in the selected communities (see Figures 2 and 3). The study selected two (2) communities, including Port Harcourt Township and Elekahia community, with a total population of three thousand one hundred and fifty-seven (3157) buildings. The study adopted a sample size determination table that was used to determine a sample size of three hundred and forty-one (341), which were distributed proportionately across the two communities (see Table 1). A random sampling technique was used to select the head of household (respondents) who were interviewed for the study. However, the key informant interview approach was used to select and interview the staff of the Rivers State Ministry of Housing, Rivers State Housing Authority, Property Development, and other professionals/experts in the built environment, such as Architects and Town Planners, to draw from their professional opinions about the subject under study. Also, physical observation and photographs were used to assess the rate of decay of residential building components and materials, the factors responsible, and how they impact the indoor spaces.

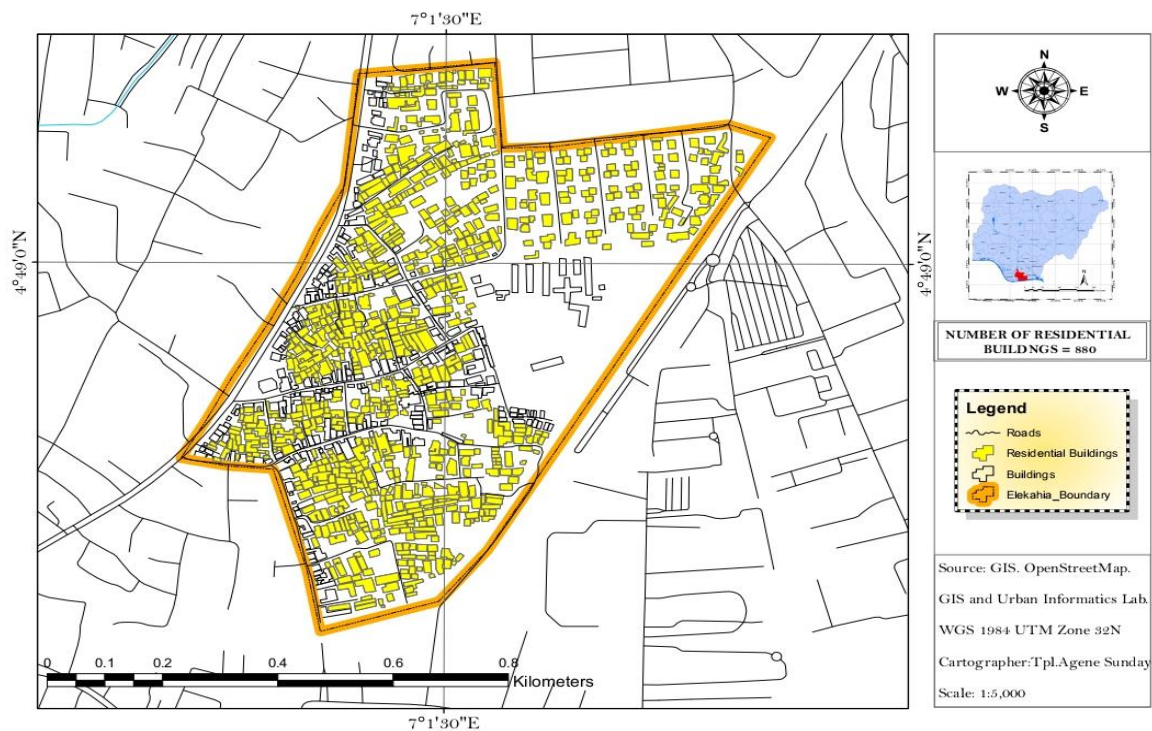
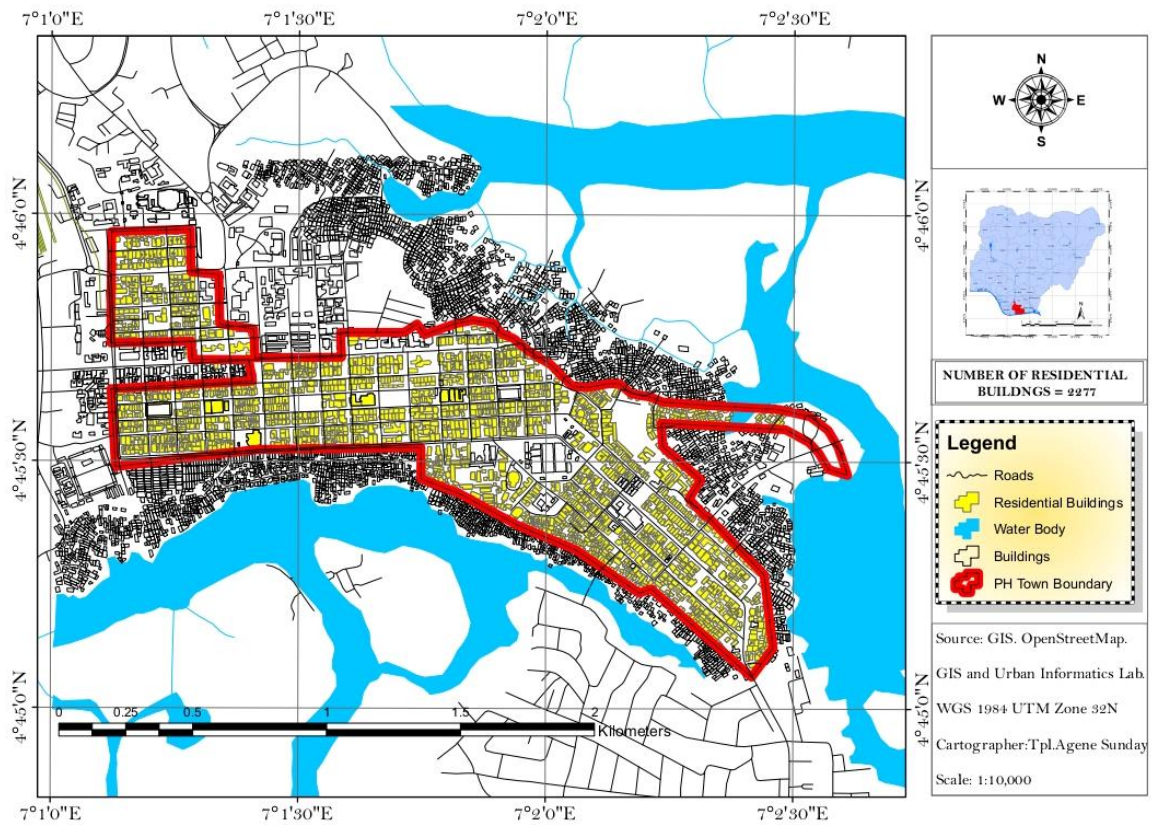


Table 1. Sample size distribution across studied neighborhoods.

Sampled Neighborhoods	Population (Number of Buildings) in the Neighborhoods	Number of Sampled Buildings
Port Harcourt Township	2,277	239
Elekahia	880	102
Total	3,157	341

Source: Researchers' Fieldwork, 2024.

RESULTS AND DISCUSSION

The Level and Various Residential Buildings Components Under Decay

The study identified the various building components and the level of decay in the study area. The study shows a severe Roof decay in Port Harcourt Township, with a mean of 4.71 as against Elekahia with a mean score of 3.12. This reflects the level of neglect by the occupants and building owners in carrying out routine maintenance (see Figure 1). Wall decay and finishers follow a similar pattern, with Port Harcourt Township leading at 4.43 and 3.91 while Elekahia with 2.70 2.48, this was attributed to proximity of building to water bodies containing sodium chloride and the construction approach that allowed capillary action and high moisture in the indoor spaces (see Figures 4 and 5). The study recorded that every building component under decay has a concurrent impact on the indoor space.

Table 2. Building components are undergoing decay.

Building Parts Are Undergoing Premature Decay	Port Harcourt Township (N = 239)		Elekahia (N = 102)	
	Mean	%	Mean	%
Roof decay	4.71	19.0	3.12	19.0
Wall decay	4.43	18.0	2.70	17.0
Windows and doors	3.06	12.0	1.91	12.0
Floor	3.71	15.0	2.01	13.0
Mechanical/plumbing components	3.60	14.0	2.32	14.0
Electrical components	1.84	7.0	1.65	10.0
Finishes	3.91	15.0	2.48	15.0
Mean decay	3.61		2.31	

Source: Researchers' Fieldwork, 2024.

Impact of Building Decay on the Indoor Spaces and the Occupants

The study demonstrated significant adverse effects on the living conditions and overall satisfaction of occupants. The findings indicate that occupants experience a reduction in usable spaces, with a mean score of 4.48, highlighting the space constraints they face due to leakage from roof, dampness on walls, broken windows and doors resulting dampness in interior spaces that encourage mold growth received a mean score of 4.61, illustrating health risks associated with such conditions, it further, Increases maintenance burdens, with a mean of 4.48, which suggests that residents are required to invest more time and resources into maintenance. It also revealed that occupants have difficulty operating components, particularly doors and windows, with a mean score of 4.64, indicating significant challenges in daily interactions with their indoor spaces. A mean score of 4.74 was reported for unhealthy living conditions for both occupants and their pets. The general reduction in the architectural values of the buildings was rated at 4.65, indicating a decline in aesthetic appeal (see Figures 4 and 5). A critical observation was also made by Ogunoh (2008) [4], Charles (2022) [9], and Ahiaba, Dimuna, and Okogun (2008) [4].

Table 3. Impact of building decay on the indoor spaces and the occupants.

Descriptive Statistics	N	Minimum	Maximum	Mean	Std. Deviation
Reduction in usable spaces in the facility for the occupants	341	4.00	5.00	4.4815	.50027
Increase in maintenance burden on the occupants	341	3.00	5.00	4.48	0.50
Occupants have difficulties operating components, especially doors and windows	341	4.00	5.00	4.64	0.56
Damp interior space induces cool and mold growth	341	3.00	5.00	4.61	0.49
Negative image of the occupants and the environment	341	3.00	5.00	4.56	0.64
Increase risk of accidents, injuries, and diseases	341	4.00	5.00	4.56	0.59
Unhealthy living conditions for both humans and pets	341	3.00	5.00	4.74	0.44
Presence of pests	341	3.00	5.00	4.74	0.54
Reduced satisfaction due to the occupancy	341	3.00	5.00	4.56	0.60
General reduction in the architectural values of the building	341	3.00	5.00	4.65	0.50
Grand mean				4.60	0.54

Source: Researchers' Fieldwork, 2024.

The attendant impact of the decay components on the indoor spaces have triggered a massive response by the occupants to high degree of being unsatisfaction with the impact of building decay on the indoor spaces especially in Port Harcourt Township were 141 users making 59.02% agreed to the unsatisfactory state of the indoor spaces, the study also revealed a higher uncertainty responses by 71 users at 69.6% in Elekahia which did not indicated absent of decay or healthy indoor spaces but revealed a relatively better indoor spaces compare to that of Port Harcourt Township.

Table 4. Occupants' rating of the conditions of the indoor spaces

Occupancy Ratings	Port Harcourt Township		Elekahia	
	N	%	N	%
Very satisfactory	0	0	0	0
Satisfactory	0	0	0	0
Uncertain	37	15.41	71	69.6
Unsatisfactory	141	59.02	24	24
Very unsatisfactory	61	25.57	7	6.4

Source: Researchers' Fieldwork, 2024.



Figure 4. Building condition in study.



Figure 5. Decay impact on the indoor space area.

Experts' Contribution on Building Decay Impact on Indoor Spaces

The expert's rating reveals a concerning trend, with most experts expressing negative assessments. Out of 10 experts, 33.33% rated the impact on indoor spaces as "very unsatisfactory," while 46.67% rated it as "unsatisfactory," suggesting that nearly 80% of the experts believe that the indoor spaces are in a poor decay state. A smaller portion, 20%, rated the situation as "uncertain," indicating some ambiguity in the level of impact. Notably, none of the experts rated the condition of indoor spaces as "satisfactory" or "very satisfactory," highlighting a clear consensus that there is a greater impact of decay on the indoor spaces (see Table 5).

Table 5. Experts' rating of the level of decay impact on indoor space.

S. N.	Experts Rating	No.	%
1	Very satisfactory	–	–
2	Satisfactory	–	–
3	Uncertain unsatisfactory	16	20.046.67
5	Very unsatisfactory	3	33.33
6	Total	10	100

Source: Researchers' Fieldwork, 2024.

CONCLUSIONS

The unsatisfactory condition of residential building and the spontaneous decay of its components and materials have in-turn impacted negative on the indoor space resulting to a healthy indoor environment and a reduction in the usable space which counters the aspiration of the world Health organization (WHO) and United Nations Habitat Global Housing Strategy (UN-Habitat GHS) that advocated for housing provision and a healthy and hygienic indoor and outdoor environment. The study has identified the contributory impact of residential building decay to indoor space as reduction in usable spaces, difficulties operating components especially doors and windows, increase in maintenance burden, damp interior space inducing cooled and mold growth, Increase risk of accidents, injuries and diseases and reduction in the architectural values of the building. These attributes have resulted in poor and unhealthy indoor spaces in residential buildings in the study area,

which was observed by both residents and professionals to be unsatisfactory. This study has also added to the body of knowledge of building science and services in architecture and in determining the best approach to maintaining a good and quality indoor space in the study area.

RECOMMENDATIONS

The recommendations suggested to improve the impact of building decay on the indoor space include the following:

1. The choice of materials should be made from the design stage and should be the responsibility of the architect or material expert.
2. A proper building survey/diagnosis should be carried out to identify the problem and its source before remedial actions are initiated.
3. Regular and timely maintenance should be carried out at least once every two years to keep residential building components and finish in a functional and healthy condition.
4. Maintenance excesses should be the responsibility of both the occupants and the building owner, both for private and government owned residential buildings.
5. Materials for external envelopes should have the ability to resist capillary action and increase moisture into the indoor space as to eliminate mold growth, dampness in the interior spaces.

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