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INVESTIGATION INTO THE CAUSES AND EFFECTS OF CRACKS IN STRUCTURAL MEMBERS OF BUILDINGS AND POSSIBLE STRATEGIES FOR REPAIR

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Abstract
Structural cracks in buildings present significant safety and integrity challenges, necessitating thorough investigation into causes, effects, and repair strategies. This study explored factors contributing to structural cracks, their implications on the structural members and building as a whole, and various repair methods from the literature. The factors were populated in questionnaires to acquire feedback from respondents with and without knowledge of crack propagation in buildings. Through analysis and observation, including survey insights and visual measurements, diverse causes emerged, from material deficiencies to environmental influences. 81% of respondents understood structural cracks, with 68% aware of common causes that are sometimes neglected. Initial thin cracks, if ignored, can escalate into serious issues and jeopardize safety. 80% of respondents would not inhabit aesthetically compromised buildings due to cracks. Repair strategies are critical to address the underlying causes and factors affecting the cracking of structural members. This will involve efforts from architects, engineers, contractors, and occupants through educational initiatives and awareness campaigns to enhance collective understanding of the impending problems and prevention measures to avoid incessant building collapse.

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1.0 INTRODUCTION
Cracks are the most predominantly occurring problems encountered in buildings. Over the years, concrete has been the most common building material used in construction, which is liable to cracking during construction, after construction, and more during use [1], [2]. Generally, there is no building structure with zero cracks. A building's structural members are its frame structure, which is made up of designed reinforcements and appropriate concrete, providing stability and strength to the building. These structural buildings are faced with various crack problems. Aruya and Chukwuemezie [3] reported that cracks are a regular occurrence in structures, and they may manifest flaws over time as a result of the building's construction practices. Cracks can affect the safety and aesthetic appearance of a structure [4], [5].

A crack is a complete or incomplete separation of concrete into two or more parts caused by tensile stress that induces strain greater than the tensile strength of concrete [6]. Cracks can either be minor or major depending on where the crack occurs in a structure. Minor cracks are cracks on non-structural members of a building, e.g., partition walls, plastering [7], [8], as shown in Figure 1 [9], while major cracks are cracks formed on structural members of a building and are responsible for making the structure unsound and may cause structural damage to the building, e.g. cracks along a column, along a beam, on slabs [7], [8]. Major cracks are also called structural cracks. Cracks that appear on load-bearing walls are also termed structural cracks [10], [11]. Cracks on structural members of a building (major cracks) are mostly dangerous as they tend to reduce the strength, stability, and safety of the members and may, in turn, cause failure, as shown in Figure 2 [12].

Cracks may be Active cracks (i.e. cracks that open and increase in length or width over time) or dormant cracks (cracks that have stopped all their movement) [13]. It can also be classified based on its width and size [14] as shown in Table 1.

Figure 1: Non-structural shrinkage crack [9]

Figure 2: Vertical structural crack on column [12]

Table 1: Classification of cracks using width size.

Crack Width	Classification
Lesser than 1mm	Thin
1mm to 2mm	Medium
Greater than 2mm	Wide

Buildings around the world are susceptible to various types of cracks, which building occupants do not pay attention to and, with time, may increase in length and width. These cracks may be caused by many factors, including improper design [14], [15], construction errors[16], environmental factors [10], or the size of aggregates used in the construction [17], [18]. Cracking is an unavoidable response of any structure however, designers are always trying to eliminate as many of the potential causes of cracking as possible, such as poor construction practices, inadequate detailing, and material defects. Designers aim to design structures with adequate tolerance to accommodate these effects [19].

Olofinnade and Busari [7], opined that cracks in a reinforced concrete part of a building can be a sign of serious structural defects that could lead to building collapse if not addressed. These cracks are often forewarning signs that a building is in distress and may require repair or reinforcement to prevent failure to perform its intended function [20].

Furthermore, structural cracks may arise as a result of poor design [14], poor construction practices [21] or overloading and thus endanger the safety of a structure. They pose relative dangers to the structural integrity of the building. A structural member of a building develops cracks every time strain in the factor exceeds its strength. According to Oseghale and Ikpo [22], the major causes of building failures were non-possession of approved drawings, or non-compliance to them, use of quacks, poor workmanship, and poor communication. Some of the causes of structural cracks in buildings identified by some researchers [4,10,16–18] are: poor design, under or over-reinforcing concrete, poor construction practices, use of poor quality materials, thermal stresses, plastic shrinkage, poor curing, poor concrete mix ratio, presence of void as a result of poor compaction, foundation settlement, vegetation, overloading and vibration, among others.

There are various effects that cracks can have on the structural integrity of a building, including reduced strength, reduced stiffness, reduced load capacity, increased deflection, increased risk of failure, increased maintenance costs, and reduced value [22]. Cracks on structural members make the reinforcement more exposed to water, causing corrosion [25]. Mehta and Burrows [26], concluded after studying various cracks that the crack growth reduced the permeability of concrete and accelerated the rate of corrosion of reinforcing steel and deterioration of concrete. Cracks make buildings lose their aesthetics and destroy the wall integrity, influence the shape protection, and reduce the sturdiness of concrete [8].

In lieu of this, this research investigates the causes, effects, and possible strategies for the repair of cracks on structural members in buildings through visitations to buildings faced with structural crack defects, and surveys from building stakeholders, (those equipped and not equipped with building construction knowledge) to improve the knowledge of stakeholders to construct more reliable structural members (with fewer cracks) and in turn more safe buildings.

2.0 RESEARCH METHOD

This paper employs a mixed methods approach, combining qualitative research (conducted to gain insights into the causes and effects of structural cracks, drawing the insights from expert opinions and experiences from people) and quantitative research (involves the collection and analysis of numerical data related to crack classifications, measurements, and the comparative assessment of repair strategies) methodologies to comprehensively investigate the causes, effects, and repair strategies associated with structural cracks in buildings.

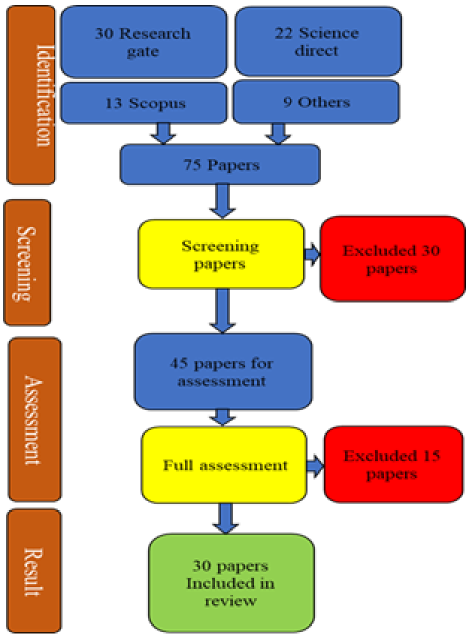

Figure 3: The flow diagram for the method of article selection

Firstly, to picture out and understand the cracks, various repositories were assessed to gather information on structural cracks, their causes, effects, and repair strategies. 75 articles were collected, comprising 40% of Research Gate, 30% of Science Direct, 18% of Scopus, and 12% of other journals as shown in Figure 3. The collected articles have about 60% of it related to the discussion. About 70% of the collected articles were of publication years not more than 10 years before the date of this paper (i.e., 2014-2024), as shown in Figure 4.

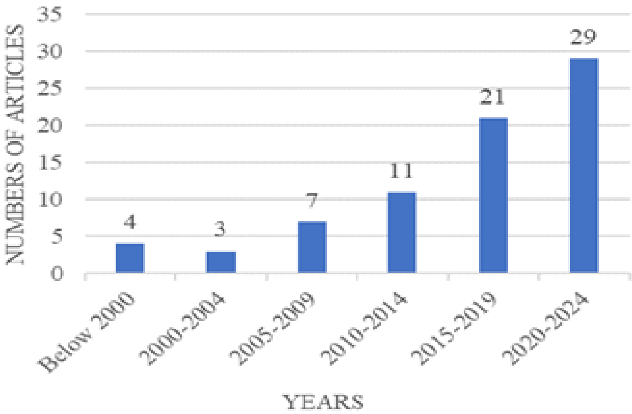

Figure 4: Year of publications for articles collected

The information harnessed from the past research was used to develop a questionnaire used in the survey, together with visitation to 30 sites so as to understand the realities of these structural cracks reported from the literature. A survey was designed to gather insights from professionals and building owners. The participants included architects, engineers, and construction professionals with experience in structural analysis, buildings, and design; building owners (from other professions) who have encountered structural cracks in their buildings; and also potential building owners. Figure 5 shows the steps taken in the preparation and analysis of the survey.

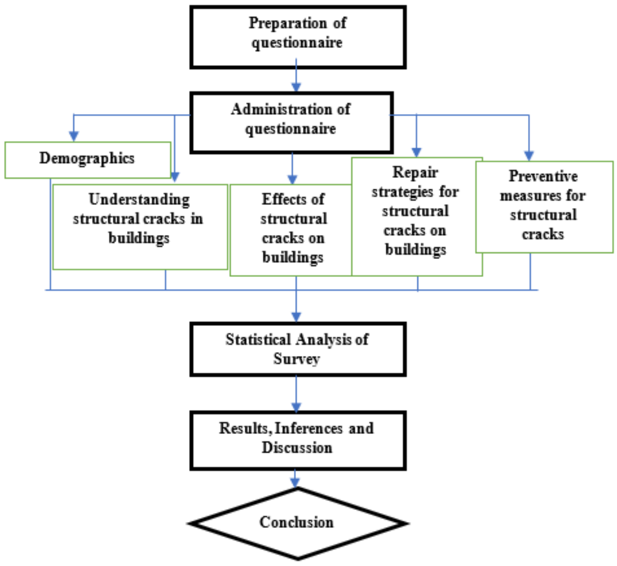

Figure 5: Flowchart showing methodology

Buildings were also selected for on-site inspections (which involve visual assessments, measurements and documentation, and construction analysis of structural cracks), encompassing various construction periods and locations. These selections aimed to provide a diverse representation of structural crack scenarios. The equipment used were: Vernier caliper, Millimeter graded Ruler, recording booklet, and Camera, as shown in Figure 6.

Figure 6: Equipment used for structural crack measurement

3.0 RESULTS AND DISCUSSIONS

3.1 General Information on Respondents (Demographics)

The respondents consist of personnel of profession relating to building and structures as well as those not relating to it to get a comprehensive result. 41% of the respondents were from professions relating to building and structures e.g. civil engineering, construction engineering, building, and quantity surveying etc. while 59% of the respondents were from other various professions not related to building and structures e.g. business, art, teaching, agriculture, etc. but were either building owners or potential building owners as shown in Figure 7.

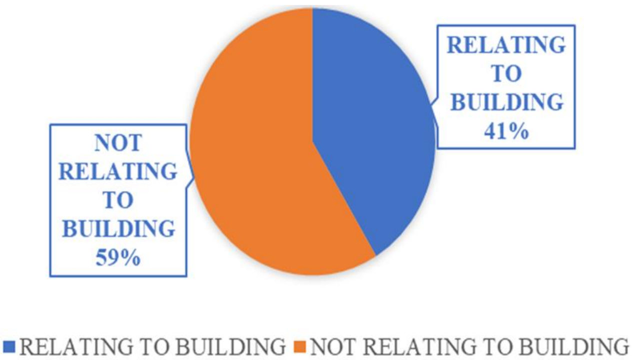

Figure 7: Profession of respondents in relation to buildings and structures

Respondents of professions relating to building and structures comprised civil engineers about 60%, builders 10%, architecture 5%, quantity surveyors 10%, and other professions related to building and structures as shown in Figure 8. 81% of the respondents understand the meaning of structural cracks in a building.

Figure 9 shows various buildings in which respondents lived and have seen or encountered cracks. 62% of the respondents lived in bungalows, 21% lived in storey buildings, 15% lived in duplexes, and others in high-rise buildings and wings. It was seen that cracks are liable to occur more in bungalows than any other type of buildings because most bungalows are not structurally designed and built.

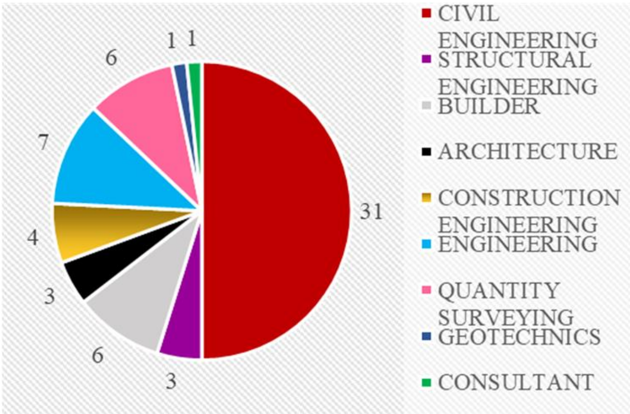

Figure 8: Respondents relating to buildings and structures

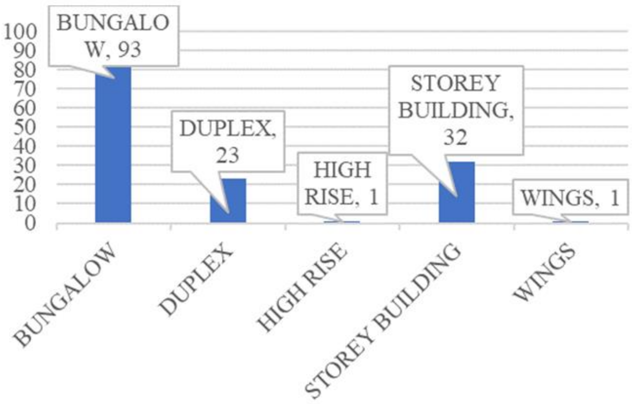

Figure 9: Different buildings where respondents live and have seen cracks

3.2 Understanding Structural Cracks in Buildings

The majority of the respondents (81%) have seen and encountered various cracks (from building partitioning and structural members) where they live and at their places of work meaning that cracks predominantly occur in buildings. 62% of the population have encountered or worked on buildings having structural cracks, indicating fewer structural cracks are encountered by most people compared to non-structural cracks. It was also noted that non-structural cracks are seen more in residential buildings as compared to other buildings such as commercial, and industrial. As 84% of respondents have encountered structural cracks in residential buildings, 37% of the respondents have encountered structural cracks in commercial buildings, 25% in industrial buildings and so many other buildings as shown in Figure 10.

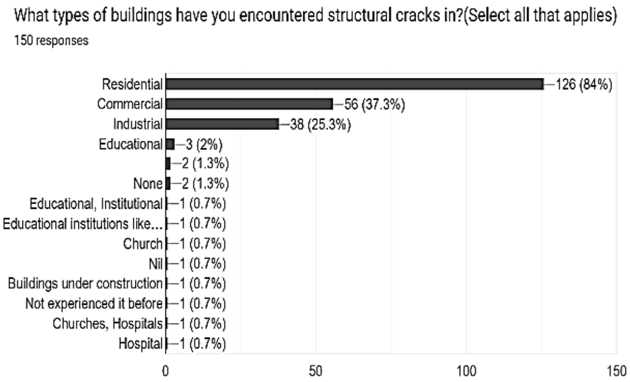

Figure 10: Various buildings where structural cracks occur

It was found that few people are aware of the various types of structural cracks in buildings, as 50% of respondents have knowledge about different types of structural cracks. 68% of the respondents are aware of the common causes of structural cracks in buildings. A few of the causes are given below:

- Excess loads on building,
- Wall subjected to too many structural loads from beams,
- Poor foundation leading to settlement,
- Over spacing of stirrup in beams and columns, and
- Inadequacy in the structural and architectural design.

Other causes stated by respondents are: voids during placement of concrete, incorrect placement of form works, improper mix ratio, vibrations during curing, adverse temperature changes, poor workability of concrete, bad construction approach of manpower, quality of the materials, poor workmanship, differential settlement, poor construction and maintenance, poor design of structural members, failure in carrying out soil test which is one of the prerequisite before planting a building, use of substandard materials, water activities and miscalculations, insufficient rebar angle in column reinforcements and so many more. These causes can be categorized into:

- Causes during design: insufficient rebar angle in column reinforcements, poor structural and architectural designs of structural members and building as a whole,
- Causes during construction: quality of the materials, poor workmanship, improper mix ratio; and
- Causes during use; excess loading, excess vibration in or around building etc.

Figure 11 shows respondents' insights on some listed causes of cracking on structural members, stating whether it can cause cracking or not. It was derived that the self-weight of the structural members has little influence or does not contribute to the formation of structural cracks on a building, as about 47% stated that the self-weight of the structural members could not cause structural cracks. Poor workmanship, poor construction practices, improper casting of structural members, and overall design of building were seen and stated as more serious and major causes of structural cracks as over 93% of respondents agreed to that. Askar and Al-kamaki [27] stated that structural cracks occur due to incorrect design, faulty construction practices, which poses significant risks to the safety and stability of building. Aruya and Chukwuemezie [3] also affirmed that cracks result majorly from poor design, shoddy construction or overloading. Research done by Olofinnade and Busari [7] showed that the major causes of cracks are as a result of poor construction techniques. Other stated factors also contribute majorly to the formation of structural cracks in a building.

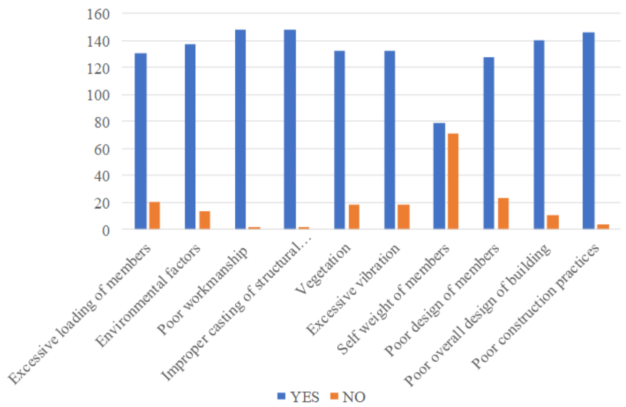

Figure 11: Some major causes of structural cracks in buildings

3.3 Effects of Structural Cracks on Buildings

It was obtained from the responses that structural cracks on a building can have various potential negative effects on the building, such as reduced stability, aesthetic issues, reduced value, insecurity, loss in strength of the overall building, weakening of structural members, and so many more as presented in Figure 12. Structural cracks cause little or large reduction in the strength and safety of a structural member which will in turn cause reduced stability in the building as a whole. 75% of the whole respondents stated that structural cracks can lead to reduced stability of the building when they occur, 73% of the total respondents also stated that it can cause reduction in the value of the building if it will be valued, 53% of the total respondents also stated that it can lead to the building losing its aesthetic value (aesthetic issues). Askar and Al-kamaki [27] stated that cracks in buildings can pose significant risks to structural integrity, safety, and aesthetics. Therefore, it was deduced from the survey that the stability and value of a building are more affected by the presence of structural cracks than its aesthetics, water leakages, and other effects. Figure 12 shows the opinions of all respondents in relation to the potential negative effects that structural cracks can pose to the building.

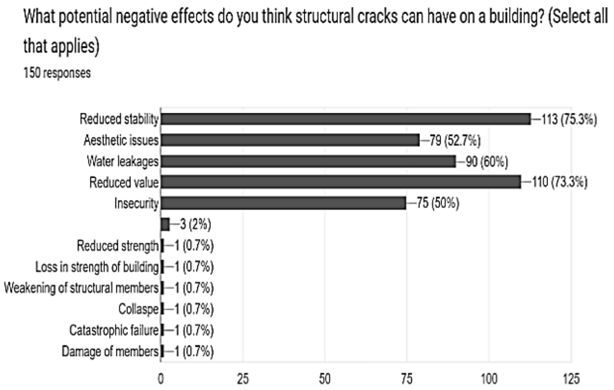

Figure 12: Negative effects of structural cracks on a building

60% of the respondents agreed that it is risky to live in a building with minor cracks while 88% of the respondents agreed that it is very dangerous to live in a building that has structural cracks on its members. So, it was also deduced that it is riskier to live in a building with structural cracks than living in a building with minor cracks. Also, it was evaluated that 80% of the respondents cannot live in a building that is compromised aesthetically (i.e., appears not to be beautiful anymore) as a result of the presence of structural cracks on the building.

It was derived from the responses of the survey that the presence of severe structural cracks on building can lead to the collapse of such building as 65% of the respondents have heard about or witnessed a building collapse which is as a result of severe structural cracks on such building. Also, thin cracks on structural members or load-bearing walls can open up and expand in width and length to form a more serious structural cracks leading to structural problems, 65% of the survey respondents have once observed or noticed cases where thin cracks have resulted to more serious structural problems (cracks) because it was not quickly looked into and repaired. Evaristus and Obinna [24] reported that some of the cracks are in propagation (active) and hence pose a real threat of extension or future collapse to the building. Various examples and scenarios were stated and discussed by respondents below:

- The residential building of the clergy in Ave Maria Catholic Church at 32 Kusenla Road, Chisco Lekki. The thin cracks in beams and slabs became wider over time because the general arrangements of slabs and beams were done with little or no experience. The spans were questionable. Although all the structural elements passed the integrity test, the cracks remained. Concrete chemicals were adopted to treat the cracks with continuous observations;
- A study of a hotel collapse in Akure, which was a result of thin cracks in the slab that later evolved into major cracks;
- The Sampoong Department Store collapse in Seoul, South Korea, in 1995. This was caused by a small crack in the building's fifth-floor slab, which eventually led to the collapse of the entire building;
- My duplex at Oke-Ogbo, Ile_Ife, Osun state had some expanding cracks due to improper reinforcement on the counter lever. We had to enlarge the rooms under the counter lever to stop the cracks;
- The collapse of a house in my neighborhood at Asaba, Delta state started from thin cracks on the wall, and proper actions were not taken, thereby leading to the total collapse of the building, and so on.

It was stated that the value of a building can depreciates up to a value lesser than 50% of the original value due to the presence of structural cracks as 22% of the total respondents believed that the value of a building should not depreciate to a value less than 50% of the original value and 78% of the total respondents stated that the depreciation value of a building should be greater than 50% of its original value because of the presence of crack issues on the building. Majorly, people will not be willing to pay much for a building that has undergone crack repairs visible to them of one kind or the other because people perceive it has defects even though it has been taken care of. 62% of the total respondents clearly stated that they cannot pay a premium for a building that has undergone structural crack repairs even though repairs were thoroughly done.

3.4 Repair Strategies for Structural Cracks in Buildings

Some people think that demolition is the only possible way to eliminate the risk posed by structural cracks in the building, but there are major repair methods and strategies that can help adjust the structural integrity of the building to avoid demolition. The underlying causes and affected members must be taken into consideration when choosing and administering repair strategies to structural cracks. About 92% of the total respondents agreed with that. Pavate [14] also stated that structural cracks are repaired based on their extent of formation and the cause behind their formation. There are various ways and methods for repairing structural cracks in buildings, some of which were listed by respondents:

- Retrofitting: This is a method used to reinforce or repair existing structures, particularly those affected by cracks or structural weaknesses. It involves the addition of additional materials or components to the structure to enhance its strength and durability. The materials are obtained for the method provided through inspections and analysis of the structural cracks to understand the causes and implications of the cracks.
- Patching: This is a relatively straightforward and cost-effective method for repairing minor structural cracks. This involves the application of patching material to the crack or damaged area according to the manufacturer's instructions. This may involve filling the cracks with the patching compound, troweling it smooth, and ensuring proper adhesion to the substrate.
- Routing and sealing: This is a method commonly used for repairing cracks in concrete structures, particularly those that are wider or deeper. The first step in routing and sealing is to prepare the crack by widening it and creating a reservoir for the sealing material. After the crack is prepared and cleaned, the sealing material is applied to fill the routed channel and seal the crack. Common sealing materials include epoxy resins, polyurethane sealants, or specialized crack fillers designed for structural applications. The sealing material is typically injected into the crack using pressure injection techniques to ensure complete filling and bonding with the surrounding concrete.

Others are drilling and plugging, stitching, rendering, filling, plastering, underpinning, etc.

It is so important that repair strategies to be used for the repair of cracks should be chosen and administered based on the underlying cause of such cracks. the majority (95%) of the total respondents agreed that it is important to first identify the underlying causes of cracks before choosing and implementing repair strategies. Also, it was deduced from the survey that the administration of repair strategies on cracked members should also depend on the location of the cracks (i.e. whether it is in the column, beam, etc.) as 92% of respondents with structural and construction knowledge agreed to that. Some advanced methods, technologies, and materials used in crack repairs are:

- Post tensioning: This is not a direct crack repair method as it is primarily used as a method of strengthening and reinforcing concrete structures rather than repairing cracks. However, it can indirectly contribute to crack repair by redistributing stresses and preventing further cracking. It can effectively contribute to the overall stability and durability of concrete structures, as shown in Figure 13 [28]. 92% of the respondents with structural knowledge of post-tensioning agreed that post-tensioning in structural members can help reduce cracks. Also Piątek and Howiacki [29] stated that Prestressed or post-tensioned concrete has important advantages over conventional reinforced concrete, the most substantial of which include extended spans, decreased cross sections, or reduced cracking. curvilinear multiwire strands are tensioned after concrete's hardening to transfer the compressive force to the concrete. The overall idea is to confront external forces and achieve extended benefits, e.g., longer spans or reduced cracking.

Figure 13: Post tensioning on the beam of a structure [28]

- Epoxy injection: an advanced technology used for the repair of structural cracks in concrete and masonry structures, as shown in Figure 14 [30]. This involves injecting epoxy resins into the crack under pressure using specialized equipment such as injection pumps or pneumatic guns. The epoxy resin flows into the crack, filling voids and bonding with the substrate. The injection process is carefully controlled to ensure that the resin penetrates the entire length and depth of the crack. The use of epoxy resins for repairing concrete cracks is a common method to restore cracked concrete structures [3]. Quick epoxy repair is extremely important not only to improve the structural integrity but to ensure that the reinforcement is protected from moisture and contaminants that could have an effect on the rebar and decrease the durability of a structure [31]. This method has also been adopted in the repair and rehabilitation of reinforced concrete (RC) structures. It is also considered one of the most common methods used for crack repair for the last two decades, and epoxy resins generally have very excellent bonding and durability characteristics [32].

Figure 14: Repair of a building beam using epoxy injection [30]

- Crack repair using microorganisms, e.g. bacteria: Certain bacteria, such as Bacillus subtilis or Sporosarcina pasteurii, are employed in MICP (Microbial Induced Calcite Precipitation) technology. These bacteria can catalyze chemical reactions that convert soluble calcium compounds into insoluble calcium carbonate (calcite), effectively sealing cracks in concrete structures. Joshi and Goyal [33] stated that early-age formation of micro-cracking in concrete structure severely affects serviceability, leading to high cost of maintenance. Apart from conventional methods of repairing cracks with sealants or treating the concrete with adhesive chemicals to prevent the cracks from widening, a microbial crack healing approach has shown promising results. The unique feature of the microbial system is that it enables the self-healing of concrete.
- Grouting: This is an advanced technology used for the repair of structural cracks which involves selection of grouting materials (such as cementitious grouts, epoxy resins, polyurethane resins, and microfine cement-based grouts etc.) which will be injected into the cracks under pressure using specialized equipment such as injection pumps or pressure grouting machines, Figure 15. The pressure helps ensure that the grouting materials penetrate deeply into the crack, filling voids and bonding with the surrounding. Silva and Oliveira [34] stated that Grout injection can also be used for repairing cracks in earth constructions and work as a complement in mixed strengthening solutions.
- The use of treated palm tree leaves fiber: This is an innovative approach that combines sustainable materials with advanced repair techniques using palm tree leaves fiber which have undergone treatment processes to enhance its mechanical properties and durability and will be integrated into various repair materials, including cementitious mortars, concrete mixes, and polymer composites. When incorporated into repair materials, palm tree leaves fibers act as reinforcement elements that help cracks and distribute stresses more effectively across the repaired area. This reduces the likelihood of crack propagation and improves the overall durability and performance of the repaired structure. In the investigations performed by Kareche and Agoudjil [35], results revealed that mortar, repair materials, and concrete reinforced with date palm fibers offer better shrinkage prevention and thus decrease the cracking effect.

Others are CFRP sheet bonding [36], [37], polymer-based grout, fiber-reinforced grout, Concrete seal tape, using water sealant, using a bonding adhesive to prime crack area etc.

Figure 15: Some repair methods for structural cracks on building [38]

3.5 Preventive Measures for Structural Cracks

Preventive measures are essential in minimizing the risk caused by structural cracks on a building as it is not possible to remove totally its occurrence in buildings. Various preventive measures should be taken before, during, and even after the construction of a building so as to reduce cracks in the building.

Some of these preventive measures were listed by respondents:

Proper supervision of project works, use of high quality materials during construction, monitoring construction processes, proper soil investigation and analysis before design and construction, good construction practices, adherence to architectural and structural drawings, reduction of heavy weight, accurate planning, calculation and implementation, workers should be well monitored, good and relatable structural and architectural design, employ experienced or skilled laborer, proper concrete mix design, avoid construction of walls on filled up soil, building should be constructed over soil strata in uniform characteristics, removing vegetation that poses threat to the structure, quality control and proper R.C design and so on.

Proper monitoring of the structural integrity of an ongoing building construction project can help prevent some certain structural cracks on the building; 92% of the respondents agreed to that. 96% of the respondents agreed that regular maintenance of a building can help in detecting and preventing the formation of cracks over time, and 97% of the respondents stated that buildings must be regularly inspected to detect and prevent structural cracks. By this, it was deduced that in the prevention of structural cracks on buildings, there should be proper inspections and maintenance on the building. By doing this, cracks can be quickly detected and repaired at early stages before they form more serious cracks and can be repaired.

Some personal experiences of some respondents are listed below:

- On a site in Victoria Island Lagos, there was a duplex that suddenly started developing structural cracks. Upon investigation, it was discovered that the cracks emanated due to the uneven settlement of the foundation. The uneven settlement was due to ongoing piling work for a multi-storey building in the adjacent compound.
- A crack on a column of a building in Kogi. The crack was opened up along its length of the crack, and it was then filled with concrete of a mix ratio 1:2:4 so as to give a firm work.
- I'll share the case of the Citigroup Center in New York City, which involves investigating and repairing structural cracks. The Citigroup Center is a 59-story skyscraper in Manhattan, New York City. In 1978, a structural engineer discovered a small hairline crack in the building's cantilever, which is a projecting structure that is supported only on one end. The engineer initially dismissed the crack as insignificant, but after further investigation, it was determined that the cantilever was not structurally sound and could collapse. The Citigroup Center's owner hired a team of engineers and architects to conduct a full investigation of the structure. The team found that the cantilever's welds were defective and that the structural calculations were miscalculated. They developed a repair plan that involved welding additional steel plates to the cantilever to increase its strength. The repairs were completed in 1979, and the Citigroup Center has remained structurally sound ever since. This case highlights the importance of investigating and repairing structural cracks before they become larger and more dangerous.

3.6 Visual Assessments of Structural Cracks

Table 2 shows the cracks found, recorded, and analyzed, including their locations, structural crack widths, and affected structural members. Structural cracks were measured by inserting needles and nails into the cracks, and the widths were measured using a digital caliper and were classified according to the information in Table 2. The majority of the measured cracks occurred on the columns of the buildings, which were caused by various reasons, as shown in Table 3. Figure 16 shows some of the locations visited. It was deduced that thin cracks occur majorly in newly constructed buildings which may evolve to more serious structural cracks if not repaired as the building is being put to use, as seen from the observation because all the cracks measured in all the building under construction were seen to be thin except for that which was abandoned before and the ones on completed projects were seen to be mostly medium and wide, meaning they evolve with time and use. Also, structural cracks occur both in ongoing and completed building construction project work. From observation of the cracks in Table 2, derivation was made about the possible causes and repair strategies that can be applied to repair the structural cracks which are shown in Table 3.

4.0 CONCLUSION

The investigation into the causes and effects of structural cracks in buildings has shed light on critical factors influencing the stability and safety of built environments. The following conclusions were made:

- Structural cracks appear in all buildings but more common in residential buildings as 84%, 37% and 25% of the total respondents stated that structural cracks occur in residential, commercial and industrial buildings respectively whose causes are not known by all as only 68% of the total survey respondents are aware of the common causes.

- Structural cracks in buildings could arise from various factors, including foundation settlement, material deficiencies, design flaws, environmental conditions, and external forces. Understanding the diverse nature of these causes is important in devising effective strategies for repairing and avoiding such structural cracks.
- The presence of structural cracks in buildings does not only compromises its aesthetic appeal and appearance but also poses serious threats to structural integrity and occupants' safety as 75% of the total respondents stated that it leads to reduced stability of the members and the building as a whole and 88% of the total survey respondents stated that it is very unsafe to live in a building with structural cracks. If it is left unaddressed, these cracks can propagate, leading to structural failure, decreased property value, and potential hazards to inhabitants and surrounding structures.
- Timely detection and intervention are crucial in reducing the progression of structural cracks and minimizing their adverse effects, as they cannot be eliminated. Early identification, monitoring, and maintenance allow for the implementation of appropriate repair strategies, preventing further deterioration and ensuring the longevity of the building's structural components.
- Effective repair strategies must be a comprehensive approach that addresses the root causes of structural cracks while considering the specific characteristics and requirements of each building. From structural reinforcements and material enhancements to moisture control measures and foundation stabilization techniques, the chosen repair methodologies should be tailored to suit the unique circumstances of the building in question.

Figure 16: Some of the cracks observed and recorded

Table 2: Computation of all structural cracks measured

S/N	Name	Classification	Member affected	Date	Construction stage	Width of crack (mm)
1	Behind SMAT building, FUTA	Vertical, Medium	column	08/11/23	Completed and in use	2.0
2	Behind SMAT building, FUTA	Horizontal, medium	Beam	18/11/23	Completed and in use	1.5
3	Gods power lodge, South gate FUTA	Vertical, thin	Load bearing wall	20/11/23	Completed and in use	0.5
4	Gods power lodge, South gate FUTA	Horizontal, thin	column	20/11/23	Completed and in use	0.35
5	Gods power lodge, South gate FUTA	Vertical, medium	Column	20/11/23	Completed and in use	1.5
6	Communion lodge, South gate FUTA	Vertical, wide	column	18/11/23	Completed and in use	3.5
7	Communion lodge, South gate FUTA	Vertical, wide	Column	18/11/23	Under construction	3.0

8	Accident and Emergency, OAUTHC, Ile Ife	Vertical, thin	beam	10/02/23	Under construction	0.3
9	Accident and Emergency, OAUTHC, Ile Ife	wide	slab	17/02/23	Completed in use	2.5
10	Residential House South gate, FUTA	Vertical, medium	column	30/07/23	Completed in use	1.8
11	Residential House, Ile Ife	Diagonal wide	column	03/04/23	Completed in use	4.0
12	New EDM building, OAU	Vertical, thin	Load bearing column	13/04/23	Completed in use	0.8
13	Residential House South gate	Vertical, medium	column	19/01/24	Under construction (abandoned)	1.8
14	Residential House South gate	Vertical, wide	column	19/01/24		3.0
15	Residential House, Ile Ife	Horizontal, thin	column	26/12/23	Newly constructed	0.3

Table 3: Possible causes and proposed repair strategies for observed cracks

S/N	Possible Cause of Structural Crack	Proposed Repair Strategy
1	Expansion joint	Epoxy injection
2	Expansion joint	Epoxy injection
3	Beam load on wall	Stitching or Filling
4	Improper casting of column	Patching
5	Improper casting of column	Patching
6	Improper casting of column	Patching
7	Improper casting of column	Patching
8	Excess construction load	Filling
9	Poor curing of slab	Filling
10	Vibration	Patching
11	Excess vibration	Stitching
12	Expansion joint	Epoxy injection
13	Poor casting	Patching
14	Excess construction load/no or inaccurate design	Epoxy injection
15	Aggregate size used	Patching

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