iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 9 **Issue:** XI **Month of publication:** November 2021

DOI: https://doi.org/10.22214/ijraset.2021.38822

www.ijraset.com

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue XI Nov 2021- Available at www.ijraset.com

An analysis of the Causes of Building Defects in Residential Properties in Diobu area of port Harcourt, River State, Nigeria.

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Abstract: ***Currently, derelict buildings with little or no amenities have remained a challenge to the physical fabric of properties in Diobu in Port Harcourt. These derelictions are observed to be affecting the economic and physical functionality of these buildings. Therefore, the paper aims to investigate the causes of the dereliction in the buildings in Diobu area in Port Harcourt Rivers State of Nigeria. A survey research design was adopted where 153 questionnaires was administered to the resident of the study area and another 56 questionnaires to property managers in Port Harcourt. Out of the 209 (Nr) questionnaires administered, a total of 197 was retrieved representing a response rate of 94%. Data gathered were analyzed using Relative Important Index, mean and percentages and presented in tabular and pictorial formats. The paper's finding revealed and confirmed that wall cracks, wall/floor dampness, roof leakages, faulty plumbing fittings, poor ventilation and peeling/faded wall paints are some of the defects in the properties in Diobu. A further investigation revealed that poor building designs, old age, poor maintenance culture, adverse climatic condition, misuse, overcrowding and insect attack are among the causes of these defects on the buildings. This research work is original and has not been previously published anywhere; its reflection is that effective maintenance culture, good occupancy ratio, use of skilled personnel and quality building materials should be encouraged by residents, property managers and landlords in order to check the menace of building defects in the study area.***
Keywords: Residential Buildings, Defects, causes, Analysis, Diobu.

I. INTRODUCTION

A building is a place where people accommodate and work together or for an organization to conduct its work (Seeley, 1987) as reported by Olanrewaju and Abdul-Aziz (2015). The purpose of a building is to give a comfortable and healthy surrounding for people to conduct activities, to provide security, sustain load and environmental shelter or control (Olli, 2004), as cited in Hang (2015). However, where there is occurrence of defects or failures in the building components, it may make the building incapable of carrying out these functions. Scholars from the different areas of construction, architecture and engineering (more broadly, the built environment) have dominated the research area of defects (Johnston and Reid, 2019). The definitions presented in the literatures and the debates that follow illustrate these disciplinary viewpoints. Defects are generally described as deterioration, damages, default or deficiency in an item by Olanrewaju and Abdul Aziz (2015). They are likewise characterized as an imperfection, fault, or flaw especially in a building by Ahzahar, Karim, Hassan, & Eman (2011).

II. LITERATURE REVIEW

The term 'building defect' has been defined differently by different authors depending on their areas of specialization. Hence, no universal term for 'building defects' has been applied across the literatures (Johnston and Reid 2019). Lateef, Khamidi and Idrus (2010) opined that "to some, it means the shortcomings in the design and construction practices, while to others, it implies the inadequacies that arise from normal wear and tear". Furthermore, Burden (2004) defined it as improper condition that may cause impact to the building structure, leading to low quality and performance, and Watt (2007) and Jingmond and Agren (2015) see it as a failing or shortcoming in the function, performance, statutory or user requirements of a building.

Basically, it is any characteristics exhibited which hinders the usability of the building for the purpose for which it was designed and constructed (Seth, 2014). To Kasim and Diyana (2009), it is the non-conformity of a building element or fittings with respect to a standard or specific feature. In the same vein, Atkinson, (1999) describes it as the non-fulfillment of intended usage requirements which are determined by law, regulations, building standards as well as in contract documents, site meeting records and other project documentations. When defects occur, it hinders the usability of the building for the purpose for which it was designed and constructed (Allotey, 2014) and could equally translate into a violation of the applicable building code, the standard of care in the community in which the project is located, or the manufacturer's recommendations (Robert, 2007).

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A. *Classification of Building Defects*

Defects have been grouped into various categories by different authors, using various basis. For instance, Robert, (2007), as cited by Kasim and Diyana (2009) classified building defects into two (2) categories- defects that affect the performance of the structure, and defects that affect the appearance of the structure. Johnston (2019) submitted that building defects can range from a mere imperfection (for example, a chipped tile or mark on a wall) to a structural fault that could create instability in a building. Apart from the classification above, Olanrewaju & Abdul-Aziz (2015), also classified defects into latent and patent defects- "latent defects are in concealed situation and not obvious and the errors will only be visible after the element is constructed and used for some time, it is normally caused by failure in design, workmanship or materials". Furthermore, Georgiou, Love and Smith (1999) described patent defects as those defects that are visually obvious and can be seen easily, they identified example as cracking that occurs at the building envelope, handrails omitted at the stairways, among others.

B. *Examples of Building Defects*

Building defects are of different types, depending on the cause of the defects and the degree of exposures to these causes. Major examples are as follows;

1) *Peeling Paint:* According to Bakri & Mydin (2013), peeling usually occurs on building facades, mainly on plastered walls, columns and other areas which are exposed to excessive rain, sun and great dampness.
2) *Roof Leakage:* To Chong, W. and Low, S. (2005), he greatest threat for the roof is the penetration of water which means leakage.
3) *Flaking:* Flaking is the lifting of small-to-large sections of the paint due to poor adhesion and to the brittleness of the paint; it happens when new plastered or skimmed walls or ceiling are not given enough time to completely dry before painting (Nijland and Larbi, 2010).
4) *Dampness:* This is generally defined as unwanted and excessive water or moisture (Bakri & Mydin, 2013). In the words of Mydin, Salim, Tan, Tawil and Ulan (2014), dampness can result from water incursion either from internal sources (e.g. leaking pipes, gutters, flashings etc.) or external sources (e.g. rainwater).
5) *Cracking:* The common causes of this are the difference thickness of plastering on the structures and insufficient bonding element that holds bricks to the column or beams (Suffian, 2013). Crazing: Crazing in concrete is the development of a network of fine random cracks or fissures on the surface of concrete caused by shrinkage of the surface layer (Nadia, Bakri and Mydin, 2013).
6) *Blistering:* Blistering is the formation of hollow bumps of different sizes on concrete surface due to entrapped air under the finished concrete surface (Bakri & Mydin, 2013).
7) *Efflorescence:* According *to* Nijland and Larbic, (2010), efflorescence is a deposit of salts, usually white, formed on a surface, the substance having emerged in solution from within either concrete or masonry and subsequently precipitated by evaporation; efflorescence can appear as a powdery substance on floors and walls and requires special care to treat.

C. *Causes of Building Defects*

In tracing the cause of building defects, Easthope, Randolph and Judd (2012) as cited by Johnston and Reid (2019) submitted that building defects are equally seen as building faults that have existed since construction or been triggered later by faulty original construction or design. These causes can be outlined as follows;

1) *Climatic Condition:* The climatic condition of a geographical area could cause some deterioration in the building components. For instance, extremely hot condition will cause crack lines to the walls facing the sunlight, this is because hot temperature will absorb all the moisture and water in the concrete (Dai, 2009).
2) *Location of Building:* According to Hang (2015), the Location of a building can have a negative effect on it; for instance, a building situated in low or swampy area could be prone to disasters like flooding.
3) Design Deficiencies: The failure of the design professionals to produce complete, accurate and well-coordinated design results in defects which may be grouped under design error, omission or a combination of both (Gatlin, 2013) and (Long & Robinson, 2014).
4) *Construction Deficiencies:* This is defined as a defect in the design, the workmanship, and/or in the materials or systems used on a project that results in a failure of a component part of a building or structure and causes damage to person or property (Johnston and Reid, 2019).
5) *Poor workmanship:* Poor workmanship can worsen the building quality and performance, such as poor installation methods, poor mixing of materials, poor handling of materials and poor planning (Mydin et al, 2014).

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6) *Construction Material Deficiencies:* The use of sub-standard or inferior building materials can cause significant problems, such as windows that leak or fail to perform and function adequately, even when properly installed. The effects of using low grade of materials will also slowly start to take effect like a cancer in a concrete, maybe after one or two years' time (Hang, 2015).
7) *Misuse and Change in Use:* According to Ahzahar, Karim, Hassan and Eman (2011), where buildings which have been converted into either commercial or office purposes, the need to install air-conditioning systems to meet modern building requirements seems necessary.

III. RESEARCH METHODOLOGY

The section demonstrates the methodological approach adopted for the collection of the relevant data, analysis and discussions. The population for study was residents of buildings in Diobu and the professional estate surveyors managing some of the residential properties in the area. However, there is no statistical document on the exact population of residents in Diobu area, hence the population of the study was unknown. Consequently, and in line with the recommendations of Israel (1992) and Ihuah (2015), Cochran's formula of n = n0 / (1+ (n0 – 1) /N) was used to arrive at the sample size of 150 respondents. Furthermore, cluster and simple random sampling techniques were adopted to select the sample size of 150 residents of the study. Similarly, 56 property managers that confirmed that managed residential properties in Diobu area were selected randomly and served questionnaires to collect the relevant data. A total of 209 copies of questionnaires were administered on the respondents and 197 copies were returned, this represents a percentage of 94%. The data collected were analyzed using relevant statistical tools like
Likert scale, Relative Importance Index (RII), Arithmetic Mean and Percentage Ratio while Tables and Pictures were seen to present the results.

IV. DISCUSSION OF RESULTS

This section provides the results/findings of the analysis carried out on the gathered data as well as providing discussion on each category or subsection.

A. Identified Defects in the Properties in the Study Area

Table 4.1 below shows the defects identified in the buildings by the residents. They are wall cracks (92% of the respondents), poor ventilation (96%), wall and floor dampness (93%), roof leakage (8%), faulty plumbing fittings (89%), poor sanitary and drainage facilities (94%), peeling paints (98%), falling roof member (93%) and faulty windows and doors (89%). This confirms Ankeli et al (2015)'s findings that "a large number of the housing stock in the study area date back to the 1950s and 60s, therefore most parts of the buildings manifest severe obsolescence".

Table 1: List of defects identified in the buildings by residents

S/N	Building Defects	Availability				
		Yes	%	No	%	Total
1	Wall Cracks	138	92%	12	8%	150
2	Poor Ventilation	144	96%	6	4%	150
3	Wall/Floor dampness	139	93%	11	7%	150
4	Roof leakage	126	84%	24	16%	150
5	Faulty plumbing fittings	133	89%	17	11%	150
6	Poor sanitary and drainage facilities	141	94%	9	6%	150
7	Peeling paints or plastering	147	98%	3	2%	150
8	Falling roof member	139	93%	11	7%	150
9	Faulty windows and doors etc	134	89%	16	11%	150

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Figure 1 -4 below depicts pictures of the various effects identified in the study area/

Figure 1: Walter dampness caused by poor drainage facilities. Figure 2: A building in the study area with damped wall

Figure 3: A building in the study area with damped wall and poor design- floor level is lower than ground level. Figure 4: A building with faded wall paint and broken window glass.

B. The Resident's Opinion on the Causes of Building Defects in the Study Area

The identified causes of the building defects are listed in the table below, using the Relative Importance Index (RII) to rank them according to their levels of severity. The formula is as follow;

RII = (n1 + 2n2+3n3+4n4+5n5)/5N

Where:

n1 = number of respondents that strongly disagreed;

n2 = number of respondents that disagreed;

n3 = number of respondents that were indifferent;

n4 = number of respondents that agreed;

n5 = number of respondents that strongly agreed and;

N = total number of respondents = 150.

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As stated in Table 2 below, about 55% of the respondent opined that the defects in the properties were caused by faulty design. This corroborates Easthope, Randolph and Judd, (2012) findings as cited by Johnston and Reid (2019) that building defects are building faults that have existed since construction or been triggered later by faulty original construction or design. A poor design, for example on the size of kitchen, septic tank, drainage etc. will put undue stress on these facilities and lead to quick deterioration. Assaf (1996) as quoted by Adejimi (2005) reported that defects due to construction inspection, inaccurate measurements among others leads to poor workmanship. Another cause of building defects in the study area is overcrowding, this was substantiated by Owei et al (2009), who submitted that the result of 1991 national population census revealed that Diobu alone accounted for about 60% of the population of Port Harcourt. Analysis of the respondents' opinion on the density of the study area revealed that 99 respondents, representing 66% of the population believed that the buildings in the study area were overcrowded. Overcrowding could take the shape of excessive number of people to facilities ratio in the compound or in each dwelling unit, this will likely lead to too frequent use and misuse of the existing facilities and consequently cause a major damaged.

Another identified cause of building defect in the study area is use of substandard building materials. The use of substandard materials and components no doubts affect maintenance to a large extent because such materials have lower lifespan and durability than standard materials and components (Waziri and Vanduhe, 2013). This view was corroborated by 87 respondents who agreed with the fact that use of substandard material was a major cause of building defects in their properties.

The ages of the building in the study are is another cause of the defects in the buildings in Diobu, 116 respondents confirmed this and it was equally underlined by Owei (2009) who submitted that at least 80% of the housing stock in Diobu dates back to 1950s and 1960s and manifests obsolescence. A major way to prevent defects in building is through a well-structured maintenance plan. Building maintenance management ensures that building facilities retain their structural, functional and aesthetic conditions throughout their lifespan and reduce unnecessary expenditures (Waziri and Vanduhe 2013). Lack of adequate maintenance will accelerate the rate of wear and tear in building and lead to a consequent breakdown. About 114 of the respondents in the study area agreed that building maintenance is a major cause of building defects in the study area, this represented 76% of the opinions sampled. Owei et al (2009) submitted that poor implementation and lack of comprehensive planning are responsible for the poor state or urban infrastructure in Diobu. Failure to plan effectively will mean that facilities and infrastructure will be over-stretched to a point of breakdown (Kio-Lawson & Dekor 2014). This is explicably a major challenge on the fabric of the neighbourhood. External factors like vandalism, misuse, abuse, among others by residents, neighbours and visitors equally contribute to the rot in the building components and facilities. About 66 (44%) of the respondents align with this. From the analysis and Table 2 below, the severity of these causes can be ranked as follows- age (0.819), lack of adequate maintenance (0.815) overcrowding (0.744), environmental forces (0.715), poor design (0.681), use of substandard building materials (0.680), use of inexperience workmen (0.677), eternal factors (0.632), insects and rodents (0.584) and lack of basic facilities (0.571).

Table 2: Analysis of the Residents' opinion on Causes of Identified Defects in the Property.

S/N	Causes of Building Defects	Unit of Measurement & Percentage										RII Value	Rank	Total
		Strongly Disagree		Disagree		Indifferent		Agree		Strongly agree				
		No	%	No	%	No	%	No	%	No	%			
1	Poor Design	17	11%	16	11%	39	26%	45	30%	33	22%	0.681	5th	150
2	Use of substandard building materials	20	13%	21	14%	22	15%	53	35%	34	23%	0.680	6th	150
3	Lack of adequate maintenance	5	3%	12	8%	19	13%	45	30%	69	46%	0.815	2nd	150
4	Use of inexperience workmen	24	16%	7	5%	41	27%	43	29%	35	23%	0.677	7th	150
5	Weather e.g. rain storm, soothe, flood etc.	18	12%	6	4%	34	23%	56	37%	36	24%	0.715	4th	150
6	External environment e.g. activities of neighbours, vandals	23	15%	17	11%	44	29%	45	30%	21	14%	0.632	8th	150
7	Old Age	7	5%	9	6%	18	12%	45	30%	71	47%	0.819	1st	150
8	Lack of basic facilities like toilets, drainage, water supply etc.	32	21%	21	14%	56	37%	19	13%	22	15%	0.571	10th	150
9	Overcrowding	9	6%	21	14%	21	14%	51	34%	48	32%	0.744	3rd	150
10	Insects & Rodents like rats, termites etc.	34	23%	23	15%	34	23%	39	26%	20	13%	0.584	9th	150

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C. The Property Managers' Opinions on the Causes of Building Defects in the Study Area

In other to have a better understanding of the causes of the building defects identified in the properties, the opinion of property managers managing some of the properties were sourced. This is important because of their experience and technical expertise in handling building defects and renovations. As depicted in Table 2 below, about 33 property managers (representing 70% of the respondents) agree that poor design is responsible for some of the defects, and 11 of them (representing 24% disagreed), while the remaining 3 (6%) were indifferent. Furthermore, 30 of them (64%) were of the opinion that the use of substandard building materials was the cause. 42 respondents (90%) opined that it was due to lack of adequate maintenance culture; 36 respondents (56%) submitted that it was due to the use of inexperienced workmen during construction or renovation of these buildings.

Table 3: Analysis of the Property Managers' opinion on Causes of Identified Defects in the Property.

S/N	Causes of Building Defects	Unit of Measurement & Percentage										RII Value	Rank	Total
		Strongly Disagree		Disagree		Indifferent		Agree		Strongly agree				
		No	%	No	%	No	%	No	%	No	%			
1	Poor Design	4	9%	7	15 %	3	6 %	22	47 %	11	23 %	0.72	8th	47
2	Use of substandard building materials	6	13 %	3	6%	8	17 %	15	32 %	15	32 %	0.73	7th	47
3	Lack of adequate maintenance	0	0%	3	6%	2	4 %	22	47 %	20	43 %	0.85	2nd	47
4	Use of inexperience workmen	8	17 %	7	15 %	6	13 %	12	26 %	14	30 %	0.67	9th	47
5	Environmental Factors e.g. rain storm, soothe, flood etc.	9	19 %	11	23 %	3	6 %	15	32 %	9	19 %	0.62	10th	47
6	Vandalism	6	13 %	3	6%	0	0 %	17	36 %	21	45 %	0.79	3rd	47
7	Old Age	2	4%	0	0%	0	0 %	23	49 %	22	47 %	0.87	1st	47
8	Lack of basic facilities like toilets, drainage, water supply etc.	4	9%	5	11 %	4	9 %	19	40 %	15	32 %	0.75	10th	47
9	Overcrowding	3	6%	0	0%	6	13 %	27	57 %	11	23 %	0.78	5th	47
10	Insects & Rodents like rats, termites etc.	4	9%	2	4%	0	0 %	31	66 %	10	21 %	0.77	6th	47

V. CONCLUSION

The study has conducted an empirical research into the causes of building defects in residential properties in Port Harcourt, using Diobu (Mile 1, 2 and 3) as a study area and it concluded that poor building designs, use of substandard building materials, lack of adequate building maintenance, use of inexperience workmen, adverse weather, old age, overcrowding and insects and rodents' infestation were the identified causes of these building defects.

VI. RECOMMENDATIONS

In other to prevent the identified causes of building defects above, the following recommendations are of great importance. It was observed that there was practically no compliance with or enforcement of relevant building laws on occupancy ratio in the study area. A good testimony to this is the overcrowded building noticed. Government, landlords and property managers should discourage this practice in order to prevent excessive stress on the component of the buildings which could lead to rapid deterioration. Furthermore, property developers should always ensure that they work with good building design that complies with all statutory building codes and regulations.

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In so doing, they also need to ensure that only experienced workmen are engaged for any construction or renovation works, this will help to eliminate the risks associated with substandard works. The onus is equally on the developer to ensure that the workmen use durable and appropriate building materials. Similarly, the residents need to see maintenance as a collective effort of both the landlord and the tenants, they need to always ensure that the building components are used carefully and also that any defective component is repaired or replaced on time before it affects other components.

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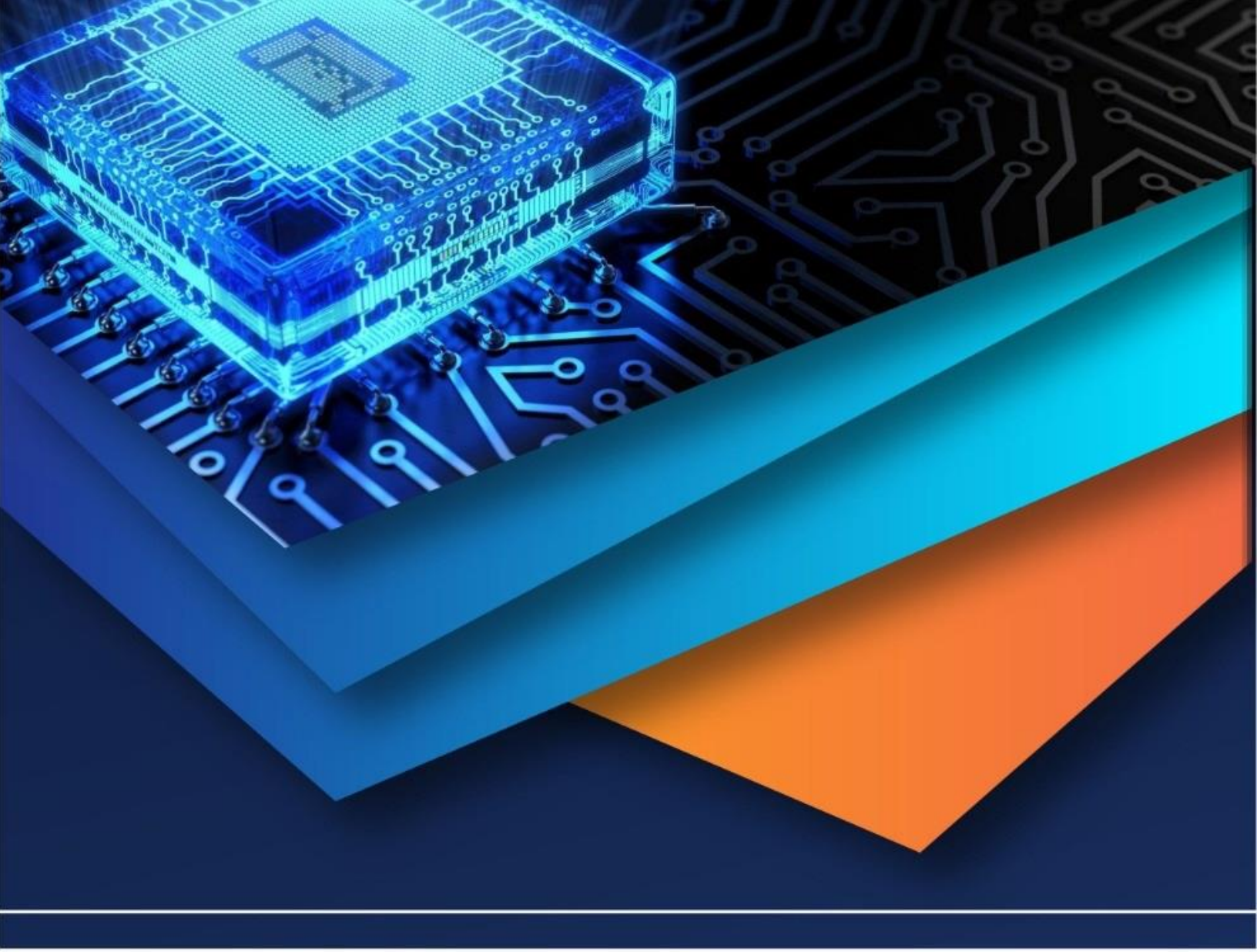

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