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The Radical Attorney of the Russian Empire – Alexander Lindfors (1837–1890)

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Abstract. The article is intended to highlight the advocacy of the well-known attorney and zemstvo leader in the Russian Empire, Alexander Lindfors (1837–1890). His name is often found on the pages of scientific publications devoted to the history of the constitutional movement in Russia among liberals of the 19th century. However, the scientific community does not have a wide knowledge of the facts of his biography due to the very limited interest in Lindfors. Only Rakhno's biography was studied by Lindfors already in the 21st century, which undoubtedly affects the amount of information about the subject of our study. Alexander Lindfors, first of all, began to engage in social activities in connection with active advocacy. But too little is known about the latter because no research has been conducted in this direction before. This study is an attempt to put together facts about Lindfors as a lawyer using the method of narrative analysis and a critical assessment of the sources used. Using these methods, the author was able to find evidence of Lindfors's participation in the most high-profile court cases against the members of the 19th-century revolutionary political organization in the Russian Empire with a name "Narodnaya Volya". Lindfors was one of a limited number of 20 attorneys known to us for appearing in the 1860-1890s during the biggest litigations against Russian revolutionaries. The most famous litigation involving A. Lindfors is the so-called "Kyiv process against the 12 "Narodnaya Volya" members". An analysis of the memories of people close to Lindfors made it possible to characterize his legal activity and confirm his direct involvement in the establishment of the Kyiv Law Society.

Keywords: Lindfors; Russian Empire; attorney; zemstvo; Narodnaya Volya.

INTRODUCTION

Alexander Lindfors (1837–1890) made history primarily as a well-known representative of the Zemsky Liberal Movement in the second half of the 19th century, one of the founders of the constitutional movement in the Russian Empire of this time. However, he was known to his contemporaries as a "Radical Attorney". Unfortunately, his career as a lawyer has not been the subject of any research. This creates an unsatisfactory context of coverage of the problem in the modern scientific space of historical science. The purpose of our scientific exploration is to highlight the contribution of A. Lindfors to the professional environment of the attorneys in the Russian Empire in the second half of the 19th century.

Such work is the first attempt to represent the main specialization of the Zemsky Legist. We can say that A. Lindfors` biography was presented in O. Rachno's scientific research only in the 21st century, but even in the mentioned work, the lawyer's activity was not analyzed. In the center of this research was put A. Lindfors` professional importance for contemporaries. That is why the analysis of the narrative about his work, which would characterize his professional qualities as an attorney, became more important for us. For the sake of obtaining such information, we turned to the search for references to A. Lindfors' advocacy in the memoirs of his associates and superficial acquaintances, representatives of his family and colleagues from the legal profession.

By critically processing the information that they have obtained and using the method of narrative analysis (one of the main biographical methods), we can reach quite objective conclusions according to the set goal.

RESULTS AND DISCUSSION

We can talk about A. Lindfors' activity in the field of jurisprudence only after 1865, when he defended his law degree as a "Candidate" at the Law Faculty of the Imperial University of St. Vladimir [8]. It was there that young A. Lindfors managed to make important acquaintances for professional activity, both between student and teaching staff. It should be emphasized at the time that the scientific degree of "Candidate" in the 1860s was different from the modern one and more in line with the status of the Master's, which is widespread in our time on the territory of Ukraine [3].

As a lawyer, A. Lindfors often consulted with his former teacher, Professor A. Kistyakovsky, as evidenced by the diary of the latter. For example, on one such visit, the professor mentioned under September 21, 1880: "Then came one by one: A. F. Lindfors, V. V. Porskalov, S. P. Yakubovich, A. D. Yurkevich and Ruzsky, a completely new personality, recommended as a member of society"[7, 292]. The last mention of "society" is directly related to the Kyiv Law Society – one of the first on the territory of the Russian Empire. A similar reference made us think that A. Lindfors was also visiting A. Kistyakovsky that day on the issues of the designated unification of legal practitioners.

The Kyiv Law Society was founded in 1877 according to a charter approved by the Minister of Education. However, the said charter was revised in 1879 and re-approved by the Minister as early as 1880 [2, 29]. In the years of A. Lindfors' life, the chairman of the society from 1877 to 1879 was the Associate Professor of civil law V. Demchenko; from 1879 to 1884 – Professor of Criminal Law A. Kistyakovsky; from 1884 to 1909 – V. Demchenko (second time) [4, 231–232].

A. Kistyakovsky respected A. Lindfors as a specialist in law. In particular, in his diary from April 5, 1876, he recorded almost the entire history of A. Lindfors' legal activities up to a certain time: "From that day, I was with a principal (in Russian: веритель) Mogilyansky; met his wife. We were talking about subjects related to the field of jurisprudence. We talked about Chernihiv attorneys. There are only two of them at the Chernihiv District court. One is Pavlushenko, a respectable man, a student of our faculty; and the other is Tikhutsky, a man with a dirty reputation and to top off a drunkard. To my question why the Chernihiv District court did not confirm Lindfors with the rank of assistant attorney, he pointed to two reasons: because of the court there was a report about the political unreliability of L[indfors] and since Lindfors did not provide detailed information about what he studied from the time he passed the exam to his appearance. And between them, the news reached them that Lindfors was fired without explaining the reason. Then I told Mogilyansky biography of Lindfors to show how unfairly the Chernihiv court did to him. Lindfors, the son of a general, graduated from the Page Corps. He served in the military service, in which he rose to the rank of lieutenant or staff captain. Captured by the movement of the 60s, he left the service and entered the Kyiv University to Faculty of Mathematics. Here he did not stay long. […] he began to prepare for the exam for a Candidate in law. Possessing living, though not deep, abilities, being pure and encyclopedic, he passed the exam for this degree. Upon receiving his degree, he went to Petersburg, where he was, as he says, an assistant to Turchanikov for two years. Upon returning to Kyiv, he wanted to practice. He took a live part in the drafting of the charter of the Law Society and then came to Chernihiv, where he suffered the aforementioned fiasco. Politically, he was known for his good relations with the Ukrainophiles led by Drag[omanov] and Antonovich. This was probably the end of him. What is that? Mogilyansky agreed that the court acted somewhat recklessly, but apologized for this for the fact that Lindfors himself did not bother to explain his biography" [6, 147–148].

The above passage should be analyzed. A. Kistyakovsky's interlocutor was his former student M. Mogilyansky – a graduate of the Chernihiv Theological Seminary and the Faculty of Law of Kyiv University. Beginning in the mid-1870s, M. Mohylyansky held the office of a member of the Chernihiv District Court, and later headed the institution [1, 12]. One way or another, but M. Mohyliansky contacted with A. Lindfors.

Next, it is worth mentioning two years of work in St. Petersburg as an assistant for Turchanikov. The latter, of course, can be understood as A. Turchanikov – one of the first professional attorneys at the St. Petersburg Trial Chamber [11, 186] and a famous liberal of his time. A. Turchanikov was one of those practitioners of the Russian Empire who could compete with any European counterparts [11, 185]. During the pe-

riod 1866–1895 he participated as a lawyer in 11 political processes in which he had to defend the ideas of the revolutionaries and the revolutionaries in particular [11, 185–186]. Provided that the peculiar legal practice of A. Lindfors was held under the guidance of the aforementioned A. Turchanikov, the further commitment of the "radical attorney" to the ideas of liberalism in the Russian Empire becomes clearer.

Imprisoned for her revolutionary views, S. Rusova, A. Lindfors' sister, recorded in her memoirs how brother had helped her escape from the Russian Empire prison. She vividly describes the emotions she has experienced since being released from prison: "I knew that even people like me tried for me and that their names could not be uttered with those witnesses who always listened to every word on a date. Soon my brother came to me – our arguments were forgotten, and he came to comfort me that soon he would take me on bail and I would return to the children. […] It took three months of dull life in prison. […] One morning I was summoned to the office and, oh, joy! – in the waiting room was my brother with a considerable package. – "Well, Nona, dress, you are free! I still managed to pull you out". I did not believe in myself – I am free, I will come out of these walls, I will see children! One minute, I drop bad clothes in my cell, change clothes, gather, but… something happens to me across my happiness. Paula, my dove, she will stay in these walls, and there, on the other side of the court, are all dear comrades. Is it a betrayal to leave them here? I shout to them: Farewell, I am going free, God forbid, and all of you are more likely to wait! As I walk out of the yard in a dream, I wave my hand to anyone who looks out the windows and the goalkeeper, clanking my keys in an awful way […]. – But I'm not afraid of him anymore, I'm on the other side of the wall, my brother is around me, he strikes out with a harsh, humming me for all my revolutionary fabrications, but I know that he is happy for me too. As many as ten thousand took gendarmes from him as a pledge that I would live on his bail for the duration of the investigation. We sit in the sleigh, go to the Old Zhytomyrska Street, I am covered by crazy fun, I rejoice in the snow, I am glad to the dog that pounces on our sleigh, and I do not quite kiss my Sasha on the street in broad daylight. – "That's how revolutionary rejoices, like a high school student!" – laughs my brother, and here we are already on the descent of Andriyevsky in his apartment, where on the stairs we run towards my beloved skies Olga and Zina. The truth was once told to me by Korolenko: "Our life, thanks to the care of a wise superior, is full of negative joys. Here you would not be arrested, you would not enjoy the release" [9, 151–152].

Despite the degree of affinity between the author of these memoirs and A. Lindfors, we need to understand the historical implications of the passage above. S. Rusova has long been featured in the Russian empires as an unreliable (dangerous) element of society. Therefore, there was a high likelihood of difficulty in being released, especially when a very unreliable citizen, such as A. Lindfors, acted as the guarantor (he had been under the supervision of the relevant Russian Empire authorities for some time). Here we can rather argue about a wide range of professional relationships, taking advantage of which the brother managed to free his sister without difficulty. Somehow, the element of S. Rusova's memoirs represents the client's emotional satisfaction with the activity of a "radical attorney".

A. Lindfors did not leave his sister for legal support. For example, in the grave situation of S. Rusova when she was under constant supervision of gendarmes in Verkhnodniprovsk with a ban on living with her husband, who worked as a statistician in Kherson in the early 1880's. S. Rusova wrote: "One day my brother came out of the steamer – what unexpected happiness it was! We chatted for three days, expressing our thoughts, competitions, and dreams. Everything that has been hurting in my soul for a long time, has changed my mind and gone through criticism of the mind of my brother and mine, all this has been reflected in our conversations. My brother was traveling to St. Petersburg and promised to get permission to live with my husband there, although Kherson was "in a martial law". And in the summer I was allowed to move, though not to Kherson – the harrow of God – to Aleshky of the Dnieper (Tavriya), nevertheless closer to Ol. Ol., it took the whole hour in a steamboat ride from Kherson" [9, 151–152].

It is known that A. Lindfors participated in the so-called "Kyiv process against the 12 "Narodnaya Volya" members" in 1884. As a lawyer, he was part of a group of attorneys defending defendants under the leadership of L. Kupernik [10, 69]. In the territory of Ukraine, the latter was said: "Where God has retreated, there it is still possible to go to Kupernik!" [5, 77]. In the case of the 12

"Narodnaya Volya" members, the trial took place from November 1 to November 9, 1884, in the Kyiv Military District Court. The attorneys assumed the "protection of the whole case from a principled side" [5, 77]. They skillfully denied the prosecution's attempts to legally quickly finish the case with a win. In the end, the lawyers succeeded in bringing the case out of Art. 249 of the Provision of punishment imposed by the prosecutor on all the accused and which could have led to their death penalty. The defense reminded the court that Art. 249 appeared in the Provision as a reaction to the Decembrist Revolt, and that it referred specifically to a military uprising, a "rebellion of troops" that could not be attributed to the "Narodnaya Volya" members.

Moreover, attorneys have denied the prosecution's attempt to file the "Narodnaya Volya" program as a chimera that pursued the only destruction. They explained that the "Narodnaya Volya" aims at destroying only the system that then dominated Russia and replacing it with another: "There is nothing chimerical, unattainable in this. After all, there are states in Western Europe with other political institutions than ours" [10, 69].

The personality of the head of the trial, General P. Kuzmin, also left its mark on the course and outcome of the trial. In 1849, a person from the noble family of the Old Believers, the thirty-year staff captain of the General Staff P. Kuzmin was arrested on the whistleblower Antonelli, and therefore spent five months in the Alekseevsky Ravel in Peter and Paul Fortress (together with M. Petrashevsky, F. Dostoevsky and others), and then convicted on the famous "Petrashevsky process". At that time, P. Kuzmin was able to masterfully self-justify, which is why he was soon released. However, he always had disdain for the provocateurs, even after reaching the rank of lieutenant-general. And this feeling seems to have survived for life [5, 77].

Through the efforts of L. Kupernik, as well as the attorneys A. Goldenveizer and A. Lindfors, the charges in the case of the 12 "Narodnaya Volya" members were so shattered that the court rendered an unexpectedly soft sentence: no any death penalty and (a rarity in military courts) three persons justified.

The Head of the Government D. Tolstoy and the Minister of War P. Vannovsky called the judgment "very weak" (the head of the Kyiv gendarme department, V. Novitsky, called it "ladylike"). D. Tolstoy personally asked the Governor-General of Ukraine A. Drenteln for the reasons for such a soft judgment. The latter replied that "hard labor in jail for at least four years cannot be considered as a soft punishment" [5, 78]. However, as a result, the head of the trial, General P. Kuzmin, was fired. Thereafter, in the court trials of the "Narodnaya Volya" were no more "ladies" punishments [10, 69].

According to M. Troitskiy's research, A. Lindfors was among a limited number of 20 attorneys known to us for his speeches in the political processes of the 1860–1890s. Among them, A. Lindfors was one of three (sic!), who was not arrested or under administrative punishments [11, 195]. We have an interesting situation: either A. Lindfors being very circumspect in the conduct of affairs, or using the intercession of some powerful person. However, these are only guesses. Undoubtedly only one thing, A. Lindfors was on the list with L. Kupernik and A. Goldveizer of the stars of the first magnitude of the Russian Empire judiciary [11, 186] in connection with participation in the trials of the "Narodnaya Volya" members.

CONCLUSIONS

Thus, we were able to find out a few clarifying facts about the biography of A. Lindfors in the field of his legal activity. Thanks to the memoirs of his contemporaries, from which we have singled out A. Kistyakovsky and S. Rusova, it is possible to draw proper conclusions. First, A. Lindfors was one of the founders of the charter of the Kyiv Law Society, one of the leading professional associations of legal practitioners on the Ukrainian territory during the Russian Empire. Secondly, A. Lindfors' professional relations with the Chernihiv District Court were expanded in the 1870s – his contact with M. Mohyliansky was indirectly revealed. Third, it was possible to find out the identity of the solicitor (lawyer), who had been practicing A. Lindfors in St. Petersburg for two years. It was the famous liberal A. Turchanikov. This fact can be regarded as the basis for the search for the start of the formation of A. Lindfors's liberal worldview, which eventually led him to the Zemsky constitutional movement. Fourth, and emotional feedback from A. Lindfors' client about his professional work as a lawyer was found. Fifthly, it examines the historical significance of the most important litigation in which A. Lindfors participated. It is about the so-called "Kyiv process against the 12 "Narodnaya Volya" members". We have con-

firmed that A. Lindfors was one of the most famous liberal attorneys of the Russian Empire at one time. And because of his fairly good knowledge of the laws and the systems that created them, he was not only able to withstand the oppressive apparatus of the empire but also remained unobstructed, unlike his work colleagues, who dared to defend the revolutionaries of the second half of the 19th century.

REFERENCES

1. Berzin, P. (2011). Nevidomi uchni O. F. Kistiakivskoho (Ya. Ya. Shostak, M. M. Stupin, M. Ya. Mohylianskyi) [Unknown students of O. F. Kistiakivskyi (Ya. Ya. Shostak, M. M. Stupin, M. Ya. Mohylianskyi)]. *Juridical Sciences, 86*, 10–13 (in Ukrainian)
[Берзін, П. (2011). Невідомі учні О. Ф. Кістяківського (Я. Я. Шостак, М. М. Ступін, М. Я. Могилянський). *Юридичні науки, 86*, 10–13].

2. Ikonnikov, V. (1884). *Istoriko-statisticheskie zapiski ob uchenykh i uchebno-vspomogatelnykh uchrezhdeniiakh Imperatorskogo universiteta sv Vladimira 1834-1884* [Historical and statistical notes on scientists and educational institutions of the Imperial University of St. Vladimir]. Kiev: V tipografii Imperatorskogo universiteta Sv. Vladimira (in Russian)
[Иконников, В. (1884). *Историко-статистические записки об ученых и учебно-вспомогательных учреждениях Императорского университета св. Владимира (1834-1884)*. Киев: В типографии Императорского университета Св. Владимира].

3. Ivanov, E. (1994). *Uchenye stepeni v Rossiiskoi imperii. XVIII v. – 1917 g.* [Scientific Degrees in the Russian Empire. 17th century – 1917]. Moscow: Institut rossiyskoy istorii (in Russian)
[Иванов, А. (1994). *Ученые степени в Российской империи XVIII в. – 1917 г.* Москва: Институт Российской истории].

4. Kaliuzhnyi R., & Doroshenko, Yu. (2000). Narys istorii Kyivskoho pravnychoho (iurydychnoho) tovarystva [An outline of history of the Kyiv Law Society]. In *Ukrainskyi pravnychyi almanakh* (pp. 224–243). Kyiv: n. d. (in Ukrainian)
[Калюжний, Р., & Дорошенко Ю. (2000). Нарис історії Київського правничого / юридичного/ товариства. В *Український правничий альманах* (с. 224-243). Київ: n. d.].

5. Kara-Murza, A. (2018). *Rossiiskii liberalizm idei i liudi* [Russian Liberalism: Ideas and People] (3th ed., Vol. 2). Moscow: Novoye izdatelstvo (in Russian)
[Кара-Мурза, А. (Ред.). (2018). *Российский либерализм: идеи и люди* (3-е изд., Т. 2). Москва: Новое издательство].

6. Kistiakivskyi, O. (1994). *Shchodennyk* [The diary] (1874–1885) (Vol. 2). Kyiv: Naukova dumka (in Ukrainian)
[Кістяковський, О. (1994). *Щоденник* (1874–1885) (Т. 2). Київ: Наукова думка].

7. Kistiakivskyi, O. F. (1995). *Shchodennyk* [The diary] (1874–1885) (Vol. 2). Kyiv: Naukova dumka (in Ukrainian)
[Кістяковський, О. (1994). *Щоденник* (1874–1885) (Т. 2). Київ: Наукова думка].

8. Kyivskyi universytet Sv. Volodymyra. (1834–1920). N. d. (Fond 16. Opys 465. Sprava 492. Arkushi 1–14). Derzhavnyi arkhiv mista Kyieva, Kyiv, Ukraine (in Ukrainian)
[Київський університет Св. Володимира. (1834–1920). N. d. (Фонд 16. Опис 465. Справа 492. Аркуші 1–14). Державний архів міста Києва, Київ, Україна].

9. Rusova, S. (1928). Moi spomyny [My memories] (1879–1915). In M. Hrushevskyi (Ed.), *Materiialy z hromadskoho y literaturnoho zhyttia Ukrainy XIX i pochatkiv XX stolittia* (Vol. 3) (pp. 147–205). Kyiv: Derzhavne vydavnytstvo Ukrainy (in Ukrainian)
[Русова, С. (1928). Мої спомини (1879–1915). В М. Грушевський (Ред.), *Матеріяли з громадського й літературного життя України XIX і початків XX століття* (Т. 3) (с. 147–205). Київ: Державне видавництво України].

10. Stetsyk, A. A. (2014). Kupernik Lev Abramovich (1845–1905) [Kupernik Lev Abramovich (1845–1905)]. *My i pravo, 3*, 68–71 (in Russian)
[Стецык, А. (2014). Куперник Лев Абрамович (1845–1905)]. *Мы и право, 3*, 68–71].

11. Trockij, N. (1979). *TSarizm pod sudom progressivnoi obshchestvennosti. 1866-1895* [Tsarism is being tried by a progressive public]. Moscow: Mysl (in Russian)
[Троцкий, Н. (1979). *Царизм под судом прогрессивной общественности. 1866-1895*. Москва: Мысль].

Metaphysical Discourse and the Logics of the Absolute

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Abstract. The article deals with the problem concerning the language of metaphysics. Metaphysics is understood as knowledge about the world as a whole. It is argued that such a perspective needs specific language tools for the description of metaphysical reality. The principal characteristic of the terms of the language aimed at describing the world metaphysically is their ultimate abstractness. It is stated that this abstractness not just corresponds but coincides with the ultimate simplicity of metaphysical reality, that is to say, the reality of the world as a whole. The analysis of the ultimate reality or the absolute leads to the conclusion that both such reality and its depiction is ruled by a special logic different from what is conventionally considered to be logical. Elements of this logic are the ultimate abstractions. As it turned out, logical laws do not apply to extremely abstract objects, first of all, the law of contradiction. In the logic of the absolute, mutually exclusive statements point both to the same and not the same reality. The analysis shows that this is not the dialectical logic of contradiction and denial, it is the logic of the consistent unity and coexistence of identity and difference. The use of identities and differences in their ultimate sense allows us to determine the basic concepts of a metaphysical description – being, existence, the existing, difference, identity. Basic concepts serve as a necessary and sufficient basis for a complete metaphysical description of the entire existing, that is, the world as a whole. Going beyond the basic concepts, we, however, move from the logic of ultimate reality to the usual logic of empirical (physical and mental) reality.

Keywords: metaphysics; logics; ultimate reality; difference; identity; the logic of ultimate reality.

INTRODUCTION

At the beginning of the 21st century, metaphysics once again, as in older times, is seen among the respectable areas of knowledge. Metaphysics traditionally is positioned as the most general and fundamental description of that reality, in which the readers of metaphysical texts usually discover themselves. The possibility of such a description is problematic due to its extreme abstractness. The problem lies within the correlation of the metaphysical description purpose and its linguistic means. To solve the problem is to find a certain minimal set of language tools that can describe everything existing or to explain the impossibility of finding such tools. In other words it goes about the basic, most elementary and, at the same time, the most effective language of metaphysics.

It is one of regularly discussed themes in nowadays analytical philosophy. Various opinions concern the possibility of semantically complete language i. e. the language which terms and statements refer not to other terms and statements but to extralinguistic reality. The situation is fairly accurately characterized by Cord Friebe noting that within analytic metaphysics the debates always come down to the question "whether there really is a substantial ontological distinction, or whether, in fact, the dispute is merely verbal" [3, p. 5]. The first position is in most cases called realistic, the second has a number of names depending on how deep is the departure from realistic stance. One can say about "deflationary intuitions threaten the robustly realist approach" [7, p. 3], about superficialism which argues that in metaphysical debates "very

often disputants are talking past one another, on account of having attached different meanings to the key terms" [4, p. 213], or dismissivism including antirealism, according to which metaphysical expressions do not have a determinate truth-value, semanticism, according to which the differences between metaphysical expressions are purely verbal, and epistemicism, according to which metaphysical expressions have little justification for being either true or false [1, p. 39–42]. The point of anti-realism in a broad sense is, in D. Chalmers' words, that there are no objective answer to the question of 'What exists?' [2, p. 77].

Some answers to this question surely do exist and are explicit. Whether they are objective is not explicit at all from the beginning, it is rather the matter of belief. The justification of this belief is in that it is the only starting point for its justification. We must adopt one or another variant to follow it till we come to a more clear and evident result.

Our choice here is realistic metaphysical language. Some arguments in its favour as well as its more detailed depiction can be found in T. Sider [9] and T. E. Tahko [10]. T Sider, in particular, proposes his variant of structural metaphysics. "The heart of metaphysics is the question: what is the world ultimately, or fundamentally, like? And fundamentality is a matter of structure: the fundamental facts are those cast in terms that carve at the joints" [9, p. 5]. It is worth saying that fundamentality is really a matter of structure, but the structure itself is not fundamental. It is too complex a phenomenon demanding some not evident preconditions.

One more conception the author of this article is sympathetic with is that of J. M. Mulder [8]. It marks a certain return to Aristotle by overcoming the dichotomy of realism and antirealism. The essence of this move is in not separating "reality as it is in itself and reality as it is for us", in destructing a fundamental gap between them [8, p. 81]. This idea seems to be not only true but extremely productive.

Still the question of implementing realistic principles in searching the elements of a metaphysical language for the description of everything that exist leaves to be open. To single out such a minimal set of the language of metaphysics elements is this article's objective. (One can learn more about the author's conception in [5, 6]).

RESULTS AND DISCUSSION

Let's begin with clarifying the subject matter of metaphysics. It is acceptable to think that this is the world as a whole (the World, to be more precise). The concept of the whole requires specification. The whole here should not be understood as something that has boundaries. The whole in our understanding is that which has something in common, that which stands out or is constituted by the common. The mentioned commonality is obvious – it is the fact of everything's existence which determines its belonging to the World (whatever we mean by existence). No doubt that existence is a term equivalent to belonging to the World; speaking of existence, we actually say that something belongs to the World. This is one and the same. The World is clearly defined as all that exists.

So, we can talk about the World as a whole regarding it to be a real object. It is important to say also about the nature of its reality. Obviously, the World as a whole is not a physical reality. This is an extremely significant and far from trivial statement. The fact is that the concept of physical reality is derived from the concept of the world, but not vice versa. No basic physical object or a system of such objects includes the world as a whole, in other words, as everything existing. Nor is the World a psychic reality either. The foregoing applies to any of the realities known as subjects of specific sciences (social, biological, virtual reality etc.). Let's say that the World as a whole is a special, peculiar reality. It is possible to limit its designation by indication to its peculiarity. But it will be appropriate to call it metaphysical reality.

Obviously, the World can be described as an absolute reality in all respects which are usually meant. The absoluteness of the World follows from its uniqueness; since it covers everything that exists, there is nothing to compare it with. First of all, it follows from here that world reality is maximally complete and general, all-encompassing. Secondly, we can talk about the ultimate simplicity and abstractness of world reality, since any complexity requires a ground for itself, which the World as a whole does not have. Due to ultimate simplicity of world reality, the concept of physical laws does not apply to it. There are no laws at all, since there are no constitutive connections between individual partial objects belonging to this reality. Connections in absolute reality, if we can talk about them, are also absolute – extremely abstract and universal,

which means that they are simple and indistinguishable.

Absolute reality is also not a subject to the laws of conventional logic. It is generally accepted that logical laws are more general and abstract than empirical (physical) ones. But they also express stable and necessary connections between objects, for example, connections of presence / absence, correspondence / contradiction. Such connections are not found in absolute reality. There is no usual logic for it by which it would be possible to connect the selected objects (and therefore, explain them).

It doesn't mean that absolute reality lacks any sort of multiplicity. Being ultimately simple and abstract this reality goes beyond the very juxtaposition of the opposites – simplicity vs complexity, abstractedness vs concreteness. Either of them is not a denial of another. That which is ultimately simple is just simple and is not non-complex in addition to it. But paradoxically this absence of non-complexity denial leads to absolute reality being both absolutely complex and simple. It is simple from the point of view of our simplifying efforts based on empirical reality's complexity. But it should look otherwise from the opposite point of view. The real absolute reality is, probably, still more undefined towards simplicity / complexity opposition.

In the long run, the simplicity of absolute reality appears to be not quite simple and can be depicted in different terms. The terms have to be combined and disconnected, which means that some kind of logic (as a movement of thought) is present here. One should assume that here we encounter another kind of logic, not the logic familiar to us in its forms that have been established for many centuries. Imagine a logic in which the basic logical laws are not valid. This is a logic in which the laws of identity, contradiction, excluded third, sufficient reason do not apply. These laws imply a clear distinction between objects and are effective only when it is possible to separate and contrast objects of thought. In absolute metaphysical reality there is no such distinction. Its fundamental specificity is that we cannot, while thinking over it, compare and contrast different objects of thought. Everything within our mental picture merges and separates, slipping away from us, we can neither completely separate, nor completely merge imaginable objects. This is because they do not have the outer ground for complete separation or contraposition. They are too simple and abstract for this.

The closest analogue of the logic indicated here from the history of philosophy is Hegel's dialectical logic. This is the logic of contradiction which is inherent in every object of thought. The dialectical contradiction is contradictory, so it comes into identity and returns back to itself. Something is directly something contrary to itself. There is a relation of negation between something and its another: one denies the other, and the other denies the first. Something, therefore, is neither itself, nor something else, but turns out to be the third something (a synthesis of thesis and antithesis). Hegelian logic is metaphysical in terms of its difference from traditional logic, but has serious flaws in terms of its relevance to the tasks of metaphysical description. The main flaw of dialectical logic is that it is based on thinking. But the world as a whole is not a thinking (as well as it is not physical being). The world as a whole is a thinking, as far as it does not differ from being, or it is being that does not differ from a thinking indistinguishable from being. Therefore, the world is not only a thinking and not only being; it is something common in being and thinking. Since being is more abstract than thinking, the common in being and thinking is being. The world is being, which is not only being. But the world is not a thinking, insofar as the latter is different from being. The difference between thinking and being is that the first objectifies its content. It makes the objects out of thoughts. For example, thinking sets before itself two objects that are mutually exclusive. And it becomes seen that in a sense this is one object. Thinking carries out a game of transitions from one to another and vice versa, makes mutual denials. But for this, thinking must remain only thinking. The World as a whole is Being that does not objectify itself for itself, but directly is also something else.

Everything that exists does not deny itself and does not contradict itself. It is something one and is something else together. And yet the world is only one thing. Moreover the world is only something other than the world. There is no contradiction in these contradictory statements. There are no transitions of thought, discrimination or identification. One does not deny the other and does not deny itself.

To summarize what has been said. In the logic of the absolute, we can only talk about what is. At the same time contradictory statements are

permissible and even obligatory. Contradictory statements do not express contradictions. Once again: there is one and there is another. The world is one and the same; the world is something other – these statements simply coexist without contradicting or denying each other, without passing into each other.

The ultimate existential determinants, therefore, are identity and difference. They are also logically compatible in absolute logic. The following statements are equally acceptable. Being is identity. Identity and being are one and the same. Being is different from its identity with itself. Being is difference. Being is different from the difference itself and from being's difference from difference. And so on. To be one and the same and to be something different from another is simply to be. So there is no difference in it. And there is an absolute undeniable difference. Still this is not a contradiction.

Absolute logic allows the difference indistinguishable from identity and, however, distinguishable from it. For the World as a whole, therefore, that logic is relevant, the elements of which, in addition to being, are identity and difference. In the language of this logic, difference and identity play the role of connectives creating logical formations (statements). Connectives link terminal terms (the role of which is played by being and its derivatives). Any combinations are allowed. They do not exclude each other, but implement new coexisting parts of reality. The intensional differences in the semantics of the language of absolute logic coincide with the extensional ones – the same thing expressed in different senses is different extensionally (the resultants are mutually complementary).

To the statements formulated earlier, one can add some more. Being is identical to Being. Being is different from Being. Being (which is only) identical with Being is identical with existence. Being (which is only) different from Being is identical with that which exist. The existing (as Being) is identical with existence. And vice versa. The existing (as such) is different from existence. And vice versa.

Such is the logic of ultimate abstractions – being, existence, that which exists, identity, difference. It is of no surprise that, reaching the limit of abstraction, the concepts begin to coincide. Meanwhile being the results of long and gradual abstraction, the concepts do not lose their differences. But speaking of ultimate differences, it is vastly important to understand that these differences are immediate; concepts differ not by something in them, but only by themselves. The direct difference is, on the other hand, the direct identity; concepts (remaining concepts, not turning into a concept) coincide, flow one into another. Everything at the ultimate level of metaphysical reality is found in everything and everything is different from everything. Nevertheless, there are no contradictions and denials (which had been pointed out by F. Bradley, who tried to grasp the essence of the Absolute reality). Thus, mutually exclusive objects which coexist (no matter how paradoxical it may seem) are at the ground of the world. Coexisting concepts expand logical and metaphysical reality.

However, this is not the logic of being and nothingness – everything happens within the limits of Being. It must be understood that nothingness is a purely logical term that does not refer to anything within the world.

Let us once again draw attention to the fact that ultimate abstractions are not only conceivable. They necessarily and always include extralinguistic reality. In a certain aspect they coincide with reality. Reality as something ontologically simple is indistinguishable from logically fully abstract conceptual content. The image of Being as such (if we have reached it) is Being itself from a certain point of view. It also has a sensory side – a sense of being that coincides (although not quite, but only by content) with pure being.

It is reasonable to use the named ultimate abstractions: being, existence, that which exists, identity, difference as the basis of a metaphysical description. At our disposal there are elementary entities (and the corresponding categories of thinking), on the basis of which a complete metaphysical description of the world becomes possible. The specified base of the metaphysical description is necessary. Ultimate abstractions, coinciding, in a certain sense, with being and only being, ground themselves and do not require anything else for their grounding. The mentioned base is complete, since it is obvious that there are no other ultimate abstractions coextensive with being. It is also sufficient – there is nothing in the world that cannot be reduced to these categories. It represents both the basis and the product of logical relationships. We can say that this is what enters into logical relations as their non-logical ground. On the other hand, this is what logically grounds itself. Thus, illogical ground turn out to

be logical. If you look at the subject from the ontological perspective, then the reality described by the ultimate metaphysical categories turns out to be both the basis of the existing and all existing itself.

Note that the logical base which have been defined coexists with a superstructure that is logically negative in relation to the base. This superstructure excludes the base and coexists with it. The logic of the absolute limit implies something not ultimate, impossible from the point of view of the limit, but coexisting with it in the logic of the absolute limit. The limit as the existing is identical with its own not-the-limit, i. e. with something different. In this aspect it is just the difference (or differing) of itself and not itself. At the same time, the limit exists as the limit of not-the-limit. In not-the-limit reality in a logical sense, the opposite to what it is in a limit reality is true. We go through the looking glass out of ultimate reality or, conversely, exit the looking glass into the familiar, empirical world. Here differences are only differences and identities are only identities. Something different cannot be identical and vice versa. Reality breaks up into separate objects that do not penetrate each other (at least completely). Mirroring the ultimate reality, the empirical world is ruled by the usual laws of logic, there separately exist an object, objects, and their aggregates, forming in whole the physical and mental world that is familiar to us.

CONCLUSION

So, metaphysical reality was looked over in the article. It has been argued that it should be understood as the reality of the world as a whole. It was stated that it can only be depicted using a special logic – the logic of ultimate reality. Elements of this logic are the ultimate abstractions. As it turned out, logical laws do not apply to extremely abstract objects, first of all, the law of contradiction. In the logic of the absolute, mutually exclusive statements point both to the same and not the same reality. The analysis showed that this is not the dialectical logic of contradiction and denial, it is the logic of the consistent unity and coexistence of identity and difference. The use of identities and differences in their ultimate sense allows us to determine the basic concepts of a metaphysical description – being, existence, the existing, difference, identity. Basic concepts serve as a necessary and sufficient basis for a complete metaphysical description of the entire existing, that is, the World as a whole. Going beyond the basic concepts, we, however, move from the logic of ultimate reality to the usual logic of empirical (physical and mental) reality.

REFERENCES

1. Bennett, K. (2013). Composition, Colocation, and Metaontology. In D. Chalmers, D. Manley, R. Wasserman (Eds.), *Metametaphysics: New Essays on the Foundations of Ontology* (pp. 38–76). Oxford: Clarendon Press.
2. Chalmers, D. (2013). Ontological Anti-Realism. In D. Chalmers, D. Manley, R. Wasserman (Eds.), *Metametaphysics: New Essays on the Foundations of Ontology* (pp. 77–129). Oxford: Clarendon Press.
3. Friebe, C. (2014). Categoricalism Versus Dispositionalism: A Case Study in Metametaphysics. *Journal for General Philosophy of Science, 45*(S1), 5–15. doi: 10.1007/s10838-014-9265-5
4. Hawthorne, J. (2013). Superficialism in Ontology. In D. Chalmers, D. Manley, R. Wasserman (Eds.), *Metametaphysics: New Essays on the Foundations of Ontology* (pp. 2013–230). Oxford: Clarendon Press.
5. Kuleshov, A. (2019). IAzyk metafiziki problemy i resheniia [The language of metaphysics: problems and solutions]. *Scientific Discussion, 1*(36), 3–11 (in Russian) [Кулешов, А. (2019). Язык метафизики: проблемы и решения. *Scientific Discussion, 1*(36), 3–11].
6. Kuleshov, A. (2019). *Nachala metafiziki* [Beginnings of metaphysics]. Stavropol: Logos (in Russian) [Кулешов, А. (2019). *Начала метафизики*. Ставрополь: Логос].

7. Manley, D. (2013). Introduction: A Guided Tour of Metametaphysics. In D. Chalmers, D. Manley, R. Wasserman (Eds.), *Metametaphysics: New Essays on the Foundations of Ontology* (pp. 1–37). Oxford: Clarendon Press.
8. Mulder J. M. (2012). What Generates the Realism / Anti-Realism Dichotomy? *Philosophica, 84*(1), 53–84.
9. Sider Th. (2013). *Writing the Book of the World*. Oxford: Clarendon Press.
10. Tahko T. E. (2015). *An Introduction to Metametaphysics*. Cambridge: University Press.

Measuring Residents Satisfaction Levels of Public Housing in Maiduguri Metropolis of Borno State, Nigeria

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Abstract. This study aims to evaluate the residents' satisfaction with public housing in the Maiduguri metropolis. The study assessed the levels of quality of housing components, occupants' preference and satisfaction. The study adopted a quantitative approach and data were collected through a questionnaire survey from 265 household heads of the housing estate proportionately selected from the target population in Maiduguri metropolis. The data collected were subjected to descriptive and inferential statistics with mean ranking, frequency distribution and multiple regression analysis to achieve the research aim. The study showed that quality of building component, Condition of a bedroom, condition of living room, condition of the roof, condition of finishing and condition of the kitchen were ranked as very good and condition of the store, condition of the dining area, condition of garage and condition of toilets were good in the study area, while public housing quality and preference significantly influence occupants' satisfaction in Maiduguri metropolis. The research recommended that occupant peculiarities should be integrated into the design and development of housing estate. This will ensure that the satisfaction of the occupants is well co-opted in the development and therefore lead to higher satisfaction and functionality of the estates. The provision of facilities and amenities in public housing estates should be based on the occupant requirements and peculiarities. This will lead to the optimal utilization of the estate after development.

Keywords: Quality; Components; Preference; Satisfaction; Public Housing.

INTRODUCTION

Public housing is the provision of low-cost housing by the government for civil occupancy. Even though public housing development policies are geared toward the satisfaction of housing occupants, the experience of building users was highly ignored in the real estate development process especially in the public sector [58]. The growing need for shelters has been on the increase without consideration for occupant needs and requirements. This is because Public housing policy structures tend to favor architects' preferences, with an overall target of low costing, while there is a need for buildings to serve the needs of people who use them [58, 68].

In another clime [26] revealed that quality plays an integral part in the construction industry. Further stressing that to build customer confidence the quality of its work should be done according to the developed quality assurance program. However, [5] revealed that there have been instances of building failures in different parts of the country, cases of abandonment of housing projects mid-way and projects failing to meet the requirements even after execution, concluding further that the success of projects can only be measured in terms of the achievement of quality. With the above statement from scholars therefore it is germane to note that the success of every construction work is to provide a qualita-

tive housing accommodation that meets the housing needs and requirements of individual occupants.

The amount of quality work influences household preferences for housing and thus influences satisfaction. Quality is, therefore, an attribute of occupants' preferences for housing. The study of housing preferences is indispensable and priorities' study where residents' taste and preference for housing are needed to ensure occupants' satisfaction through the production of qualitative housing. As a commodity that is largely produced in the private sector, housing is developed to appeal to different consumers' tastes and preferences [112]. Hence, there is a need to determine whether there is a correspondence between the types of housing supplied in the market and the types of housing that people want. However, a study by [93] shows that preferences are inherently unstable and can be expected to change for a specific household whenever significant changes in the constraints occur. That is why [78] stated that to develop a housing unit that satisfies its residents, it is important to understand the characteristics of existing and prospective residents. Invariably, a consensus is needed to be keyed in and reflected the common attributes of the household in drawing a standard for quality assurance framework by every partner in the building industry be it government or private individual.

Consequently, this study will strictly relate to public housing estates. As observed by [76] certain types of housing are supported and even promoted by public policy through for example tax policy, land use planning techniques and direct and indirect subsidies. Housing is a commodity the choice of which is characterized by complex individual attributes. The study on measurement of residents' satisfaction levels of public housing in Maiduguri is meant to explore on the most common attributes that influence individual residents choice of housing in the study area and see whether such attribute is in tandem with already built public estates but if not how these attribute can be captured in the statement of government policy so that an appreciable level of household satisfaction can be achieved. To this, the study evaluates the residents' satisfaction levels of public housing in the study area.

Statement of the Problem. It has been revealed that international concerns have been growing over the deteriorating housing condition in urban areas of developing nations [3]. The issues of poor housing quality are, therefore, a global phenomenon which was further confirmed by [11] that though housing is regarded as the right of every individual, a great proportion of Nigerian population lives in substandard, deplorable and unsanitary residential environments. Authors [99] the quality of housing within any neighborhood should be such that satisfies minimum health standards and good living standard, but should also be affordable to all categories of households. However, [9, 30] opined that government investment in housing in the third world are limited and wasted on expensive projects designed to woo electorates rather than directed to meet real needs for housing. In addition to aforementioned [30] revealed that the non-consideration of socio-economic parameters for an organization that is responsible for housing provision has been identified as one of the major reasons for the housing inadequacies and poor quality in most urban fringes of developing countries hence, Nigeria was not an exception.

While reviewing the literature on housing choice and preference, authors [8] submitted that those searching for home do not typically have concrete, well-defined preferences; rather, housing preference is (re)shape during the problem-solving process. Several studies including [63] and [79] assert that when choosing a housing option, decision-makers are subject to a variety of influences and must make a various trade-off. Revealing further that the process of choosing can encompass the interlinked influences of preference, market conditions, market availability, government regulations, real estate agents, friends, family as well as both internal and external personal factors such as lifestyle and socio-economic status, it was on this premise that the issue of housing preference has widely researched because it provides valuable information for the planning and development of housing for various residential groups with different needs [75]. Parts of the problem assert [14] is that the traditional practices of implementing housing projects have often ignored the predominant themes and plurality of community perspectives and thus failed to effectively address the needs of the people.

On the issues of satisfaction [110] opined that the management of public housing by the government in most countries is often labeled with poor maintenance, low rentals and often than not, ten-

ants are unsatisfied with their dwelling units. However, [106] observed that increasing attention for urban neighborhoods by policymakers caused a renewed interest in the neighborhood (dis)satisfaction. Therefore the combined effect of the problem is so glaring to the extent that psychological well-being can affect one's judgment about dwelling environment quality whose condition is lower than others, whereas failures of many housing projects can be linked to lack of participation and in-depth understanding of the community issues [14]. Authors [32] poor housing is to be held responsible for several social problems, including identifiable physical mental diseases of occupants' maladjustment of a different kind, low self-esteem of slum dwellers, barriers to economic improvement, etc.

Although there are several studies on various aspects of public housing such as housing quality assessment [11]; housing preferences of residents [112]; and assessment of residential satisfaction with public housing [90] in and around Nigeria using various dimension, none of the studies examined the relevance of housing quality and residents 'satisfaction of public housing. Thus the study identified this as a gap and intends to investigate the residents' satisfaction of public housing in Maiduguri, Borno State.

This study aims to assess the residents' satisfaction with public housing in Maiduguri, to suggest ways to improve housing quality and preference to meet the satisfaction of public housing in the study area.

LITERATURE REVIEW

Public Housing. According to [80], Public housing is often used as a generic term to refer to all

Publicly assisted housing, accordingly, it is a specific federal program created than in 1937, the low-rent public housing program as the first major federal rental housing assistance program. Further, the public housing program serves some of the poorest families in the nation, including persons who are elderly, persons who are living with disabilities and other families with and without children [80]. Concluding that Families who live in public housing generally pay rent equal to 30 % of their adjusted gross income; average rents paid by public housing families lag substantially behind private market rents paid by similar families.

Authors [2], refer Public housing to a form of housing provision, which emphasizes the role of the State (government and its agencies) in helping to provide housing, particularly for poor, low-income and more vulnerable groups in the society. Further describing it as taken varied forms in different geographical contexts and other descriptive terms sometimes used instead of public housing include; social housing, state-housing, state-sponsored housing, welfare housing, non-profit housing, low-cost housing, affordable housing, and mass housing. In [57], Public housing is referred to as government-provided or subsidized housing projects, which presumes the inability of the private sector to fully meet the housing needs of the entire population, especially the low-income groups. It is also called 'social housing ' or 'state-housing'(in the United Kingdom) and 'welfare housing' (in the United States).

Accordingly, two broad approaches to public housing have been identified: Government-provided housing and Government-sponsored housing [84]. Public housing programs have been criticized for failing to provide quality, affordable and adequate housing units to the target population in most developing countries [94]. Yet studies have indicated that governments in developing countries are not relenting in their efforts at addressing the problem of providing adequate, affordable and sustainable housing [2].

Housing Quality. Authors [2, 80], defines quality as the acceptable level (standard) of something when compared to other things like it; how good or bad something is. Authors [51] viewed quality as the ability of products and processes to conform to established requirements, stating further that quality, as well as project success, in construction projects should be capable of being regarded as the fulfillment of expectation of those contributors and stakeholders involved in such projects. Invariably, quality is an attribute of standard [3]. Furthermore, [2, 3, 6] asserts that quality cannot be considered differently from the process by which it is considered.

Authors [3, 65] further affirm that standards in housing are a measure of acceptability at a given time, place, in a given set of cultural, technological and economic conditions. Consequently, the need for good housing quality is imperative. In a study [11] indicate that over an estimated billion of the world's city residents live in insufficient quality housing, mostly in the sprawling slums

and squatter settlements in developing countries. Probably, this might not be far from the submission by [87] on the Global housing Research Initiative on American & Caribbean country that established a preponderance evident gaps in their study to include the absence of a common standard for housing quality globally or in the region, and thus indicate limited methods of assessing housing quality that can be used to measure impacts across national programs or to serve as enforced targets.

However, [11] concluded on the study of housing quality that housing, in Nigeria, is in short supply, poor quality and expensive for the generality of the populace. It suffices to say that housing quality is just one of the preferences to satisfying the resident need and requirement in a housing estate. Therefore, measuring the housing quality through regular tenant satisfaction surveys has become an important tool and local governments in both the UK and the USA have regularly apply this tool to measuring housing satisfaction [12]. The essence of this measurement is to assess the level of, and ensure that households are satisfied with the provided housing and its services.

Authors [2, 41] explain that planners and designers have used several criteria over the years to evaluate housing quality. These include; economic criteria such as the relationship between rent and income, physical criteria such as the integrity of the dwelling and the present plumbing and fixtures, social criteria such as the incidence of diseases and the degree which overcrowding of housing occupies, they, however, concluded that housing quality is highly dependent on the appropriate strategies of housing provision in the country. Authors [1, 4, 11] amongst others, established in their studies that inadequate or complete absence of infrastructure was a bane to economic and social development in Nigeria, an attestation to the afore-stated anomalies.

It was established in [3] that Good quality housing must possess a general layout of good appearance, structures built with good materials among others while general customs and habits of the people are given topmost consideration, but concluded that, the aforementioned qualities have not been the case in most public housing estates in Nigeria. The above review of studies shows how significant housing quality is to residents of a particular housing, hence it could be seen as a yardstick for measuring occupants' satisfaction. It is expedient to note also that housing Quality is now gaining global attention through various researches and studies hence, it is expected that if government and development partners will give it the attention it deserves within the proper context of the time, it would minimize if not curb the problems of infrastructural decay.

Authors [8] stated that a dwelling can provide more satisfaction to its residents if, besides being available, it meets the residents' requirements. This study is, therefore, one amongst many that will dwell on the impact of the quality of housing and the occupants' satisfaction

Housing Satisfaction. Satisfaction studies cut across a wide range of disciplines in the management and social sciences as well as the built environment. Generally speaking, satisfaction is a subjective evaluation of the performance of products or services in meeting the needs and expectations of users or customers [15, 56]. Researchers have come to define housing satisfaction as an individual's subjective assessment of whether or not his/her needs are being met [92, 93, 105]. Similarly, [28] opined that Studies on residential satisfaction promote a better understanding of the key sources of satisfaction and dissatisfaction among residents; factors influencing their satisfaction levels; as well as how residents are most likely to react in the event of dissatisfaction with the housing conditions. Further examining satisfaction, [44] and [8] explained that satisfaction in housing means the sentiments of satisfaction and happiness to the housing place which creates these feelings. Satisfaction is generally taken to mean an evaluative attitude towards some object or experience [61]. More so Satisfaction with goods and services provided by public bodies has also emerged according to [61] "as a focus of research and a major subject of governmental interest in Organization for Economic Cooperation and Development countries". However, most research conducted on satisfaction in the public sector has been undertaken by public bodies themselves and has been directed to informing managerial decisions rather than addressing theoretical questions about expectations [61].

According to [24] and [8], housing is often viewed as an entity involving a large number of units displaying aspects such as physical quality, location, the standard of services offered by the government and private owners as well as neighborhood characteristics. Residential satisfaction has been used as a measure to examine the success of housing development projects.

Resident satisfaction has been in use since the early 1960s as the basis for optimizing the architectural design of large housing developments, where feedback was collected from residents of housing projects about resident's views on the physical features of proposed housing developments and then feeding those views back into the design process.

Authors [41] defined residential satisfaction as the emotional response to a person's dwelling; the positive or negative feeling that the occupants have for where they reside, the premise on this definition by [40] signifies that residential satisfaction can either be positive or negative. The definition and assessment of satisfaction today use structured surveys followed by statistical correlation of variables [46]. In their study, authors [8] corroborate with the work of [29] and [48] who display similar views on the concept of housing satisfaction based on their observation on past studies. In their opinion, the concept of housing satisfaction has been used for four major objectives. It is the key to predict an individual's perception of the overall quality of life. It is also an indicator of an individual mobility which later changes the demand on housing and influences surrounding area change.

Thirdly, it is used as an ad hoc measurement of private sector development success as an evaluation tool to measure resident's acceptance of prevailing shortcomings for existing surrounding area development. Finally, housing satisfaction acts as a variable in determining the relationship between the resident's background and his attitude towards mobility. In another clime, Research has shown that living in socially undesirable housing has adverse social and psychological effects [31, 33, 81, 89, 107]. Also, [81] revealed poor housing to be held responsible for some social problems, including identifiable physical and mental diseases of occupants' maladjustments of different kinds, intra-family and inter-family crowding, low self-esteem of slum dwellers, barriers to economic improvement, the problem of adequately educating the children.

Affirming the aforementioned indices [98] stated that 90% of area boys and girls are products of poor housing and homelessness. It is crucial to note therefore that the studies of housing satisfaction help to predict the positive and negative influences which aim to appreciate the need and aspiration of the individual household for maximum housing satisfaction and improve housing policy.

Measuring of Housing Satisfaction. Authors [53] observed that Neighbourhood characteristics, public facilities, and housing characteristics to be the main factors of residential satisfaction further identified three (3) housing characteristics that determine housing satisfaction based on housing type, housing price, and housing size. However, authors [112] found that housing characteristics can be determined through demography variables such as age, gender, and household income, explaining further that with regards household income one may assume a greater satisfaction with higher income status.

According to [18] study, satisfaction can be measured on two levels; first is the overall level of housing satisfaction and second is the satisfaction with the various components of the dwelling. Accordingly, satisfaction indices can be self-weighting; this means the individual considers the housing attributes deemed necessary for the type of ideal housing he/she would like to have. Then the individual compares his/her ideal to his/her actual housing and weighs both in his/her mind to determine overall satisfaction based upon how well housing needs and aspirations are being met in conclusion it narrowed on four factors that influence housing satisfaction, namely, Age, education, household size, and housing quality. It suffices to say that there are numerous attributes used in the determination of housing satisfaction. However, a study by [8], affirm that housing satisfaction is associated with the personality characteristics of the residents. In the same vein, [96], perceived quality and physical comfort as variables contributing to housing satisfaction, while authors [69] emphasized that residents' relationship with management staff play an important role in influencing satisfaction. Similarly, [60] stressed homeownership and [42] concluded that aggregate income contributes to housing satisfaction.

Author [58] reviewed the factors influencing residential satisfaction to include physical surrounding, structural aspect, internal hygiene of the house, cleanliness, landscaping of the surrounding area, number and size of rooms, kitchen, bathrooms, study area, living room, privacy, bedrooms location, staircase, dining area, quality of physical attributes, the durability of building materials, structural soundness, potable water, sewage disposal system, electricity supply, connectivity to other areas, infrastructure, territorial dominance, and safe environment.

It was further revealed that the housing condition which encompasses the physical state of the house and the immediate environments is significantly related to residential satisfaction. The studies reviewed show that a good housing physical attributes such as the room, floors, ceilings, wall, door, windows, toilets; and the serenity of the environment in terms of cleanliness, safety, aesthetics, landscaping, location, services, and improved infrastructure are related to a higher level of residential satisfaction to the residents of the house and vice versa.

Occupants' Preference. Preferences are temporary states of mind about what kind of housing is desired and feasible at the current moment given the current constraints "included in the idea that preferences involve the choice of one option over another" [112]. Housing Preferences are expressions of values but expressed preference may not directly relate to a single or obvious value [109]. However, [93] expressed that Preferences are inherently unstable and can be expected to change for a specific household whenever significant changes in the constraints occur. The literature on preference centers around and mostly considered as special treatment (enactment of the zoning ordinance) rather than the implementation of the law to cover the general community. Hence, the intent as with most developed countries was to create an atmosphere for affordable housing.

METHODOLOGY

Research Population / Sample frame. The target population of this study were the total number of three residential housing estates of two/three bedroom units in the study area (Table 1–3).

Table 1 – Population, sample frame and sample size of the study

Location		Name of estate	No. Of housing units (population)	Stratum
1	Maiduguri	Dikwa low-cost	98	32
2	Maiduguri	Abbagana taraf	500	166
3	Maiduguri	202 housing estate	202	67
Total			800	265

Table 2 – Questionnaire Administration

Questionnaire	Number	Response rate
Administered	265	-
Collected	212	53%
Valid	190	48%

Table 3 – Demographic Information of the respondents

No	Attributes	Options	Frequency	%
1	Age	Under 30 years	13	6.8
		31 to 60 years	157	82.6
		Over 61 years	20	10.5
2	Gender	Male	133	70.0
		Female	57	30.0
			190	100.0
3	How long have you lived here	Under one year	1	.5
		1-5 years	67	35.3
		Over 5 years	122	64.2
4	How often do you stay at home	Some times	4	2.1
		Most of the time	50	26.3
		Evenings / weekends	106	55.8
		Other	30	15.8
5	Nature of tenure	It was allocated to me	124	65.3
		I bought it from the person allocated to	15	7.9
		I bought it much later after allocation	7	3.7
		I am a tenant	44	23.2

Sampling Techniques. The procedure for choosing the sample units from a population is known as sampling techniques [100]. For this study, stratify random sampling was employed; this is because the respondents were group according to housing estates.

Sample size. Author [71] stated that the sample must be of an optimum size i.e., it should neither be excessively large nor too small. Authors [73] revealed a simplified table for estimating the confidence level needed from a given population. Thus, indicating a randomly chosen sample from a given population to falls within 0.05 sample proportion with a 95 percent level of confidence. Thus using [73] table the sample size of 265 out of a population of 800 was chosen. Thus, a sample size of 265 will be adopted.

Method of data collection. The instrument adopted for data collection was a questionnaire, thus to ensure smooth investigation of issues the study has adopted the use of structured ques-

tions where a predetermined set of questions was employed to cross-examine residents in the study area. The use of a close-ended questionnaire was vital to eliminate the subjective bias of interest in questions.

Method of Data Analysis and Presentation . The study employed the use of descriptive and inferential statistics to analyze the data collected. Statistical Package for Social Science (SPSS, version 23) was adopted for statistical analysis of the data collected from the questionnaire survey.

Normality of the Field data. Before multiple regression analysis to answer the research question, a normality test was carried out using skewness and kurtosis to meet the assumption of multiple regression analysis as suggested in [104]. This is to show that the data is normally distributed and acceptable for the analysis. Thus it shows neither to skew to the right nor left hence, the data distribution ranges from -1.291 to -.001 which is within the acceptable range of +/-2 recommended in [111].

The Reliability of the constructs. The reliability of the constructs was analyzed by finding Cronbach's alpha as suggested by [104]. Overall Cronbach's alpha for the questionnaire was 0.965. This means that the questionnaire as a whole is reliable and acceptable. The reliability test for the field data presented in the Table 4 below showed that the Cronbach's alphas obtained for each of the constructs are above acceptable alpha of 0.7.

Table 4 – Reliability Results of the Field Data

Constructs	Cronbach's Alpha	Standardized Cronbach's Alpha	N of Items
Building Components Quality	.922	.924	9
Nonphysical features (Intangible) Quality	.777	.807	8
Physical features (Tangible) Quality	.931	.932	11
Building components Preference	.940	.942	8
Nonphysical features (Intangible) Preference	.958	.958	8
Physical features (Tangible) Preference	.937	.938	11
Building Components Satisfaction	.965	.967	8
Nonphysical features (Intangible) Satisfaction	.956	.959	8
Physical features (Tangible) Satisfaction	.958	.959	11

Criteria for ranking. As seven (7) Likert scale was used in data collection and analysis, the same ranking scale was used in a mean ranking scale (Table 5).

Table 5 – Seven (5) Likert scale criteria for building performance ranking

No	Quality	Preference	Satisfaction	Ranking scale
1	Excellent	Extremely important	Extremely satisfied	6.01 - 7.00
2	Very good	Very important	Very satisfied	5.01 - 6.00
3	Good	Important	Satisfied	4.01 - 5.00
4	Neither good nor poor	Neutral	Neither satisfied nor dissatisfied	3.01 - 4.00
5	Poor	Less important	Dissatisfied	2.01 - 3.00
6	Very poor	Very less important	Very dissatisfied	1.01 - 2.00
7	Extremely poor	Extremely less important	Extremely dissatisfied	- 1.00

The scale on housing quality based on occupants' perception ranges between excellent and extremely poor, while scale for preference was based on extremely important and extremely less important. However, occupants' satisfaction rating ranges between extremely satisfied and extremely dissatisfied as in [17].

RESULTS AND DISCUSSION

The data analyses results and findings for each research question are presented below. The analysis results were presented in tables and findings were explain in textual forms. A 7-point Likert scale was used throughout the study with different constructs having similar or different scale descriptors.

Level of public housing Quality in Maiduguri metropolis. Descriptive statistics based on the mean ranking was carried out to assess the quality of public housing in Maiduguri metropolis, Borno State. The results showed the ranking, mean and standard deviation for each Item. Table 6 below shows the quality of public housing components in the Maiduguri metropolis.

Table 6 – Quality of building components in Maiduguri public housing

Variables	Mean	Std. Deviation	Quality (Level)	Rank
Condition of bedroom	5.2842	1.20986	Very Good	1
Condition of living room	5.2579	1.06001	Very Good	2
Condition of roof	5.0842	1.04059	Very Good	3
Condition of Finishing	5.0105	1.20839	Very Good	4
Condition of kitchen	5.0053	1.03124	Good	5
Condition of store	4.9263	1.03118	Good	6
Condition of dining area	4.9105	1.13034	Good	7
Condition of garage	4.9105	1.31229	Good	8
Condition of toilets	4.8053	1.25102	Good	9

Overall Quality (Level) - 5.0216 (Very Good)

It shows that the qualities of public housing components that were highest, based on the seven-point measurement scale, were a condition of a bedroom with a mean score of 5.2842 ranked 1 among the housing quality, condition of living room with a mean score of 5.2579 ranked 2, condition of the roof with the mean score of 5.0842 ranked the 3, Condition of Finishing ranked the 4 with the mean score of 5.0105 and condition of kitchen ranked the 5 with a mean score of 5.0053, followed by other housing condition which are a condition of the store, condition of the dining area, condition of garage and Condition of toilets with mean scores of 4.9263, 4.9105, 4.9105 and 4.8053, ranked the 6, 7, 8, and 9 respectively.

However, the overall mean score for the level of housing condition components was 5.0216, which is very good.

Quality of Nonphysical (Intangible) features. Descriptive statistics based on the mean ranking was carried out to assess the Quality of Nonphysical (Intangible) features in Maiduguri metropolis, Borno State. The results showed the ranking, mean and standard deviation for each Item.

Table 7 below shows the Quality of Nonphysical (Intangible) features in the Maiduguri metropolis.

Table 7 – Quality of nonphysical (Intangible) features

Variables	Mean	Std. Deviation	Quality (Level)	Rank
Condition of privacy	5.8474	1.20091	Very Good	1
Condition of ventilation	5.7842	.95992	Very Good	2
Condition of internal appearance	5.2947	1.00131	Very Good	3
Condition of design	5.2789	1.20452	Very Good	4
Condition of external appearance	5.2000	1.02972	Very Good	5
Condition of natural lighting	5.0158	1.09097	Very Good	6
Condition of light generally	4.8211	.95927	Good	7
Condition of artificial lighting	3.5684	1.83241	Neither good nor poor	8

Overall Quality (Level) - 5.1013 (Very Good)

It shows that the Quality of Nonphysical (Intangible) features that were highest, based on the seven-point measurement scale, were Condition of privacy, Condition of ventilation, Condition of internal appearance, Condition of design, Condition of external appearance and Condition of natural lighting with the mean scores of 5.8474, 5.7842, 5.2947, 5.2789, 5.2000 and 5.0158 ranked the 1, 2, 3, 4, 5, and 6 respectively, and the

least quality of nonphysical feature are Condition of light generally and Condition of artificial lighting with means scores of 4.8211 and 3.5684 ranked 7 and 8 respectively. However, the overall mean score for determining the level of Quality of Nonphysical features (Intangible) was 5.1013, which means very good quality.

Quality of physical (tangible) features. Descriptive statistics based on the mean ranking was carried out to assess the Quality of Physical features (Tangible) in Maiduguri metropolis, Nigeria. The results showed the ranking, mean and standard deviation for each Item.

Table 8 below shows the Quality of Physical (Tangible) features in the Maiduguri metropolis.

Table 8 – Quality of physical (tangible) features

Variables	Mean	Std. Deviation	Quality (Level)	Rank
Condition of electric facilities	5.1105	1.18786	Very Good	1
Condition of wall	5.0579	1.23948	Very Good	2
Condition of floor	5.0526	1.09707	Very Good	3
Condition of plumbing facilities	5.0421	1.10234	Very Good	4
Condition of ceiling	5.0368	1.00985	Very Good	5
Condition of heating facilities	4.8579	1.18447	Good	6
Condition of doors/windows	4.8263	1.22424	Good	7
Condition of cooling facilities	4.8211	1.12197	Good	8
Condition of nets on window	4.8000	1.26491	Good	9
Condition of fence	4.7368	1.29476	Good	10
Condition of burglary proof	4.7368	1.11470	Good	11

Overall Quality (Level) – 4.9163 (Good)

It shows that the quality of Physical (Tangible) features that were most, based on the seven-point measurement scale, are Condition of electric facilities, Condition of the wall, Condition of the floor, Condition of plumbing facilities and Condition of the ceiling with the mean scores of 5.1105, 5.0579, 5.0526, 5.0421 and 5.0368 ranked the 1, 2 3, 4 and 5 respectively. The other quality of physical features (tangible) is Condition of heating facilities, Condition of doors/windows, Condition of cooling facilities, Condition of nets on the window, Condition of fence and Condition of burglary proof with mean scores 4.8579, 4.8263, 4.8211, 4.8000, 4.7368 and 4.7368 ranked the 6, 7, 8, 9, 10 and 11 respectively. Therefore, the overall mean scores to determine the level of Quality of Physical features (Tangible) in the Maiduguri metropolis was 4.9163.

Level of occupants' satisfaction with building components in Maiduguri public housing. Descriptive statistics based on the mean ranking was carried out to assess the occupants' satisfaction with the public housing components in Maiduguri metropolis, Borno State. The results showed the ranking, mean and standard deviation for each Item.

Table 9 below shows the occupants' satisfaction with the public housing components in Maiduguri metropolis.

Table 9 – Level of occupants' satisfaction with building components in Maiduguri public housing

Variable	Mean	Std. Deviation	Quality (Level)	Rank
Condition of bedroom	5.4526	1.29524	Very Satisfied	1
Condition of living room	5.3316	1.25591	Very Satisfied	2
Condition of store	5.1947	1.03329	Very Satisfied	3
Condition of kitchen	5.1895	1.04699	Very Satisfied	4
Condition of roof	5.1737	1.06723	Very Satisfied	5
Condition of Finishing	5.0158	1.19291	Very Satisfied	6
Condition of toilets	4.9263	1.42348	Satisfied	7
Condition of dining area	4.8053	1.20799	Satisfied	8

Overall Quality (Level) – 5.1362 (Very Satisfied)

It shows that the occupants' satisfaction with the public housing that is highest, based on the seven-point measurement scale, is satisfaction with Condition of a bedroom, Condition of living room, Condition of the store, Condition of the kitchen, Condition of roof and Condition of Finishing with the mean scores of 5.4526, 5.3316, 5.1947, 5.1895, 5.1737 and 5.0158 and ranked the 1, 2, 3, 4 and 5 respectively, other occupants' satisfaction with the public housing is Condition

of toilets and Condition of the dining area with the mean value of 4.9263 and 4.8053 ranked the 7 and 8 respectively. The mean score for assessing the level of occupants' satisfaction with the public housing component in Maiduguri metropolis was 5.1362, indicating very satisfied.

Occupants' Satisfaction with Nonphysical (Intangible) features. Descriptive statistics based on the mean ranking was carried out to assess the occupants' satisfaction with Nonphysical features (Intangible) in Maiduguri metropolis, Nigeria. The results showed the ranking, mean and standard deviation for each Item.

Table 10 below shows the occupants' satisfaction with Nonphysical (Intangible) features in Maiduguri metropolis.

Table 10 – Level of occupants' Satisfaction with Nonphysical (intangible) features

Variable	Mean	Std. Deviation	Satisfaction (Level)	Rank
Condition of natural lighting	5.2105	1.08276	Very Satisfied	1
Condition of ventilation	5.2105	1.08764	Very Satisfied	2
Condition of privacy	5.1526	1.26527	Very Satisfied	3
Condition of internal appearance	5.0368	1.07088	Very Satisfied	4
Condition of external appearance	5.0053	.95672	Very Satisfied	5
Condition of design	4.9947	1.12921	Satisfied	6
Condition of artificial lighting	4.9789	1.24704	Satisfied	7
Condition of light generally	4.8526	1.33308	Satisfied	8

Overall Quality (Level) – 5.0553 (Very Satisfied)

It shows that the occupants' satisfaction with Nonphysical (Intangible) features that are most, based on the seven-point measurement scale, are Condition of natural lighting, Condition of ventilation, Condition of privacy, Condition of internal appearance and Condition of external appearance with the mean scores 5.2105, 5.2105, 5.1526, 5.0368 and 5.0053 ranked the 1, 2, 3, 4 and 5 respectively. The other occupants' satisfaction with Nonphysical (intangible) features are Condition of design, Condition of artificial lighting and Condition of light generally with mean scores of 4.9947, 4.9789 and 4.8526 ranked the 6, 7 and 8 respectively. Therefore, the overall mean score for assessing the level of occupants' satisfaction with nonphysical (Intangible) features in Maiduguri metropolis was 5.0553, indicating very satisfied.

Occupants' satisfaction with the quality of physical (tangible) features. Descriptive statistics based on the mean ranking was carried out to assess the occupants' satisfaction with Quality of Physical (Tangible) features in Maiduguri metropolis, Borno State. The results showed the ranking, mean and standard deviation for each Item. Table 11 below shows the occupants' satisfaction with Quality of Physical (tangible) features in Maiduguri metropolis.

Table 11 – Level of Occupants' Satisfaction with Quality of Physical (Tangible) features

Variable	Mean	Std. Deviation	Satisfaction (Level)	Rank
Condition of doors and windows	5.2368	1.10397	Very Satisfied	1
Condition of ceiling	5.1737	.97391	Very Satisfied	2
Condition of floor	5.1211	1.03947	Very Satisfied	3
Condition of nets on window	5.1000	1.10578	Very Satisfied	4
Condition of plumbing facilities	5.1000	1.04172	Very Satisfied	5
Condition of electric facilities	5.0579	.93255	Very Satisfied	6
Condition of burglary proof	5.0474	1.18762	Very Satisfied	7
Condition of fence	5.0316	.99153	Very Satisfied	8
Condition of wall	5.0000	1.03892	Satisfied	9
Condition of cooling facilities	4.7053	1.20294	Satisfied	10
Condition of heating facilities	4.7000	1.20822	Satisfied	11

Overall Quality (Level) – 5.0249 (Very Satisfied)

It shows that the occupants' satisfaction with Quality of Physical (tangible) features that are most, based on the seven-point measurement scale, are Condition of doors and windows, Condition of the ceiling, Condition of the floor, Condition of nets on the window, Condition of plumbing facilities, Condition of electric facilities, Condition of burglary proof, Condition of fence and Condition of the wall with the mean scores 5.2368, 5.1737, 5.1211, 5.1000, 5.1000, 5.0579, 5.0474, 5.0316 and 5.0000 ranked the 1, 2, 3, 4, 5, 6, 7, 8 and 9 respectively. The least occupants' satisfaction with Quality of Physical (tangible) features are Condition of cooling facilities and Condition of heating facilities with mean scores of 4.7053 and 4.7000 ranked the 10 and 11 respectively. However, the overall mean score for assessing the level of occupants' satisfaction with Quality of physical (tangible) features in the Maiduguri metropolis was 5.0249 indicating a very satisfying level.

Preference of building components that occupiers need in public housing. Descriptive statistics based on the mean ranking was carried out to assess the components attributes that occupiers need in a public housing estate in Maiduguri metropolis, Borno State. The results showed the ranking, mean and standard deviation for each Item.

Table 12 below shows the preference of building components in a public housing estate in Maiduguri metropolis that occupiers needs in a public housing estate in the study area that is most, based on the seven-point measurement scale, are Condition of bedroom and toilets with mean scores of 6.1632 and 6.0211 and ranked the 1 and 2 respectively.

Table 12 – Preference of Building Components that Occupiers need in Public Housing

Variables	Mean	Std. Deviation	Preferable (Level)	Rank
Bedroom	6.1632	1.06890	Extremely important	1
Toilets	6.0211	1.18169	Extremely important	2
Living Room	5.9474	1.20289	Very important	3
Roof	5.7526	1.12069	Very important	4
Finishing	5.7211	1.00321	Very important	5
Store	5.6895	1.08056	Very important	6
Kitchen	5.6263	1.20946	Very important	7
Dining Area	5.1316	1.44330	Very important	8

Overall Quality (Level) – 5.7566 (Very important)

Other Preferences of building components that occupiers need in public housing are living room, roof, Finishing, store, kitchen and dining area with mean scores of 5.9474, 5.7526, 5.7211, 5.6895, 5.6263 and 5.1316 ranked the 3, 4, 5 and 6 respectively. Therefore, the overall mean score for assessing the Preference of building components that occupiers need in public housing in the Maiduguri metropolis was 5.7566 indicating very important needs.

Preference of nonphysical (intangible) features that occupiers need in public housing. Descriptive statistics based on the mean ranking was carried out to assess the Preference nonphysical (intangible) features that occupiers need in a public housing estate in Maiduguri metropolis, Borno State. The results showed the ranking, mean and standard deviation for each Item.

Table 13 below shows the Nonphysical (intangible) features that occupiers need in a public housing estate in Maiduguri metropolis.

Table 13 – Preference of nonphysical (intangible) features that occupiers need in public housing

Variables	Mean	Std. Deviation	Preferable (Level)	Rank
Privacy	6.0000	1.31334	Extremely important	1
Ventilation	5.9105	1.25458	Very important	2
Light Generally	5.7316	1.04732	Very important	3
Internal Appearance	5.6000	1.27574	Very important	4
Natural Lighting	5.5684	1.25274	Very important	5
External Appearance	5.5211	1.13019	Very important	6
Design	5.4842	1.25873	Very important	7
Artificial Lighting	5.1421	1.28311	Very important	8

Remark – 5.6197 (Very important)

It shows that the Nonphysical features (Intangible) that occupiers need in a public housing estate in the study area that is most, based on the seven-point measurement scale, are privacy with mean scores of 6.0000 ranked the 1 and followed by ventilation, light generally, internal appearance, natural lighting, external appearance, design and artificial lighting with their mean scores of 5.9105, 5.7316, 5.6000, 5.5684, 5.5211, 5.4842 and 5.1421 ranked the 2, 3, 4, 5, 6, and, 7 respectively. However, the overall mean score for assessing the nonphysical (intangible) features that occupiers need in public housing in the Maiduguri metropolis was 5.6197, indicating very important needs.

Preference of physical (tangible) features that occupiers need in public housing. Descriptive statistics based on the mean ranking was carried out to assess the Preference of physical (tangible) features that occupiers needs in a public housing estate in Maiduguri metropolis, Borno State. The results showed the ranking, mean and standard deviation for each Item.

Table 14 shows the Preference of physical (tangible) features that occupiers need in a public housing estate in Maiduguri metropolis.

Table 14 – Preference of physical (tangible) features that occupiers needs in public housing

Variable	Mean	Std. Deviation	Preferable (Level)	Rank
Burglary Proof	6.0895	1.02735	Extremely Important	1
Nets On Window	6.0474	1.16513	Extremely important	2
Doors And Windows	6.0263	.99965	Extremely important	3
Fence	5.9632	1.01508	Very important	4
Ceiling	5.8895	.92776	Very important	5
Floor	5.8579	1.09632	Very important	6
Wall	5.8000	.88611	Very important	7
Plumbing Facilities	5.7737	1.11571	Very important	8
Electric Facilities	5.6947	.98747	Very important	9
Heating Facilities	5.4579	1.26232	Very important	10
Cooling Facilities	5.4211	1.26891	Very important	11

Remark – 5.8201 (Very important)

It shows that the physical (tangible) features that occupiers needs in a public housing estate in the study area that are most, based on the seven-point measurement scale, are burglary proof, nets on window and doors and windows with mean scores of 6.0895, 6.0474 and 6.0263 and ranked the 1, 2 and 3 respectively. Other physical features (Tangible) that occupiers needs in public housing in the study area are fence, ceiling, floor, wall, plumbing facilities, electric facilities, heating facilities and cooling facilities with their mean scores of 5.9632, 5.8895, 5.8579, 5.8000, 5.7737, 5.6947, 5.4579 and 5.4211 ranked the 4, 5, 6, 7, 8, 9, 10 and 11 respectively. Therefore, the overall mean score for assessing the physical (tangible) features that occupiers needs in public housing in Maiduguri metropolis was 5.8201, indicating very important needs

Effects of component attributes' housing quality and occupants' preference on satisfaction in the study area. A regression analysis was carried out to assess the effects of housing quality and occupants' preference on the satisfaction of public housing in the study area. The result was presented in table 15 below indicated the value was R^2=.261, f(2, 187)=33.001, p<.001. The model produced an overall R-value of 0.511 and an R-square value of 0.261 with F-statistics of 33.001 which are significant as indicated by the p-value of 0.001 far below the recommended maximum of 0.05 [104]. This means that the independent variable building components Preference and building components quality explained 26.1 % large significance (p<0.001) effect size on Building components Satisfaction in the study area.

Table 15 – Effects of component attributes' housing quality and occupants' preference on satisfaction in the study area

Model Summary					Df	F	Sig.
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate			
1	.511	.261	.253	.92717	2 187	33.001	.000

Notes: a) Predictors: (Constant), Building components Preference, Building Components Quality; b) Dependent Variable: Building Components Satisfaction

Contribution of individual building components quality and building components preference on

satisfaction. The regression analysis beta result indicating the individual effects of building components quality and building components preference on the satisfaction of public housing in the study area. The regression coefficient shown in table 16 below indicated that building component quality is the significant determinant of building component preference because the p-value (0.000) is less than the significance level at 0.05.

Table 16 – Contribution of building components quality and building components preference on satisfaction

Coefficients							
Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.	Correlations
		B	Std. Error	Beta			Zero-order
1	(Constant)	1.279	.487		2.627	.009	
	Building Components Quality	.450	.078	.377	5.763	.000	.448
	Building components Preference	.278	.071	.255	3.891	.000	.360

Notes: a) Dependent Variable: Building Components Satisfaction

Similarly, the contribution of building component preference into building component satisfaction is significant as shown by a t-statistics and p-value of 3.891 and 0.00 respectively at a 5% level of significance. Therefore the building component quality and preference are what determines to build component satisfaction. Thus, if the building component quality increases by 1 Likert value, the Likert value of building component satisfaction will increase by 0.377 likewise an increase of building component preference by 1 Likert value will increase building component satisfaction by 0.255. Hence, the building component quality and building component preference are what determine to build component satisfaction.

CONCLUSION

The findings from the survey carried out indicated that the quality of public housing condition of a bedroom, condition of living room, condition of the roof, condition of finishing and condition of the kitchen were very good in the study area and also the study revealed that occupant' satisfaction level with building components conditions of a bedroom, living rooms, stores, kitchen, roof, and finishing were very satisfied and others condition of toilet and condition of dining area were satisfied by the occupants in the area and study findings indicated that the occupant's preference with building components of a bedroom, toilets, living room, roof, finishing, stores, kitchen and dining in the study area. The study demonstrated a strong significant effect of building components, housing quality and occupants' preference on satisfaction.

Also, the research recommended occupants' peculiarities should be integrated into the design and development of housing estate. This will ensure that the satisfaction of the occupants is well co-opted in the development and therefore lead to higher satisfaction and functionality of the estate.

Also, the provision of facilities and amenities in public housing estate should be based on the occupants' requirements and peculiarities. This will lead to the optimal utilization of the estate after development.

REFERENCES

1. Abiodun, P. B., & Segun, A. O. (2005). An Assessment of Housing Status in a Typical Nigerian Town. *Journal of Applied Sciences, 5*(3), 437–440. doi: 10.3923/jas.2005.437.440
2. Adeleye, A. O., Azeez, O. T., & Yusuff, O. I. (2014). Perception of Housing Quality by Residents and Non Residents of Ibara Housing Estate, Abeokuta, Ogun State, Nigeria. *American Journal of Human Ecology, 3*(3). doi: 10.11634/216796221403586

3. Adeleye, O. A, & Anofojie, A. E. (2011). *Housing Quality in Festac Town, Lagos State, Nigeria*. Retrieved https://www.semanticscholar.org/paper/Housing-Quality-in-Festac-Town%2C-Lagos-State%2C-Adeleye-Anofojie/791c0632c90c155137d29ed97bde41b7bebb8deb

4. Aduda, G. T. (2007). *Budget monitoring and Price Intelligence Unit (due process): A mechanism for combating corruption in infrastructure delivery in Nigeria. Case study*. Retrieved from https://www.gov.uk/dfid-research-outputs/budget-monitoring-and-price-intelligence-unit-due-process-a-mechanism-for-combating-corruption-in-infrastructure-delivery-in-nigeria-case-study

5. Afolarin, A. O. (2013). Factors affecting Quality in the Delivery of Public Housing Projects in Lagos State, Nigeria. *International Journal of Engineering and Technology, 3*(3), 332–336

6. Afon, A. O. (2000). The use of residents' Environmental Quality Indicator (EQI) data in the core residential housing improvement. In O. B. Akinbamijo, A. S. Famehinmi, D. R. Ogunsemi, & A. Olotuah (Eds.), *Effective housing in the 21st century Nigeria* (pp. 115– 122). Akure: The Environment Forum.

7. Aguinis, H. (2011). *Organizational responsibility: Doing good and doing well*. Retrieved from http://www.hermanaguinis.com/OR5.pdf

8. Ajayi, M., Nwosu, A., & Ajani, Y. (2015). Students' satisfaction with hostel facilities in federal university of technology, Akure, Nigeria. European Scientific Journal, 11(34), 402–415.

9. Akeju, A. A. (2007). Challenges to providing affordable housing in Nigeria. In *Emerging Urban Africa International Conference on Housing Finance in Nigeria*. Abuja, October 2007. Retrieved from http://www.sciepub.com/reference/126719

10. Al-Momani, A. H. (2000). Examining service quality within construction processes. *Technovation, 20*(11), 643–651. doi: 10.1016/s0166-4972(00)00002-x

11. Anofojie, A. E., & Kadiri, M. (2014). Housing quality assessment in selected public residential estates in Amuwo-Odofin LGA, Lagos, Nigeria. *International Journal of Research, 2*(6), 2311–2484.

12. Ayodeji, O. A. (2013). A study of liquidity in residential property sales transaction in lagos state Nigeria. Retrieved from http://m.covenantuniversity.edu.ng/content/download/23659/160478/file/WABER+2013+Conference+proceedings.pdf

13. Baur, D., & Schmitz, H. P. (2011). Corporations and NGOs: When Accountability Leads to Co-optation. *Journal of Business Ethics, 106*(1), 9–21. doi: 10.1007/s10551-011-1057-9

14. Begum, H. (2015). *Improving access to housing for low-income communities in Dhaka: from rhetoric to reality in community participation* (Doctoral thesis). Retrieved from https://eprints.qut.edu.au/82794/4/Halima_Begum_Thesis.pdf

15. Bhatti, R. (2013). *A study of library usage and satisfaction by social scientists at Bahauddin Zakariya University, Multan*. Retrieved from https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=2341&context=libphilprac

16. Boehm, T. P., & Schlottmann, A. M. (1999). Does Home Ownership by Parents Have an Economic Impact on Their Children? Journal *of Housing Economics, 8*(3), 217–232. doi: 10.1006/jhec.1999.0248

17. Braunsberger, K., & Gates, R. (2009). Developing inventories for satisfaction and Likert scales in a service environment. *Journal of Services Marketing, 23*(4), 219–225. doi: 10.1108/08876040910965557

18. Bromley, D. B. (2000). Psychological Aspects of Corporate Identity, Image and Reputation. *Corporate Reputation Review, 3*(3), 240–252. doi: 10.1057/palgrave.crr.1540117

19. Bruns, A. S. (2017, March). *The determinants of Corporate Social Responsibility: empirical evidence from the Netherland* (Master's thesis). Retrieved from http://essay.utwente.nl/72020/1/BRUNS_MA_BMS.pdf

20. Carroll, C. (2016). *The SAGE Encyclopedia of Corporate Reputation*. Thousand Oaks: SAGE.

21. Choudhury, I. (2005). *A conceptual model of resident satisfaction with reference to neighbourhood composition*. Retrieved from https://repository.up.ac.za/bitstream/handle/2263/10301/A%20conceptual%20model%20of%20resident%20satisfaction.pdf?sequence=1&isAllowed=y

22. Chun, R. (2005). Corporate reputation: Meaning and measurement. *International Journal of Management Reviews, 7*(2), 91–109. doi: 10.1111/j.1468-2370.2005.00109.x

23. Coakes, S. J., Steed, L. G., & Dzidic, P. (2006). *SPSS: Analysis without Anguish. Version 13.0 for Windows*. Milton: John Wiley & Sons.

24. Curley A. (2008). *Deconcentrating poverty: program effects on neighborhood diversity and social cohesion*. Conference paper for Housing Studies Association. York: University of York.

25. De Freitas, C., García-Ramirez, M., Aambø, A., & Buttigieg, S. C. (2014). Transforming health policies through migrant user involvement: Lessons learnt from three European countries. *Psychosocial Intervention, 23*(2), 105–113. doi: 10.1016/j.psi.2014.07.007

26. Dharani, K. (2015). Study on negligence of quality assurance and proposing an effective framework for total quality management. *International Journal of Research in Engineering and Technology, 04*(02), 604–609. doi: 10.15623/ijret.2015.0402084

27. Doorley, J., & Garcia, H. F. (2015). *Reputation management: The key to successful public relations and corporate communication*. New York: Routledge.

28. Ebiaride, E. C., & Umeh, O. L. (2015). Factors Influencing Users' Satisfaction in Public and Private Estate in Lagos, Nigeria. *ATBU Journal of Environmental Technology, 8*(2), 30–41

29. Elsinga, M., & Hoekstra, J. (2005). Homeownership and housing satisfaction. *Journal of Housing and the Built Environment, 20*(4), 401–424. doi: 10.1007/s10901-005-9023-4

30. Emakhu, S. E., & Ubangari, A. Y. (2015). Analysis of housing quality in the peripheral Area of Lafia Town. *International Journal of Geography and Regional Planning Research, 1*(3), 9–17.

31. Eni, C. M. (2014). Evaluation of Residents' View on Affordability of Public Housing in Awka and Onitsha, Nigeria. *Journal of Economics and Sustainable Development, 5*(17), 126–143

32. Eni, Ch. M. (2015). Appraisal of occupants' satisfaction of social considerations of public housing in Anambra state, Nigeria. *International Journal of Civil Engineering, Construction and Estate Management, 3*(1), 15–33.

33. Fanning, R. M., & Gaba, D. M. (2007). The Role of Debriefing in Simulation-Based Learning. *Simulation in Healthcare: The Journal of the Society for Simulation in Healthcare, 2*(2), 115–125. doi: 10.1097/sih.0b013e3180315539

34. Feldman, P. M., Bahamonde, R. A., & Velasquez Bellido, I. (2014). A new approach for measuring corporate reputation. Revista de Administração de Empresas, 54(1), 53–66. doi: 10.1590/s0034-759020140102

35. Festus, I. A., & Amos, I. O. (2005). Housing Policy in Nigeria: An Overview. *American International Journal of Contemporary Research, 5*(2), 53–59.

36. Fill, C., & Roper, S. (2012). *Corporate reputation: brand and communication*. Harlow: Pearson.

37. Fombrun, C. J., & Van Riel, C. B. M. (2003). *Fame & fortune: How the world's top companies develop winning reputations*. Upper Saddle River: Pearson Education.

38. Foreman, J., & Argenti, P. A. (2005). How Corporate Communication Influences Strategy Implementation, Reputation and the Corporate Brand: An Exploratory Qualitative Study. *Corporate Reputation Review, 8*(3), 245–264. doi: 10.1057/palgrave.crr.1540253

39. Forrest, R. & Lee, J. (2003). *Housing and Social change: East-West Perspective*. London: Routledge / Taylor & Francis Group.

40. Francescato, G. (1963). Il dialetto di Erto. *Zeitschrift Für Romanische Philologie (ZrP), 79*(5-6). doi: 10.1515/zrph.1963.79.5-6.492

41. Francescato, G., Weidemann, S., & Anderson, J. R. (1989). Evaluating the Built Environment from the Users' Point of View: An Attitudinal Model of Residential Satisfaction. *Building Evaluation*, 181–198. doi: 10.1007/978-1-4899-3722-3_14

42. Frank, B., & Enkawa, T. (2009). Economic drivers of dwelling satisfaction. *International Journal of Housing Markets and Analysis, 2*(1), 6–20. doi: 10.1108/17538270910939538

43. Fu, X., Bhat, R. C., Pendyala, M. R., & Vadlamani, S., & Garikapati, M. V. (2015). *Understanding the multiple Dimensions of Residential Choice*. Retrieved from http://www.caee.utexas.edu/prof/bhat/ABSTRACTS/MultiDimensionsofResChoiceGHDM_8June2015.pdf

44. Geller, S. L., Abramson, A. J., & de Leon, E. (2010). *The Nonprofit Technology Gap – Myth or Reality?* Retrieved from https://www.researchgate.net/publication/275336167_The_Nonprofit_Technology_Gap_-_Myth_or_Reality

45. Golin, A. (2003). *Trust or Consequences: Build trust today or lose your market tomorrow*. Nashville: AMACOM.

46. Goodchild, B. (2016). *Homes, cities and neighbourhoods: planning and the residential landscapes of modern Britain*. N. d.: Routledge.

47. Grunig, J. E., & Hung, C. F. (2002). *The effect of relationships on reputation and reputation on relationships: a cognitive, behavioral study*. Retrieved from https://www.researchgate.net/publication/247855482_The_effect_of_relationships_on_reputation_and_reputation_on_relationships_A_cognitive

48. Hassanain, M. A. (2008). On the performance evaluation of sustainable student housing facilities. *Journal of Facilities Management, 6*(3), 212–225. doi: 10.1108/14725960810885989

49. Hatch, M. J., & Schultz, M. (2009). Of Bricks and Brands. *Organizational Dynamics, 38*(2), 117–130. doi: 10.1016/j.orgdyn.2009.02.008

50. Helmig, B., Spraul, K., & Ingenhoff, D. (2013). Under Positive Pressure. *Business & Society, 55*(2), 151–187. doi: 10.1177/0007650313477841

51. Heravitorbati, A., Coffey, V., Trigunarsyah, B., & Saghatforoush, E. (2011). Examination of process to develop a frame-work for better implementation of quality practices in building projects. In *2nd International Conference on Construction and Project Management* (ICCPM 2011), 16–18 September 2011, Grand Mercure Roxy Hotel, Singapore.

52. Hoang, D., Kopp, A., & Chandler, J. A. (2015). Interactions betweenDrosophilaand its natural yeast symbionts—IsSaccharomyces cerevisiaea good model for studying the fly-yeast relationship? *PeerJ, 3*, e1116. doi: 10.7717/peerj.1116

53. Huang, Z., & Du, X. (2015). Assessment and determinants of residential satisfaction with public housing in Hangzhou, China. *Habitat International, 47*, 218–230. doi: 10.1016/j.habitatint.2015.01.025

54. Hussain, I., Rashid, J. (2015). Determinants of the Quality of Housing in Poor and Non-Poor Household. *Gomal University Journal of Research, 31*(2), 87–98.

55. Ibem, E. O., & Amole, D. (2012). Residential Satisfaction in Public Core Housing in Abeokuta, Ogun State, Nigeria. *Social Indicators Research, 113*(1), 563–581. doi: 10.1007/s11205-012-0111-z

56. Ibem, O. E, Opoko, A. P, Adeboye, A., & Amole, D. (2013). Performance evaluation of residential buildings in public housing estates in Ogun State, Nigeria: Users' satisfaction perspective. *Frontiers of Architectural Research, 2*(2), 178–190. doi: 10.1016/j.foar.2013.02.001

57. Ilesanmi, O. A., (2012). Housing Neighbourhood quality and Quality of life in public Housing in Lagos, Nigeria. *International Journal for Housing science, 36*(4), 231–240.

58. Ishiyaku, B. (2016). Evaluation of Nigerian public housing performance using occupants' experience and satisfaction (Doctoral thesis). Retrieved from https://www.researchgate.net/publication/319043444_EVALUATION_OF_NIGERIAN_PUBLIC_HOUSING_PERFORMANCE_USING_OCCUPANTS'_EXPERIENCE_AND_SATISFACTION

59. Jafaar, M., Hasan, N. L., Mohamad, O., & Ramaya, T. (2017). *The Determinants of Housing Satisfaction Level: A Study on Residential Development Project by Penang Development Corporation (PDC)*. Retrieved from https://jurnalkemanusiaan.utm.my/index.php/kemanusiaan/article/download/144/137

60. James III, R. (2009). Customer satisfaction with apartment housing offered by Real Estate Investment Trusts (REITs). *International Journal of Consumer Studies, 33*(5), 572–580. doi: 10.1111/j.1470-6431.2009.00800.x

61. James, O. (2007). Evaluating the Expectations Disconfirmation and Expectations Anchoring Approaches to Citizen Satisfaction with Local Public Services. Journal of Public Administration Research and Theory, 19(1), 107–123. doi: 10.1093/jopart/mum034

62. James, R. N. (2007). Multifamily Housing Characteristics and Tenant Satisfaction. *Journal of Performance of Constructed Facilities, 21*(6), 472–480. doi: 10.1061/(asce)0887-3828(2007)21:6(472)

63. Jansen, S. J. T., Coolen, H. C. C. H., & Goetgeluk, R. W. (2011). Discussion and Directions for Future Research. *The Measurement and Analysis of Housing Preference and Choice*, 253–264. doi: 10.1007/978-90-481-8894-9_11

64. Jenkins, S. P., & Maynard, A. K. (1983). Intergenerational Continuities in Housing. *Urban Studies, 20*(4), 431–438. doi: 10.1080/00420988320080791

65. Jiboye, D. (2010). Evaluating Users' Household-Size and Housing Quality in Osogbo, Nigeria. *Ethiopian Journal of Environmental Studies and Management, 3*(2). doi: 10.4314/ejesm.v3i2.59825

66. Jirón, P., & Fadda, G. (2003). *A quality of life assessment to improve urban and housing policies in Chile*. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.197.567

67. Kampen, J. K., De Walle, S. V., & Bouckaert, G. (2006). *Assessing the relation between satisfaction with public service delivery and trust in Government*. Retrieved from https://www.researchgate.net/publication/283599865_Assessing_the_relation_between_satisfaction_with_public_service_delivery_and_trust_in_government_The_impact_of_the_predisposition_of_citizens_toward_government_on_evaluations_of_its_performance

68. Kasim, R., Ahmad, A. R., & Eni, S. (2007). *Skills for engaging communities in the housing neighbourhood facilities process: the European experience*. Retrieved from https://www.researchgate.net/publication/242161901_SKILLS_FOR_ENGAGING_COMMUNITIES_IN_THE_HOUSING_NEIGHBOURHOOD_FACILITIES_PROCESS_THE_EUROPEAN_EXPERIENCE

69. Khozaei, M., Soleimani, A., Najafi, P., & Feizi, M. (2007). Effect of Salt Levels and Cropping Methods on Wheat Agronomic Characteristics. *Pakistan Journal of Biological Sciences, 10*(6), 950–954. doi: 10.3923/pjbs.2007.950.954

70. Kim, J.-N., Hung-Baesecke, C.-J. F., Yang, S.-U., & Grunig, J. E. (2013). A Strategic Management Approach to Reputation, Relationships, and Publics: The Research Heritage of the Excellence

Theory. *The Handbook of Communication and Corporate Reputation*, 197–212. doi: 10.1002/9781118335529.ch18

71. Kothari, C. R. (2011). *Research methodology: Methods and techniques* (2nd ed.). New Delhi: New Age International.
72. Kowaltowski, D. C. C. K., da Silva, V. G., Pina, S. A. M. G., Labaki, L. C., Ruschel, R. C., & de Carvalho Moreira, D. (2006). Quality of life and sustainability issues as seen by the population of low-income housing in the region of Campinas, Brazil. *Habitat International, 30*(4), 1100–1114. doi: 10.1016/j.habitatint.2006.04.003
73. Krejcie, R. V., & Morgan, D. W. (1970). *Determinining Sample Size for Research Activities* . Retrieved from https://home.kku.ac.th/sompong/guest_speaker/KrejcieandMorgan_article.pdf
74. Kurian, M. S., Thampuran, A. (2011). Assessment of Housing Quality. *Institute of Town Planners, 8*(2), 74–77.
75. Lan, H. (2011). *A study on Housing Preference of Young households Using Stated-Preference Approach*. Retrieved from http://kth.diva-portal.org/smash/get/diva2:460839/FULLTEXT01.pdf
76. Lauster, N. T. (2008). Better Homes and Families: Housing Markets and Young Couple Stability in Sweden. *Journal of Marriage and Family, 70*(4), 891–903. doi: 10.1111/j.1741-3737.2008.00534.x
77. Lawrence, R. J. (2004). Housing and health: from interdisciplinary principles to transdisciplinary research and practice. *Futures, 36*(4), 487–502. doi: 10.1016/j.futures.2003.10.001
78. Lee, C., Dobson, A., Brown, W., Bryson, L., Byles, J., Warner-Smith, P., & Young, A. (2005). Cohort Profile: The Australian Longitudinal Study on Women's Health. *International Journal of Epidemiology*, 34(5), 987–991. doi: 10.1093/ije/dyi098
79. Levy, D., Murphy, L., & Lee, C. K. C. (2008). Influences and Emotions: Exploring Family Decision-making Processes when Buying a House. *Housing Studies, 23*(2), 271–289. doi: 10.1080/02673030801893164
80. MacCarty, M. (2014). *Introduction to public housing*. Retrieved from https://fas.org/sgp/crs/misc/R41654.pdf
81. Macpherson, R., Shepherd, G., & Thyarappa, P. (2012). Supported accommodation for people with severe mental illness: an update. *Advances in Psychiatric Treatment, 18*(5), 381–391. doi: 10.1192/apt.bp.110.008714
82. Mahon, J. F. (2002). Corporate Reputation. *Business & Society, 41*(4), 415–445. doi: 10.1177/0007650302238776
83. Mahon, J. F., & Wartick, S. L. (2003). Dealing with Stakeholders: How Reputation, Credibility and Framing Influence the Game. *Corporate Reputation Review, 6*(1), 19–35. doi: 10.1057/palgrave.crr.1540187
84. Marston, G. (2004). Managerialism and public housing reform. *Housing Studies, 19*(1), 5–20. doi: 10.1080/0267303042000152140
85. Matthews, R. J., Smith, L. K., Hancock, R. M., Jagger, C., & Spiers, N. A. (2005). Socioeconomic factors associated with the onset of disability in older age: a longitudinal study of people aged 75 years and over. *Social Science & Medicine, 61*(7), 1567–1575. doi: 10.1016/j.socscimed.2005.02.007
86. McArthur, T. (2005). The first English learner's dictionary: the Chinese dimension. *English Today, 21*(1), 60–64. doi: 10.1017/s0266078405001148
87. McTarnaghan, S., Martín, C., Srini, T., Collazos, J., Gold, A., Suminski, M., & Guzman, Y. (2016). *Literature Review of Housing in Latin America and the Caribbean*. Retrieved from https://www.urban.org/sites/default/files/publication/84806/2000957-Literature-Review-of-Housing-in-Latin-America-and-the-Caribbean.pdf

88. Melewar, T. C., Karaosmanoglu, E., & Paterson, D. (2005). Corporate identity: concept, components and contribution. *Journal of General Management, 31*(1), 59–81. doi: 10.1177/030630700503100104

89. Mitchell, J., & Weale, M. R. (2007). *The rationality and reliability of expectations reported by British households: micro evidence from the British household panel survey*. Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2785294

90. Mohit, M. A., & Azim, M. (2012). Assessment of Residential Satisfaction with Public Housing in Hulhumale', Maldives. *Procedia - Social and Behavioral Sciences, 50*, 756–770. doi: 10.1016/j.sbspro.2012.08.078

91. Moreno, R. (2011, January). *Policymaking from a 'macroprudential' perspective in emerging market economies*. Retrieved from https://www.bis.org/publ/work336.pdf

92. Morris, A. K., & Hiebert, J. (2009). Introduction: Building Knowledge Bases and Improving Systems of Practice. *The Elementary School Journal, 109*(5), 429–441. doi: 10.1086/596994

93. Morris, E. W., & Winter, M. (1978). *Housing, Family and Society*. New York: Wiley.

94. Mukhija, V. (2004). The Contradictions in Enabling Private Developers of Affordable Housing: A Cautionary Case from Ahmedabad, India. *Urban Studies, 41*(11), 2231–2244. doi: 10.1080/0042098042000268438

95. Niedomysl, T. (2008). Residential Preferences for Interregional Migration in Sweden: Demographic, Socioeconomic, and Geographical Determinants. *Environment and Planning A: Economy and Space, 40*(5), 1109–1131. doi: 10.1068/a39177

96. Niemeyer, S. M., Bruin, M., Cook, C. C., Laux, S., Memken, J., White, B. J., … Yust, B. (2007). Local Housing and Service Decisions. *Journal of Housing for the Elderly, 20*(4), 5–22. doi: 10.1300/j081v20n04_02

97. Norquist, K. (2009). *Local Preferences in Affordable Housing: Special Treatment for Those Who Live or Work in a Municipality*. Retrieved from https://lawdigitalcommons.bc.edu/cgi/viewcontent.cgi?referer=&httpsredir=1&article=1005&context=ealr

98. Nubi, O. T. (2008, October). *Affordable Housing Delivery in Nigeria*. Cape Town.

99. Okewole, I. A., & Aribigbola, A. (2006). Innovations and sustainability in Housing Policy Conception and Implementation in Nigeria. In *The Built Environment: Innovation Policy and Sustainable Development* (pp. 414–420). Ota: Covenant University.

100. Olawande, O. A. (2010, April). *Arterial Road Network and Commercial Property Values: Case Study of Ikeja, Nigeria*. Retrieved from http://eprints.covenantuniversity.edu.ng/107/1/Arterial_Road_Network_and_Commercial_Property_Values%5B1%5D.pdf

101. Olotuah, A. O. (2010). Housing development and environmental degeneration in Nigeria. *The Built & Human Environment Review, 3*, 42–48.

102. Olotuah, A. O., & Taiwo, A. A, (2015). Housing Strategies and Quality of Housing in Nigeria: What lessons from Wales. *Developing Country Studies, 5*(16), 1–5.

103. Oso, Y. W., & Onen, D. (2009). *A General guide to writing research proposal and report*. Nairobi: Jomo Kenyata Foundation.

104. Pallant, J. (2016). *SPSS Survival Manual: A step by step guide to data analysis using SPSS* (6th ed.). Maidenhead: Open University Press.

105. Park, I.-S., Kim, J.-H., & Kim, J.-J. (2008). The Effects of the Residential Satisfaction and Brand Image on the Customer Loyalty in the Apartment Market. *Journal of the Architectural Institute of Korea. Planning & Design, 24*(9), 57–64.

106. Parkes, A., Kearns, A., & Atkinson, R. (2002). What Makes People Dissatisfied with their Neighbourhoods? *Urban Studies, 39*(13), 2413–2438. doi: 10.1080/0042098022000027031

107. Riaz, A., Muhammad, S., Ashraf, I., & Zafar, M. I. (2012). Role of Punjab rural support program in improving economic conditions of rural women through micro financing. *Pakistan Journal of Agricultural Sciences, 49*(2), 211–216

108. Rojas, E. (2014). *Housing Policies, Quality of Housing and Urban Development. Lessons from the Latin American Experience 1960-2010*.

109. Roske, M. D. (1983). *Housing in Transition*. New York: Holt, Rinehart and Winston.

110. Salleh, N. A., Yusof, N., Salleh, A. G., & Johari, N. (2011). Tenant Satisfaction in Public Housing and its Relationship with Rent Arrears: Majlis Bandaraya Ipoh, Perak, Malaysia. *International Journal of Trade, Economics and Finance*, 10–18. doi: 10.7763/ijtef.2011.v2.72

111. Schultz, F., Castelló, I., & Morsing, M. (2013). The construction of corporate social responsibility in network societies: A communication view. *Journal of business ethics, 115*(4), 681-692.

112. Shi, L. (2005). *Housing preferences of residents in Stellenbosch, South Africa*. Retrieved from https://core.ac.uk/download/pdf/37322137.pdf

Analyzing Variables in Wheel of Participation a Synergy in Facilities Management for Enhancing Academic Performance

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Abstract. This study analyzed variables in the wheel of participation advocated by Davidson (1998); in this study, wheel of participation is adopted as synergy in facilities management for the maintenance of university community infrastructure and facilities, to examine the effects of synergy by the local community and the university authority in facilities management for enhancing academic performance in Abubakar Tafawa Balewa University, Bauchi (ATBU). 100 questionnaires composed on 5 level-Linkert scales were randomly distributed, Reliability analysis was conducted to check the level of internal consistency among the measuring items, while Multiple Regression Analysis and Structural Equation Modelling with AMOS simultaneously analyzed the effects of the exogenous variables (information, consultation, participation & empowerment) on the endogenous variable (academic excellence) in ATBU. Estimates of the structural model revealed that information sharing, consultation with stakeholders, participation by local community members and empowering stakeholders do not influence academic excellence. While the regression analysis indicated a weak relationship between all the four predictor variables and the academic excellence; and with R^2 of 0.029 meant that the predictor variables accounted for only 2.9 % of the variance on academic excellence, thus, 97.1 % is accounted for by other variables not covered in this study. Further studies are recommended to supplement more predictor variables like students´ talent, intuition, flair, willingness to learn (zeal), finance and so on; using the inductive approach.

Keywords: Wheel of Participation; Facilities Management; Academic Performance.

INTRODUCTION

A complementary relationship exists between the existing university facilities and quality of academic performance, as in [4] that the physical environment of the academic institution can determine academic success; authors [15] posited that aging building facilities constitute a great hindrance to efficient teaching and learning. This study analyzed variables in the wheel of participation advocated by Davidson in 1998 [9]; in this study, wheel of participation is adopted as synergy in facilities management for the maintenance of university community infrastructure and facilities, to examine the effects of synergy by the local community and the university authority in facilities management for enhancing academic performance in Abubakar Tafawa Balewa University, Bauchi (ATBU). According to Rogers and Robinsons (2004) cited in [14], Community engagement is a holistic approach that establishes a flatform whereby public service providers and community members will partake a roll in decision making on ways to provide optimum services to the community.

The synergy between the university community and the authority in decision making on project construction and system maintenance will integrate users to have facilities at heart; authors [20] outlined that understanding project goals, monitoring, controlling, solving problems and

proper allocation of resources is very crucial, these are necessary to extend the life span of school facilities to support teaching and learning, as students can be seen as customers who receive service in an academic institution, effective provision, and maintenance of facilities in schools can inevitably enhance students´ care and general welfare, thereby boosting students´ performance; this assertion is supported by [3] wherein a proposition, Alexander classified customers as an integral part of an organization whose care and welfare can improve organizational (school) effectiveness.

LITERATURE REVIEW

In the United Kingdom, the Town and Country Planning Act of 1947 has some elements of public participation, it was made official in 1968 mainly in the planning process which entailed the development control process and development plan process [14]. The degree of participation and who should participate should be defined, on the bases of Arnstein's Ladder of participation, author [22] advocates five levels of participation (Figure 1), in the area of sharing information, regular consultation, taking the right decision together, acting together and supports to community initiatives. Low level of participation leads to the poor commitment from the sides of the government as a service and facility provider, and also a poor commitment by other stakeholders.

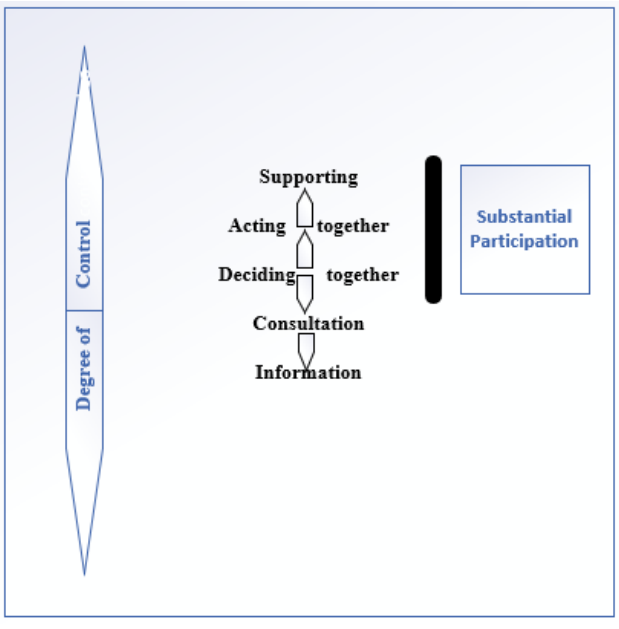

Figure 1 – Level of Participation

Notes: adopted by [22]

The hierarchy of stakeholders usually starts from the politicians who initiate; down to the management bodies at federal, states and municipal levels (these are trained officers that provide and maintains services and facilities); other stakeholders are residents and occupiers of business premises; however, to avoid hierarchical conflicts whereby stakeholders will meddle into the defined line of duty of other stakeholders, level of participation must be spelled out to local community members, as advocated by [22]. Author [14] has advocated for community engagement at the level of the decision-making process, and featured a model of participation developed by Davidson in 1998, which outlined four major headings for community engagement titled the wheel of participation shown in Figure 2.

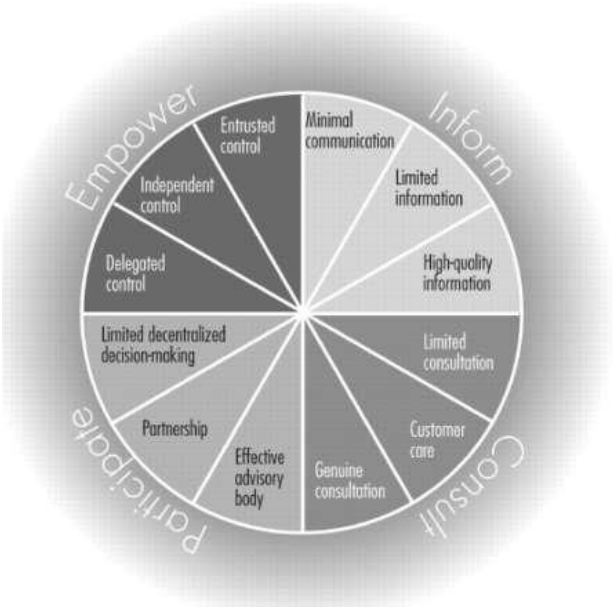

Figure 2 – The wheel of participation [14]

The headings in Figure 2; information, consultation, participation, and empowerment are the exogenous variables, with their corresponding sub-themes illustrated in Table 1. The sub-themes were construed to form the measurement items in the questionnaire.

The endogenous variable (academic performance) has ten (10) measurement items sourced from different articles relevant to facilities management as they relate or play some roles in student's academic performance; these are shown in Table 2 below.

Table 1 – Themes and sub-themes in Davidson's wheel of participation

No	Themes / Main Variables	Sub-themes	Goals
1	Information	Minimal Communication	Make all stakeholders well informed on existing problems & solutions.
2		Limited Information	
3		High-Quality Information	
4	Consultation	Limited Consultation	Envisaged feedback, acknowledge concerns & reciprocate to community on the impact of their inputs.
5		Customer Care	
6		Genuine Consultation	
7	Participation	Limited Decentralized Decision Making	Work with the public groups putting their concerns & aspirations at the fore.
8		Partnership	
9		Effective Advisory Body	
10	Empowerment	Entrusted Control	Acting for the public and implement public decision first
11		Independent Control	
12		Delegated Control	

Table 2 – Sources of Items for the Endogenous Variable (academic performance)

No	Measurement Items	Source
1	Sport	[4]
2	Room space (hostel)	[10]
3	Garden	[4]
4	Healthcare	[10], [4]
5	Sanitation	[6]
6	Streetlight (security)	[6]
7	Security	[10], [6], [4] & [15]
8	Ict	[4]
9	Food (canteen)	[5]
10	Library (Reading space)	[19]

Authors [11] posited a supplement to the wheel of participation called collaboration, in it, a room for partnership with the public was provided, to work in the area of developing more alternatives and identification of solutions; the collaboration posited here, strengthens a strong synergy of partnership for innovations in addressing community problems and considering local advice at the fore. Table 3 explicitly shows the working tools at every level of community engagement; each of the five levels inevitably has direct interaction with the public, for instance at information level there are information sessions; at consultation level, there are focus group and surveys; at involvement level, there are workshops; while at collaboration level there are citizen committees and at empowerment level, there are citizen juries and delegated decisions.

Table 3 – Identification of Tools for Synergy in Facilities Management

No	Major Variables	Working Tools
1	Inform	Fact sheets. Websites. Information sessions.
2	Consult	Focus group. Surveys.
3	Involve	Workshops. Deliberate polling.
4	Collaborate	Citizen committees. Concensus building. Participatory decision making.
5	Empower	Citizen juries. Ballots. Delegated decisions.

Adapted by [11]

The goal of each level can be achieved by exploring the working tools corresponding to the level so that an individual member is incorporated to express his/her view in facility provision and management. The five levels of participation according to [16] can start from the lowest to the highest degree of participation as shown in Figure 3.

James D. Wolfensohn, (World Bank President) buttressed the notion of participation in his statement in 1996 that working together and empowering stakeholders especially the poor, beyond just sharing information and consultation to decision-making; this was also posited by [19], but J. D. Wolfensohn went further to entrusts the ownership of community facilities in the hands of all stakeholders; thus, this sense of ownership is essential to the goal of sustainable development [17]. Though, public participation in facilities development and maintenance, as well as environmental management, entails political issues with international concern since 1992 when the UNCED enshrined public participation in Agenda

21 as a stride toward sustainable development [17]. The integration of different interests and opinions as well as enhancing development incorporating local knowledge are some of the advantages of participation, however, this is not without corresponding disadvantage, a major risk in participation is that it consumes time and is expensive [17].

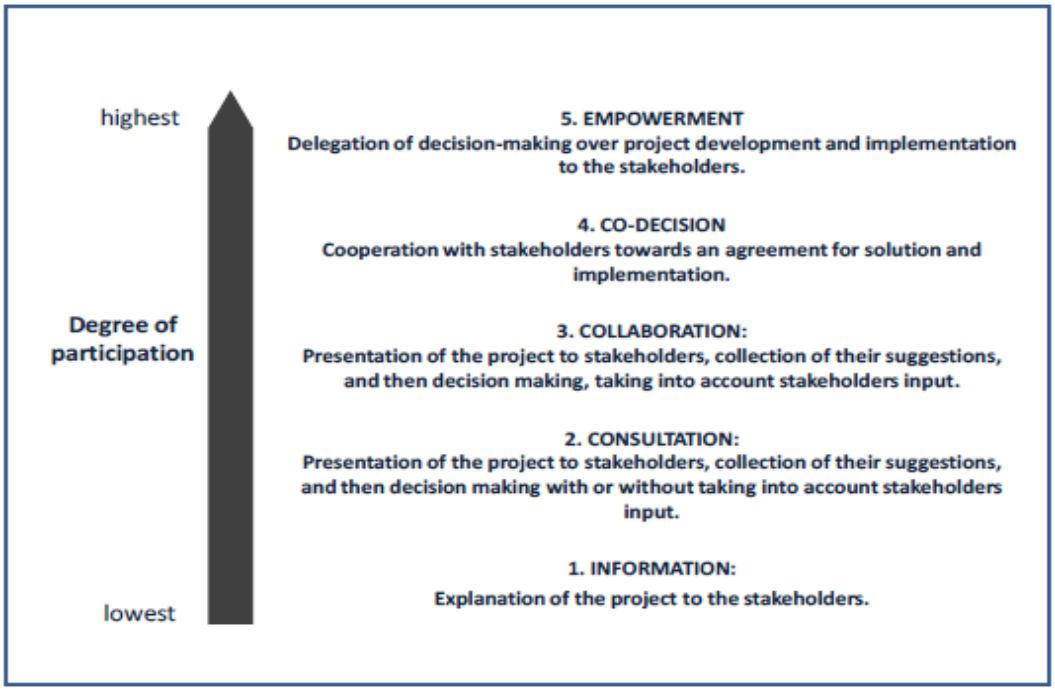

Figure 3 – Degree of Participation [16]

MATERIALS AND METHOD

The study analyzed variables of public participation reported in the wheel of participation, each of the 4 variables (exogenous variables) was accompanied with 3 sub-variables (Figure 2); furthermore, the same wheel of participation adopted by [8] illuminated more on each sub-variable and was further used to develop the measurement items in the questionnaire; the sources of measurement items for the endogenous variable (academic performance) was reported in Table 2. The questionnaire was composed on a 5 level-Linkert scale, randomly distributed. Simple random sampling was adopted because the sample frame was accurate and easily accessible using a random number table, thus, 100 questionnaires were distributed at the ATBU Yelwa campus in Bauchi. Reliability analysis was conducted to check the level of consistency in the measuring items, while Multiple Regression and SEM with AMOS simultaneously analyzed the effects of the exogenous variables (information, consultation, participation & empowerment) on the endogenous variable (academic excellence) in ATBU. The hunch of hypotheses was given in Table 4.

Table 4 – Reliability Analysis

No	Exogenous and Endogenous Constructs	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	Measurement Items / Construct
1	Information	0.965	0.968	6
2	Consultation	0.952	0.956	6
3	Participation	0.889	0.890	6
4	Empowerment	0.915	0.925	6
5	Academic Performance	0.880	0.878	10
Total				34

The study consists of four exogenous (independent variables) derived from [9] which was cited in [14]; the aim is to test the derived theories on the endogenous (dependent variable) academic performance, whose notion came as a result of the poor condition of students´ lavatories and other facilities in the university. The analysis involved six items of measurement for each exogenous variable and ten items for the endogenous variable (Table 4), the five constructs were subjected to reliability analysis using Cronbach's Al-

pha. This is necessary to check the level of internal consistency between the items under each variable, in [13, 14, 18] alpha value from 0.7 to 0.95 depicts good internal consistency of items.

The confirmatory factor analysis shown in Figure 4, has partially achieved good fitness indexes given that AGFI and GFI have values as low as 0.671 and 0.728 respectively. In Chau & Hu, 2001; Hair et al., 2010 cited in [1] that for AGFI and GFI value > 0.80 was accepted, these are still lower than the threshold value. CFI at 0.906 has achieved absolute fitness [5]; NFI and TLI with 0.822 and 0.894 respectively are can be acceptable. While RMSEA at 0.091 is acceptable, according to [2] a model could be considered weak when RMSEA was greater than 1.0; also in Browne et al., 1993 cited in [1] that RMSEA at less than 0.10 was acceptable; and Chi/Sq/df at 1.906 < 3.00 is accepted, while in [21] ChiSq/df is required at less than 5.0.

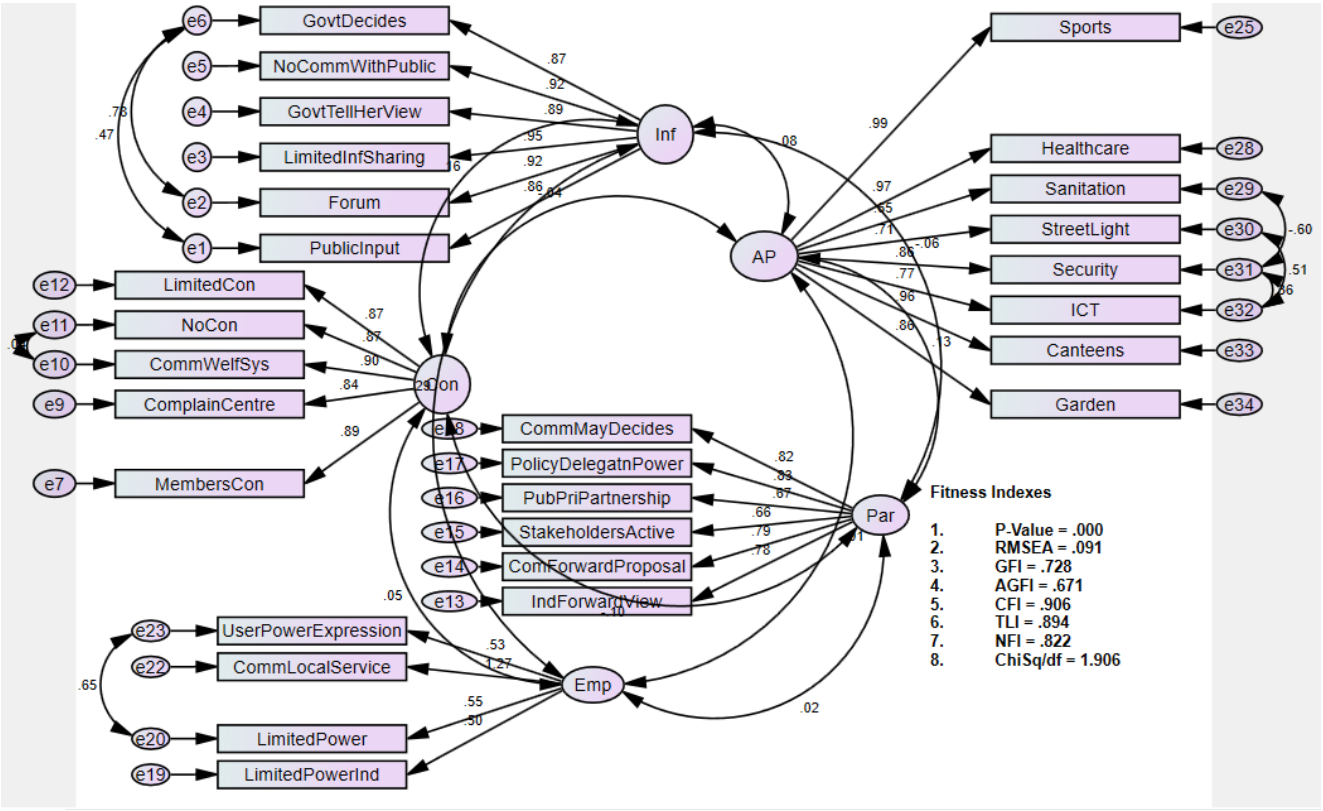

Figure 4 – The Confirmatory Factor Analysis (Measurement Model)

The structural model. The structural model indicates the extent to which a given variable influence another variable [7]. The structural model in Figure 5 below is an improvement from the measurement model in Figure 4. The model on Figure 5 indicated how the predictor variables influenced the dependent variable, the links between the latent unobserved variables are single-headed arrows pointing towards the dependent variable [7, 5]; and provided a means for testing the hunch of the hypotheses formulated according to the latent unobserved constructs. The factor loadings for each measurement item under each variable are well above 0.60 as required in the rule of thumb [5]; in the fitness indexes, GFI and AGFI have not satisfied the basic level of 0.90; RMSEA is slightly above 0.08 as required but according to [2] a model could be considered weak if RMSEA is greater than 1.0; also in (Browne et al., 1993 cited in [1] that RMSEA at less than 0.10 is acceptable; NFI > 0.80 could be accepted as a recommended value for a good fit, as in Chau & Hu, 2001; Hair et al., 2010 cited in [1]; CFI and TLI are already well above 0.90 (Figure 5), and with good factor loadings the model can be upheld.

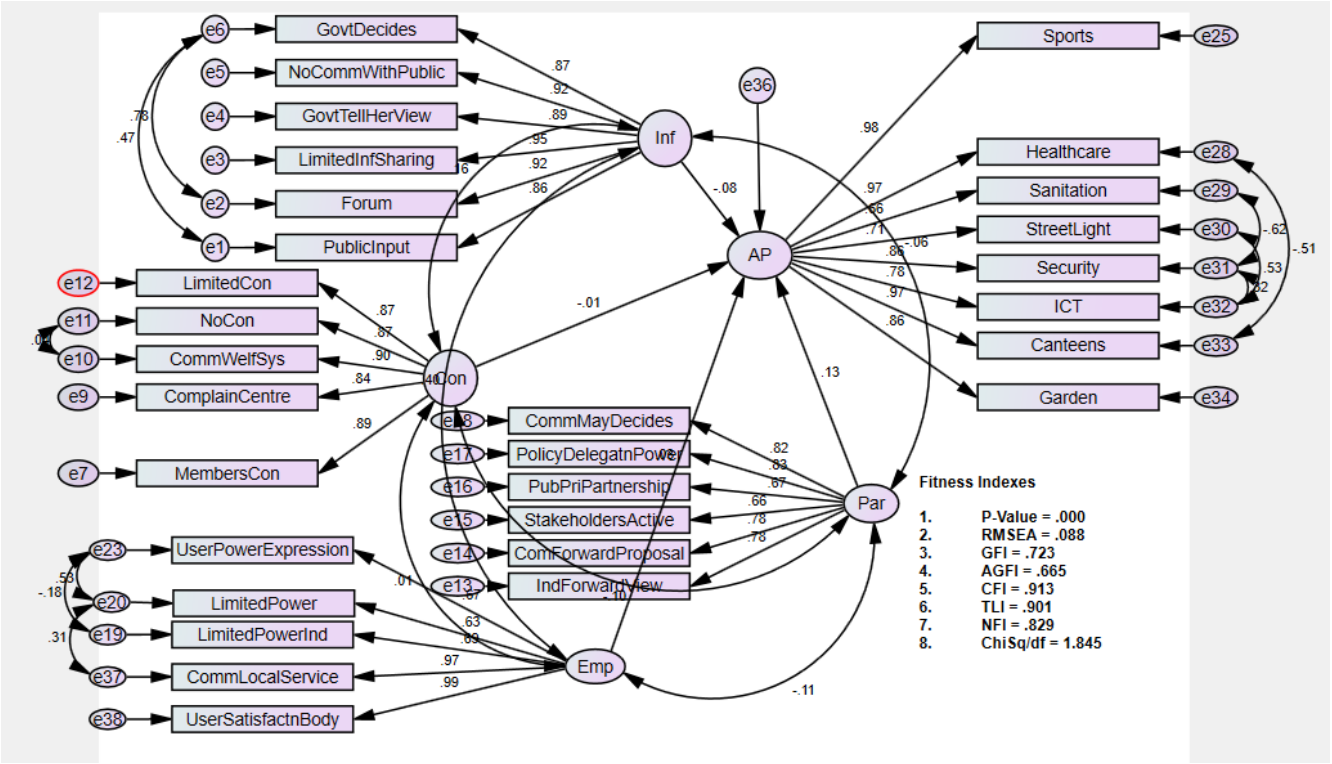

Figure 5 – Structural Model

The analysis of the influence of the exogenous variables against the endogenous variable in Figure 5 above paved the way to reject or fail to reject the statement of hypotheses formulated between the variables. In Table 5 below, the P-Values are above 0.05 which is at 95% confidence interval and reveals that the four exogenous variables do not influence the endogenous variable based on the empirical data collected and analyzed in the study area.

Table 5 – Estimates for the Structural Model

Path	Unstandardized Estimates	Standard Error	Critical Ratio	P-Value	Remark
Inf Inf AP	-0.077	0.104	-0.740	0.459	Rejected
Con AP	-0.006	0.098	-0.059	0.953	Rejected
Emp AP	0.029	0.107	0.266	0.790	Rejected
Par AP	0.129	0.100	1.288	0.198	Rejected

The estimates from the results, therefore, answered the hypotheses. H1 in Table 5 provides an answer to the proposition that assumes information sharing with students on school facilities management can enhance students´ academic performance in ATBU Bauchi; with P-Value 0.459 > 0.05 means the hypothesis is not supported.

In H2 measures whether Consultation with students on school facilities management can enhance students´ academic performance in ATBU Bauchi; but with P-Value 0.953 > 0.05 means the hypothesis is not supported.

The third hypothesis that empowering students some control on school facilities management can enhance academic performance, the estimates in Table 5 reports a P-Value of 0.790 thus, not supported.

The fourth hypothesis that engaging students to participate in school facilities management can enhance their academic performance is equally repudiated with P-Value 0.198 > 0.05 (Table 5). The result of the hypothesis testing was given in Table 6.

The Model Summary on Table 7 shows that R with a value of 0.170 (17 %) indicated a weak correlation between all the exogenous variables and the endogenous variable, and the R^2 of 0.029 meant that the exogenous variables explained or predicted just 2.9 % of the variance in the endogenous variable (Table 7). In other words, all the predictors could only account for 2.9 % of the variance in academic performance, and 97.1 % might be predicted by other variables not covered in this study.

Table 6 – Hypothesis Testing

No	Hypothesis	Results
H1	Information sharing with students on school facilities management can enhance Academic Performance	Not supported
H2	Consultation with students on school facilities management can enhance Academic Performance	Not supported
H3	Empowering students some control on school facilities management can enhance Academic Performance	Not supported
H4	Engaging students to participate in school facilities management can enhance Academic Performance.	Not supported

The model summary in Table 8 reports the individual effect of each exogenous (predictor) variable on the endogenous variable. On the R column, it can be discerned that all the predictors depict weak correlation with the dependent variable (academic performance); only participation correlates with 11.8 % which is very weak. The R Square column depicts very insignificant influence by each predictor (Table 8), and apparently, the last column testified to that. These results reflect the structural equation modeling analysis presented in Tables 5 and 6 above.

Table 7 – Cumulative Model Summary showing effects on the Endogenous variable

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.170a	.029	-.008	.84967	.029	.779	4	105	.541

Notes: a) Predictors: (Constant), Empowerment, Consultation, Participation, Information

Table 8 – Model Summary of Individual Predictor Variables

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1 Information	.078a	.006	-.003	.84752	.006	.668	1	108	.415
Consultation	.003a	.000	-.009	.85013	.000	.001	1	108	.976
Participation	.118a	.014	.005	.84421	.014	1.522	1	108	.220
Empowerment	.055a	.003	-.006	.84886	.003	.324	1	108	.570

CONCLUSIONS

The estimates of the structural model revealed that the exogenous variables (information, consultation, participation, and empowerment) do not influence the endogenous variable (academic excellence) based on the empirical data collected and analyzed in the study area, as none of the P-values falls within the acceptable region of less than 0.05. In the regression analysis, the R column with a value of 0.170 (17 %) indicated a weak correlation between all the predictor variables and the dependent variable; and the R^2 of 0.029 meant that the predictor variables explained or accounted for only 2.9% of the variance in the dependent variable. In other words, all the predictors could only account for 2.9% of the variance in academic performance, and 97.1 % is predicted or accounted for by other variables not covered in this study. The individual effect of each exogenous (predictor) variables on academic excellence (Table 8) shows in the R column all the predictors depicts weak correlation with the dependent variable (academic performance); while the R Square and the P-value both depict very insignificant influence by each predictor. Further studies are recommended to supplement more predictor variables like students´ talent, intuition, flair, willingness to learn (zeal), finance and so on; using the inductive approach.

REFERENCES

1. Akinyode, B. F. (2016). The Use of Structural Equation Modelling (SEM) in Built Environment Disciplines. *Research on Humanities and Social Sciences, 6*(6), 109–120.
2. Alavifar, A., Karimimalayer, M., & Anuar, M. (2012). Structural Equation Modeling Vs Multiple Regression. *Engineering Science and Technology, 2*(2), 326–329.
3. Alexander, K. (2016). *Facilities Management: Theory and Practice*. London: Routledge.
4. Asiabaka, I. P. (2008). The Need for Effective facility Management in Schools in Nigeria. *New New York Science Journal, 4*(8), 10–21.
5. Awang, Z. (2014). *A handbook on Structural Equation Modeling*. Selangor, MPWS Rich Resources.
6. Booty, F. (2009). *Facilities Management Handbook* (4th ed.). Oxford: Butterworth-Heinemann.
7. Byrne, B. M. (2010). *Structural Equation Modeling with Amos: Basic Concepts, Applications, and Programming* (2nd ed.). New York: Routledge.
8. Carter, C. (2006). *Environmental Governance: The Power and Pitfalls of Participatory Processes*. Retrieved from https://www.semanticscholar.org/paper/Environmental-Governance-%3A-The-Power-and-Pitfalls-Carter/47f808d142bcab669b1fb516baa2fb97dcbcfcd3
9. Davidson, S. (1998). Spinning the Wheel of Empowerment. *Planning, 3*, 14–15.
10. Douglas Omoregie, A., Oluwaseyi Alabi, A., Ayodeji Emmanuel, O., … Emmanuel Imuetinyan, A. (2018). Stakeholders' Perception of Sustainability in Educational Buildings in Nigeria. *International Journal of Sustainable Construction Engineering Technology, 9*(1). doi: 10.30880/ijscet.2018.09.01.001
11. Facility Management Association of Australia. (2012). *Facilities Management Good Practice Guide*. Retrieved from https://www.ocn.org.au/sites/default/files/documents/Facilities%20Management%20Good%20Practice%20Guide%202012.pdf
12. Gençtürk, E., Gökçek, T., & Güneş, G. (2010). Reliability and validity study of the technology proficiency self-assessment scale. *Procedia - Social and Behavioral Sciences, 2*(2), 2863–2867. doi: 10.1016/j.sbspro.2010.03.429
13. Gliem, J. A., & Gliem, R. R. (2003). *Calculating, interpreting, and reporting Cronbach's alpha reliability coefficient for Likert-type Scales*. Retrieved from https://scholarworks.iupui.edu/bitstream/handle/1805/344/Gliem%20%26%20Gliem.pdf?sequence=1&isAllowed=y
14. Kasim, R. (2011). *Community- based Facilities management: Theory and Practice*. Batu Pahat: Penerbit UTHM.
15. Lunenburg, F. C. (2010). *School Facilities Management. National Forum of Educational Administration & Supervision Journal, 27*(4), 1–7.
16. Luyet, V., Schlaepfer, R., Parlange, M. B., & Buttler, A. (2012). A framework to implement Stakeholder participation in environmental projects. *Journal of Environmental Management, 111*, 213–219. doi: 10.1016/j.jenvman.2012.06.026
17. Schroeder, P.M. (2013, October). *Specific Operational Mechanisms and Practices for Public Participation in Environmental Planning and Assessments*. Retrieved from http://en.chinagate.cn/archives/egp/2015-07/28/content_36168098.htm
18. Tavakol, M. & Dennick, R. (2011). Making Sense of Cronbach's Alpha. *International Journal of Medical Education, 2*, 53–55. doi: 10.5116/ijme.4dfb.8dfd
19. Then, D. S., Jones, K. & Hinks, J. (Eds.). (2004). *Facilities Management and Maintenance. Human Elements in Facilities Management*. Proceedings of the CIBW70 2004 Hong Kong International Symposium. Retrieved from https://www.irbnet.de/daten/iconda/cib294.pdf

20. Wai, S. H., Yusof, A. M., Ismail, S., & Tey, K. H. (2012). *Critical Success Factors for Sustainable Building in Malaysia*. Retrieved from http://www.ipedr.com/vol45/025-ICMTS2012-M00025.pdf

21. Wan Afthanorhan, W. (2014). Modeling the Multiple Indirect Effects among Latent Constructs by using Structural Equation Modeling: Volunteerism Program. *International Journal of Advances in Applied Sciences, 3*(1), 25–32.

22. Wilcox, D. (1994). *The Guide to Effective Participation Book*. Retrieved from http://www.partnerships.org.uk/guide/main1.html

Effect of Locust Bean Pod Ash and Eggshell Ash on the Mortar Compressive and Flexural Strengths of Cement Blends

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Abstract. An increase in the generation of biogenic wastes such as locust bean pods and eggshells coupled with the need to drive sustainability in the cement industry has led the use of these wastes as cement replacement materials. The paper aims to investigate the effect of locust bean pod ash (LBPA) and eggshell ash (ESA) on the mortar compressive and flexural strength of ternary cement blends. The LBPA was obtained by calcining locust bean pod (LBP) at various temperatures of 800-900 °C and time of 60–120 minutes at an interval of 50 °C and 30 minutes respectively to determine the optimal conditions. The chemical composition of Ordinary Portland cement (OPC), LBPA and ESA were obtained via X-ray Fluorescence (XRF) Spectrometer and LBPA chemical composition did not satisfy one of the requirements specified by ASTM C618-01 (2001) with SiO_2+ Al_2O_3+Fe_2O_3 of 30.42 wt. % which is less than 50 wt. %, but satisfies SO_3 content requirement of 0.7 wt. % and Loss on Ignition (LOI) of 7.12 wt. % and contains 19.42 wt. % CaO which is within the range of 10-30 wt. % CaO is class C pozzolan. The compressive strength of blended cement mortars at the early age of 2 and 7 days produced better strengths for cement blends with higher ESA content than LBPA especially at LBPA/LBPA-ESA ratio of 0, 0.4 and 0.6 for 2.5 wt. % cement replacement respectively. The early strength gain could be attributed to the provision of more nucleation sites by ESA inclusion which results in the acceleration of cement hydration rate. On the other hand, the enhanced strengths at 28 days of cement blended with various replacement from 2.5–10 wt. % could be attributed to the pozzolanic reaction between the available lime and reactive silica from LBPA despite clinker diminution which was close to control. Another reason for enhanced strength' could be attributed to the increased potassium content by an increase in LBPA content resulting in a gradual strength gain (retarder) muscovite formation $K_2Al_2Si_6Al_4O_{20}(OH)_4$. All cement blends experienced an increase in the mortar compressive and flexural strengths as the curing day progressed with some blends producing enhanced strength compared to control especially with 1.5 ESA1LBPA produced the best strength at 50.15 (6.82) N/mm^2 against 48.80 (6.80) N/mm^2. This enhanced strength could be related to the pozzolanic activity and the high potassium content from LBPA despite clinker diminution, especially at 28 days.

Keywords: Locust Bean Pod Ash; Eggshell Ash; Compressive Strength; Flexural Strength Pozzolan; Flexural Strength; Cement blends.

INTRODUCTION

The demand for cement arising from inadequate housing coupled with the need to solve the problem of release of CO_2 leading to the greenhouse effect and an enormous amount of energy is required for cement production. Cement is a widely employed construction material owing to its stability and flexibility in designs of building structures with advantages ranging from built-in fire resistance, high compressive strength to low maintenance [31]. One alternative solution to these challenges is the partial replacement of cement by appropriate materials such as pozzolans. These pozzolanic materials are siliceous or aluminous materials that themselves have lit-

tle or no cementitious properties but when in finely divided form and the presence of moisture reacts with $CaOH_2$ which is liberated during cement hydration at ordinary temperature to form more cementitious materials according to [7]. Pozzolan possesses the characteristics of reacting with free lime released during cement hydration to form stable insoluble calcium silicates to reduce sulfate, salt and chloride attacks [22]. Researches in cement and concrete technology have concentrated on the use of waste materials as a potential replacement as alternatives for cement in the concrete industry and the need to introduce new materials or recycled materials as cement replacement materials are gaining popularity and as a result of increasingly stringent environmental legislation [2]. Pozzolanic activity of a material can be assessed by the ability of the material to react with $Ca(OH)_2(CH)$ by monitoring the consumption of CH or measuring the strength development. The pozzolan influence is dependent on the quality and quantity of active phases in the pozzolan [10].

Agricultural wastes generated from poultry farms, bakeries, confectioneries, and restaurants which can cause environmental pollution, if not properly disposed of. The increasing demand for cement can address the problem of dumping waste and drive sustainability via the proper utilization or recycling of these biogenic wastes such as eggshell ash. Eggshell ash is byproducts of agricultural wastes obtained from the calcination of eggshell powder at 500 °C to produce calcium oxide which has shown according to [20] that it is a good accelerator, thereby decreasing the setting time of cement [14]. Eggshell is composed of mostly 93.7 % of calcium carbonates and other constituents like phosphates and magnesium which is similar to limestone, thus can be employed as a partial cement replacement material [2, 23]. Authors [20] investigated the effect of ESA from 0–2.5 wt. % at an interval of 0.5 wt. % on setting time of cement blend and observed that setting was accelerated as the ESA content was increased. They also observed that percentage reduction from 1.4–32 wt. % and 2.83–34 wt. % for the initial and final setting times respectively as cement is replaced with the ESA content from 0-2.5 wt. %. Authors [19] investigated the effect of ESA for cement replacement from 5–30 wt. % at an interval of 5 wt. % on the concrete compressive strength and found that 10 wt. % ESA cement blend produced an enhanced strength of 32.36 % and 23.43 % for 7 and 28 days compared with control. Authors [9] also investigated the replacement of cement with ESA from 1–5 wt. % at an interval of 1 wt. % and observed a similar trend of accelerated setting time as the ESA content was increased. It was also concluded that up to 3 wt. % cement replacement with ESA produced a better strength compared with control. Authors [14] investigated the feasibility and viability of employing ESA and its effects on the water consistency and setting time of cement blend and It was seen that both setting time of the cement blended with ESA was shortened as the ESA content was increased from 0–2 wt. % at an interval of 0.5 wt. %.

Locust bean pod husks are byproducts of agricultural wastes obtained from locust bean trees which are deciduous trees mostly grown and harvested in the Sub-Sahara Africa region as well as the Northern part of Nigeria [1]. The improper disposal of various agricultural waste such as rice husk, groundnut husk, corn cob, and locust beans is an environmental concern and thus, the necessity to convert these waste to useful materials since many calcined agricultural wastes are rich in amorphous silica such as rice husk ash, coal bottom ash, fly ash, groundnut shell ash, etc. [13, 15, 18, 24, 26]. These biomasses could be employed as partial cement replacement materials due to their potentials of enhancing the strength of cement blends despite clinker diminution as a result of the reaction of amorphous silica with available lime from ordinary cement hydration [18, 24]. Authors [3] investigated the replacement of cement with up to 50 wt. % LBWA at an interval of 5 wt. % on the concrete strength and observed that an increase in the strength as the curing day progressed from 2 to 28 days for all cement blends with a higher strength value obtained at 28 days. The general trend was that the concrete compressive strength diminished steadily as the % LBWA was gradually increased with cement replacement not up to 10 wt. % providing the targeted concrete compressive strength of 20 N/mm^2. Authors [5] studied the use of LBWA as partial cement replacement in concrete structures and observed that as the cement replacement with LBWA led to a decrease in the concrete strength for grade 20, 25 and 30 with an increase in strengths as the curing days progressed. It also observed that beyond 10 wt. % cement replacement with LBWA, the concrete compressive strength at 28 days for grades 20, 25 and 30 were 22.33, 24.38 and 24.22 N/mm^2 respectively. Authors [4] investigated the effect of replacing LBPA on the setting times and ob-

served that as the LBPA content increased up to 30%, the initial and final setting time experienced retardation by 66.8 % and 39.7 % respectively while LBPA cement blends beyond 15 wt. % resulted in a decrease in its concrete compressive strength in a decrease in its concrete compressive strength while the concrete mix workability diminished as the LBPA content was increased. The enhanced compressive strength of 15 wt. % LBPA cement blend agreed with results from SEM – EDS and XRD which indicated Calcium Silicate Hydrate (C-S-H) gel compared to other samples. They also suggested that the nature of the LBPA in terms of the crystalline or amorphous influenced the setting time which was dependent on the process of obtaining the ash. Authors [17] observed that 7 days' strength of control was better than LBPA cement mortar since the hydration rate of OPC was more rapid compared with LBPA cement blends while the cement replacement with up to 12 wt. % LBPA produces similar compressive strength in comparison with control. Authors [21] investigated the effect of replacing cement with LBPA between 0–25 wt. % at a 5 wt. % interval and observed a decrease in the compressive strength by 46 % as the LBPA was increased up to 25 wt. % while 5 wt. % LBPA cement blend produced similar strength to control. Authors [32] indicated that as the concentration of KCl was increased from 0–14 g/l, the concrete compressive strength of the OPC concrete increased for all 28 and 90-days results. They suggested that the probable chemical reaction for the hydration of cement with K concentration is the reason for the retardation of the setting time attributed to the formation of muscovite. $K_2Al_2Si_6Al_4O_{20}(OH)_4$ and the large size of potassium ions involved in the crystallization of muscovite leading to an increase in the void. Thus, the presence of K^+ ions results in retardation of the initial and final setting time.

MATERIALS

Superset cement CEM II A-L conforms to the NIS 444 standards obtained from Ashaka cement ltd, Gombe state. Eggshells were collected from chick hatcheries, bakeries, fast food joints and restaurants. The eggshell ash (ESA) was prepared by burning fowls' eggshells at a temperature of 500 °C for 1 hour to obtain complete ash while Locust bean pods (LBP) were collected from Badabdi community, Gombe state, Nigeria. The fine aggregate used was CEN-NORMSAND (DIN EN 196-1) which conforms to ISO 679 with a net weight of 1350±5g as standard sand. The distilled water was employed for mortar preparation and a well quantifiable amount for paste preparation. Water is needed for the hydration reaction of cement and also to make it workable during mixing. Table 1 indicates the chemical composition of OPC, LBPA, and ESA while Table 2 presents the chemical composition of the various locust bean pod ash calcined at 800, 850 and 900 °C at 1 and 2 hours respectively.

Table 1 – Chemical composition of Portland Cement, Locust bean pod ash and Eggshell ash

Oxides	OPC, wt. %	LBPA, wt. %	ESA, wt. %
SiO_2	23.87	9.48	0.19
Al_2O_3	7.87	2.00	0.54
Fe_2O_3	3.94	18.94	0.34
CaO	57.34	19.42	49.58
MgO	1.76	5.95	0.82
SO_3	1.05	0.70	0.51
K_2O	0.00	27.54	0.40
Na_2O	0.36	0.44	-
P_2O_5	-	7.71	-
Mn_2O_3	-	0.29	-
TiO_2	-	0.15	-
Cl	-	0.02	-
Cr_2O_3	-	0.04	-
SrO	-	0.14	-
LOI	3.81	7.19	47.62
$CaCO_3$			88.49
Sum of Conc.	100.00	100.00	100.00

Table 2 – Chemical composition of different calcination temperature and time of LBPA

Compounds	800 °C		850 °C		900 °C	
	1 hr.	2 hrs.	1 hr.	2 hrs.	1 hr.	2hrs.
SiO_2	6.66	6.48	9.48	9.43	9.44	9.69
Al_2O_3	3.28	3.34	2.00	2.98	1.90	1.73
Fe_2O_3	19.71	19.48	18.94	17.79	17.74	17.09
CaO	18.37	18.33	19.42	18.58	18.40	18.19
MgO	6.50	6.50	5.95	5.77	7.28	7.29
SO_3	1.89	1.86	0.70	1.47	0.67	0.66
K_2O	26.42	26.39	27.54	27.75	26.44	27.39
Na_2O	1.47	1.47	0.44	0.50	0.43	0.33
P_2O_5	7.95	7.83	7.71	7.59	8.16	7.58
Mn_2O_3	2.82	2.83	0.29	0.28	0.31	0.29
TiO_2	0.06	0.07	0.15	0.15	0.21	0.15
Cl	0.02	0.03	0.02	0.03	0.04	0.03
Cr_2O_3	0.06	0.08	0.04	0.04	0.05	0.04
SrO	0.19	0.15	0.14	0.15	0.15	0.15
LOI	4.61	5.16	7.19	7.50	8.79	9.40
Sum Total	100	100	100	100	100	100

PROCEDURE

The locust bean pods were dried under the sun for three days, crushed to about 0.5 mm size using the jaw crusher and then burnt locally using charcoal-burner though the pod was not allowed to make contact with the charcoal. Ten grams (10 g) of the initially burnt locust beans sample were weighed and then placed in an electric furnace. The samples were then calcined at different temperatures (800 °C, 850 °C & 900 °C) for 1 hour & 2 hours respectively to obtain the optimum temperature and time. Eggshells obtained from bakeries were sorted, sun-dried and crushed with a mortar and pestle. The ground eggshell powder was then calcined at a temperature of 500 °C at 1 hr. The resultant ashes from the calcination of the locust bean and eggshell powder were analyzed via a fused bead machine for the oxide analysis. One-gram (1 g) of the samples to be analyzed were weighed into a clean dry platinum crucible and 8 grams of X-ray flux (Granular) type Lithium tetraborate 66 % and lithium metaborate 34 % was weighed and mixed thoroughly with the sample. 1 ml of 25 % LiBr solution using a 1ml pipette was added to avoid the sample from sticking to the platinum crucible. The prepared samples were then placed in VFD 4000 Fused Bead Machine and the machine was set ON for the process to begin. The beads were well labeled for proper identification and then ran through the XRF spectrometer on a reference curve program and the results were obtained. The ash content was purely obtained and the percentage loss was calculated for each of the heated samples and the optimum condition was determined at 850 °C for 1 hour.

Mortar compressive strengths of various cement blends were determined by compressive strength tests on mortar cubes compacted using a standard vibration machine. Standard sand was used for the preparation of cement mortar with the specimens set in 70.6 mm cubes (EN 196-1). The compressive strength tests of mortar samples were determined according to ASTM specification C39 after 2, 7 and 28 days of standard curing. The test specimens are stored in moist air climatic chamber at 20 °C for 24 hours, after which it was removed, marked and submerged into clear fresh water at 20±2 °C until curing days at 2, 7 and 28 days. The water for curing was monitored daily to maintain the temperature as specified. The flexural strength tests were achieved by performing a surface point test on the prism by EN 1052-2 by applying load horizontally on the prism by a hydraulic jack. The pictures of dried eggshell, standard sand, eggshell ash, locust bean pod ash are shown in Figures 1–4 respectively.

Experimental Design Mix. The experimental matrix for LBPA-ESA cement blends with cement replacement between 0-10 wt. % is presented in Table 3. Resource [6] standard mix ratio of mortar cubes which can be employed for internal walls and surfaces of great importance was adopted for this study. A water/cement ratio of 0.4 was employed in molding mortar cubes comprising of ESA of 2.5 wt. %, 5 wt. %, 7.5 wt. % and 10 wt. % which was gradually replaced with LBPA for different mixes.

Figure 1 – Dried Eggshell

Figure 2 – Standard Sand EN 196-1

Figure 3 – Eggshell Ash

Figure 4 – Locust Beans Pod Ash

RESULTS AND DISCUSSION

The chemical composition obtained from the XRF analysis of OPC, LBPA, and ESA were presented in Table 1. The percentage of reactive silicates content of CEM II A-L 42.5 N contains 23.87 wt. % which is higher than 9.48 wt. % for LBPA. The results of the chemical composition of LBPA indicates that it does not satisfy most requirements specified by [8] with 30.41 wt.% of SiO_2+Al_2O_3+Fe_2O_3 which is less than 50 wt.% but satisfies the other requirements such as SO_3 content of 0.7 wt. % which is less than the maximum of 5 wt. % and LOI of 7.12 wt. %, it contains 19.42 wt. % CaO which is within the range of 10–30 wt. % CaO which fall into class C pozzolan. A similar trend was observed for [16] but obtained a lower SiO_2+Al_2O_3+Fe_2O_3 content of 25 wt. %. The XRF analysis of the calcined eggshell (ESA) reveals a high amount of CaO of 49.58 wt. % ($CaCO_3$ 88.49 wt. %) along with minute quantities of SiO_2, Al_2O_3, Fe_2O_3, MgO, SO_3, K_2O and Na_2O below 1 wt. % while ESA LOI was 47.62 wt. % which was high indicating the presence of non- decomposed limestone.

Author [33] revealed that eggshell was mainly composed of 93.70 wt. % calcium carbonate, 4.20 wt. % organic matter, 1.30 wt. % magnesium carbonate, and 0.8 wt. % of calcium phosphate. According to authors [30], the decomposition of $CaCO_3$ to CaO (lime) was evident at about 820 °C in which $CaCO_3$ is the main constituent and at 500 °C, the weight loss of the calcined ESP could be due to dehydration of water and loss of organic matter to produce ESA.

Table 3 – Experimental Matrix for the various cement blends

No	Blends	LBPA / LBPA ESA	ESA, wt. %	LBPA, wt. %	OPC, wt. %	ESA, g	LBPA, g	OPC, g
1	0ESA0LBPA	0	0	0	100	0	0	500
2	2.5ESA	0	2.5	0	97.5	12.5	0	487.5
3	2ESA0.5LBPA	0.2	2	0.5	97.5	10	2.5	487.5
4	1.5ESA1LBPA	0.4	1.5	1	97.5	7.5	5	487.5
5	1.25ESA1.25LBPA	0.5	1.25	1.25	97.5	6.25	6.25	487.5
6	1ESA1.5LBPA	0.6	1	1.5	97.5	5	7.5	487.5
7	0.5ESP2LBPA	0.8	0.5	2	97.5	2.5	10	487.5
8	2.5LBPA	1	0	2.5	97.5	0	12.5	487.5
9	5ESA	0	5	0	95	25	0	475
10	4ESA1LBPA	0.2	4	1	95	20	5	475
11	3ESA2LBPA	0.4	3	2	95	15	10	475
12	2.5ESA2.5LBPA	0.5	2.5	2.5	95	12.5	12.5	475
13	2ESA3LBPA	0.6	2	3	95	10	15	475
14	1ESP4LBPA	0.8	1	4	95	5	20	475
15	5LBPA	1	0	5	95	0	25	475
16	7.5ESP	0	7.5	0	92.5	37.5	0	462.5
17	6ESA1.5LBPA	0.2	6	1.5	92.5	30	7.5	462.5

No	Blends	LBPA / LBPA ESA	ESA, wt. %	LBPA, wt. %	OPC, wt. %	ESA, g	LBPA, g	OPC, g
18	4.5ESA3LBPA	0.4	4.5	3	92.5	22.5	15	462.5
19	3.75ESA3.75LBPA	0.5	3.75	3.75	92.5	18.75	18.75	462.5
20	3ESA4.5LBPA	0.6	3	4.5	92.5	15	22.5	462.5
21	1.5ESA6LBPA	0.8	1.5	6	92.5	7.5	30	462.5
22	7.5LBPA	1	0	7.5	92.5	0	37.5	462.5
23	10ESA	0	10	0	90	50	0	450
24	8ESA2LBPA	0.2	8	2	90	40	10	450
25	6ESA4LBPA	0.4	6	4	90	30	20	450
26	5ESA5LBPA	0.5	5	5	90	25	25	450
27	4ESA6LBPA	0.6	4	6	90	20	30	450
28	2ESA8LBPA	0.8	2	8	90	10	40	450
29	10LBPA	1	0	10	90	0	50	450

Table 4 presents some determining physical properties of the cement CEM II A-L 42.5N while the mortar compressive and flexural strengths of control specimen and 28 cement blends at various curing ages were determined and presented in Table 5.

Table 4 – Physical Properties of Control Sample (CEM II A-L 42.5N)

Property			
Curing age, days	2	7	28
Compressive Strength (N/mm^2)	23.84	38.99	48.18
Flexural Strength (N/mm^2)	4.46	6.13	6.80
Setting Time (mins) Initial setting	117	Final setting	186
Water Consistency (%)	29		
Expansion (mm)	0		

Table 5 – Mortar Compressive and Flexural strengths of various cement blends and curing ages

No	Blends	Compressive Strength (Flexural Strength) N/mm^2		
		2-days	7-days	28-days
1	OPC	23.84 (4.46)	38.99 (6.13)	48.18 (6.80)
2	2.5ESA	27.93 (4.61)	34.46 (5.80)	53.19 (7.33)
3	2ESA0.5LBPA	21.03 (3.91)	34.60 (5.35)	46.44 (6.42)
4	1.5ESA1 LBPA	26.74 (4.43)	32.77 (4.85)	50.15 (6.82)
5	1.25ESA1.25 LBPA	21.91 (4.00)	29.05 (4.25)	47.21 (6.44)
6	1ESA1.5 LBPA	24.21 (4.38)	30.27 (4.51)	47.32 (6.71)
7	0.5ESP2LBPA	22.37 (4.30)	31.4 (4.80)	45.19 (6.37)
8	2.5LBPA	23.18 (4.31)	31.85 (4.37)	46.00 (6.43)
9	5ESA	27.93 (5.10)	37.35 (6.10)	44.95 (6.30)
10	4ESA1LBPA	21.46 (4.26)	29.69 (4.79)	43.00 (6.20)
11	3ESA2LBPA	22.18 (3.70)	35.46 (5.92)	46.58 (6.55)
12	2.5ESA2.5LBPA	17.16 (3.33)	30.80 (4.54)	39.83 (6.37)
13	2ESA3LBPA	21.01 (3.37)	34.46 (5.80)	46.57 (6.50)
14	1ESP4LBPA	23.08 (4.14)	30.60 (4.19)	47.20 (6.37)
15	5LBPA	18.1 (3.74)	35.4 (5.21)	40.09 (6.21)
16	7.5ESP	17.77 (3.40)	32.77 (4.85)	45.13 (6.41)
17	6ESA1.5LBPA	21.93 (3.75)	34.25 (5.11)	46.62 (6.51)
18	4.5ESA3LBPA	19.11 (3.62)	33.19 (5.42)	48.10 (6.71)
19	3.75ESA3.75LBPA	18.65 (3.57)	29.67 (4.79)	35.76 (6.19)
20	3ESA4.5LBPA	16.89 (3.01)	32.79 (4.11)	47.20 (6.65)
21	1.5ESA6LBPA	21.65 (4.40)	32.51 (5.75)	38.75 (6.42)
22	7.5LBPA	23.20 (4.61)	34.30 (5.49)	41.92 (6.03)
23	10ESA	23.71 (4.42)	36.52 (5.16)	43.18 (6.99)
24	8ESA2LBPA	23.19 (4.38)	33.66 (5.71)	48.00 (6.75)
25	6ESA4LBPA	23.43 (4.09)	34.29 (5.62)	42.14 (6.24)
26	5ESA5LBPA	26.47 (4.76)	32.72 (4.79)	41.28 (6.07)
27	4ESA6LBPA	23.13 (4.20)	34.97 (5.24)	45.70 (6.58)
28	2ESA8LBPA	22.75 (4.42)	35.26 (5.80)	47.10 (6.77)
29	10LBPA	23.06 (4.59)	34.54 (6.26)	43.18 (6.99)

Compressive strength of cement blended with ESA and LBPA. Figure 5 indicated that for 2.5 wt. % cement replacement at 2 days, cement blends with higher ESA content produced better mortar compressive strengths than those with higher LBPA content especially at LBPA/LBPA-ESA ratios of 0, 0.4 and 0.6 respectively. Similar trends were observed for the ESA cement blend and limestone cement blend employed in [24] work. This early strength of the cement blended with ESA (the calcium oxide present in ESA which is similar to limestone) could be attributed to the provision of more nucleation sites via the production of calcium hydroxide (CH) at the early stage coupled with additional lime from ESA inclusion [11, 29] resulting in acceleration of the hydration rate, thereby resulting in accelerated early strength [27, 28].

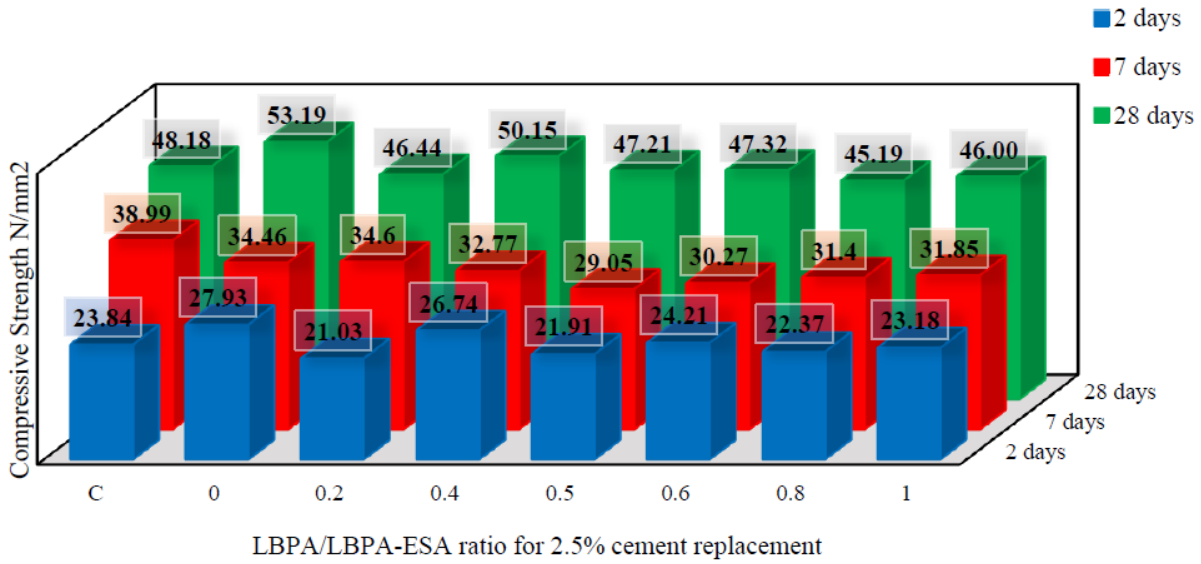

Figure 5 – Variation of SCM content and curing age on the mortar compressive strength at 2.5 % cement replacement

Similarly, works by [13, 26, 12] indicated that the inclusion of ESA (similar to limestone powder) could lead to the formation of monocarbonate, thus stabilizing ettringite at the expenses of monosulphate, thereby increasing the volume of the hydrates and in turn enhance its compressive strength of the cement blended with ESA. All cement blends at 2 days produced compressive strengths above 91 % of the control strength as illustrated in Figure 5. The 7 days compressive strength for cement blends also produced better strengths for cement blends containing more ESA content than LBPA content with neither better than control.

It was also observed that the 28-day mortar compressive strength produced two cement blends with enhanced strength of 53.19 N/mm^2 and 50.15 N/mm^2 as against to control of 48.18 N/mm^2 at LBPA/LBPA-ESA ratio of 0 and 0.4 respectively. This enhanced strength could be attributed to the pozzolanic reaction from available lime and silica from LBPA despite diminution of clinker content resulting in the enhanced strength which was close to control. It could also be suggested that an increase in potassium content due to an increase in LBPA results in a gradual strength gain (retarder) due to the formation of muscovite $K_2Al_2Si_6Al_4O_{20}(OH)_4$ [32] despite clinker diminution. The mortar compressive strength of all the blends experienced an increase as the curing day progressed as illustrated in Figures 6–8 respectively.

Figures 6–8 showed that all mortar compressive strengths at 2, 7 and 28 days for cement blends beyond 5 wt. % replacement were either slightly or significantly lower than the control except for LBPA/LBPA-ESA ratio of 0.0 for 5 wt. % cement replacement which produced a better 2 days compressive strength of 27.93 N/mm^2 against control compressive strength of 23.84 N/mm^2.

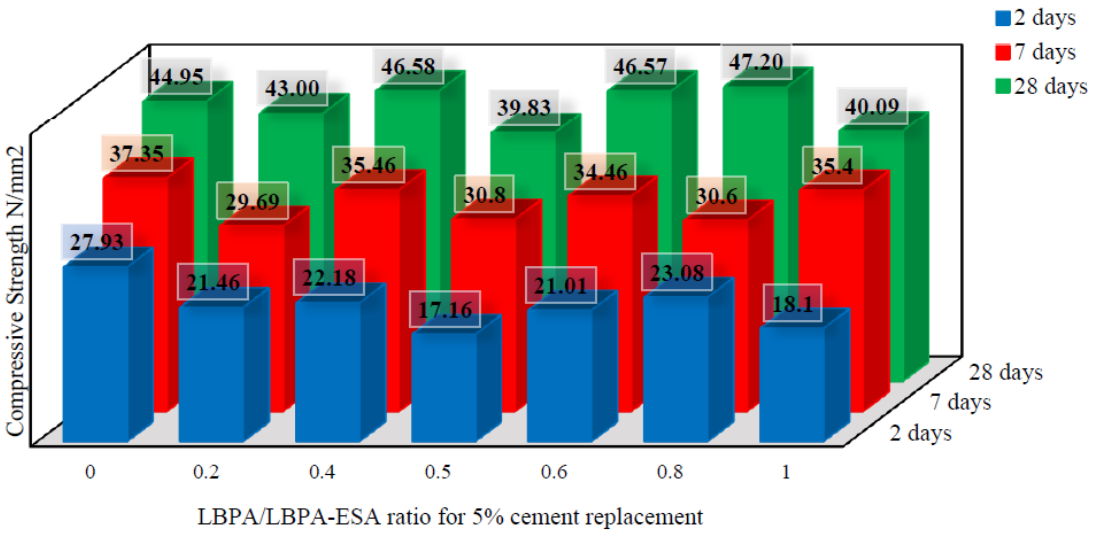

Figure 6 – Variation of SCM content and curing age on the mortar compressive strength at 5 % cement replacement

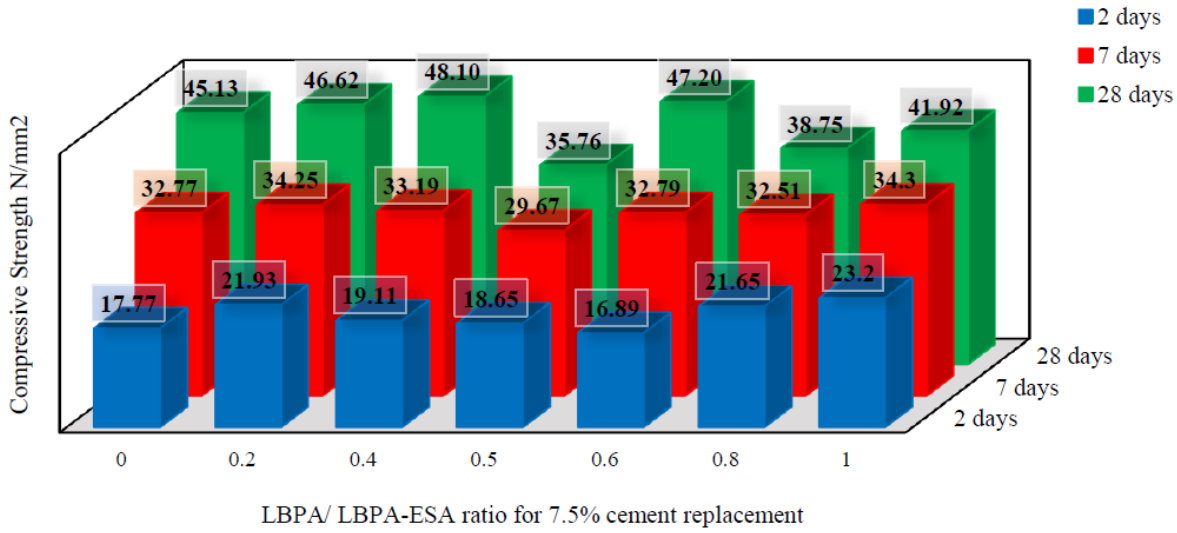

Figure 7 – Variation of SCM content and curing age on the mortar compressive strength at 7.5 % cement replacement

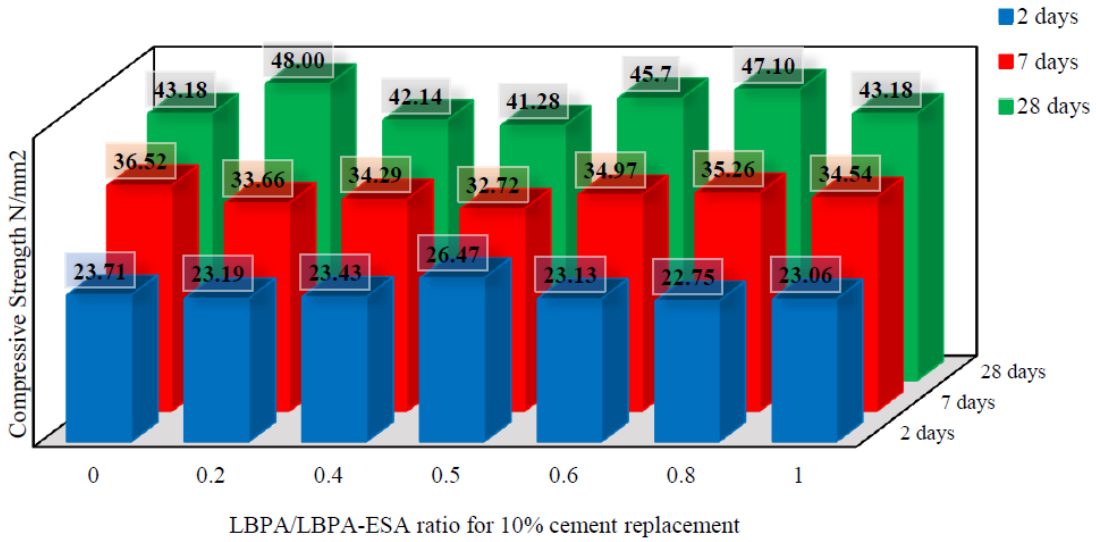

Figure 8 – Variation of SCM content and curing age on the mortar compressive strength at 10 % cement replacement

The reason for the enhanced strength despite cement replacement of 5 wt.% could be attributed to the pozzolanic reaction between the available lime from the hydration of calcium silicate and the silica present in the LBPA, resulting in the formation of more CSH, leading to a denser and an enhanced strength which is in agreement with [24, 26] coupled with the formation of muscovite which also enhances the mortar compressive strength [32] as illustrated in equation (1).

$$K^{+}+3Al_2O_3+7SiO_2+2H_2O \text{ --} K_2Al_2Si_6Al_4O_{20}(OH)_4+SiO^{2-} \quad (1)$$

Similar trends of improved strength despite the reduction in the clinker content were observed for 7.5 wt. % and 10 wt. % cement replacement with LBPA and ESA as illustrated in Figures 7 and 8 respectively. The inclusion of CH crystals from ESA on the hydration of calcium silicates tends to enhance the early rate of cement hydration by the provision of more nucleation sites, thereby resulting in accelerated early strength which agrees with [11, 29, 27, 25]. Figure 8 indicated that Cement blends produced enhanced strengths at early ages between 2 and 7 days for LBPA/ LBPA-ESA ratio of 0.4, 0.6 and 1 respectively in comparison with control with hydration rate ranging from 23.6 % to 54.98 % for cement blends compared to 63.55 % for control. Similar mortar compressive strength for blends with 10 wt. % cement replacement compared with the control despite clinker diminution.

Flexural strength of cement blended with ESA and LBPA. The variation of LBPA, ESA content and curing age on the mortar flexural strength of cement blends at various cement replacement of 2.5, 5, 7.5 and 10 wt. % are illustrated in Figures 9–12 respectively. It could be also be observed from Figure 9 for 2.5 wt. % cement replacement, that most of the blends at various LBPA/LBPA-ESA ratios produced slightly lower 28 days strengths compared with control, whereas cement blends with LBPA/LBPA-ESA ratio of 0 and 0.4 produced better strengths of 7.33 N/mm^2 and 6.82 N/mm^2 against the control of 6.8 N/mm^2 despite cement replacement.

Figure 10 indicated most cement blends produced lower 2 days flexural strength at 5 wt. % cement replacement expect ESA cement blend with a flexural strength of 5.10 N/mm^2 against control strength of 4.46 N/mm^2. All blends produced lower flexural strengths for 28 days ranging from 6.2–6.55 N/mm^2 as against 6.8 N/mm^2 for control with a similar trend of lower 7 days flexural strength of cement blends compared to control at 5, 7.5, and 10 wt. % cement replacement respectively. It also observed that most of the cement blends with 7.5 wt. % cement replacement produced slightly close 28 days flexural strengths compared to control despite clinker diminution as illustrated in Figure 11.

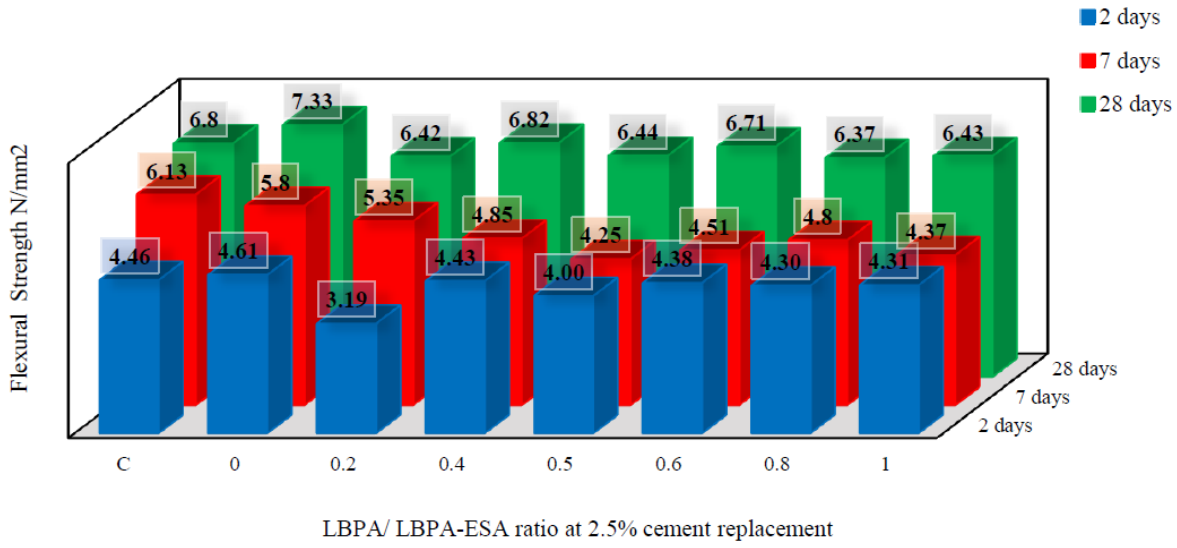

Figure 9 – Variation of SCM content and curing age on the mortar flexural strength at 2.5 % cement replacement

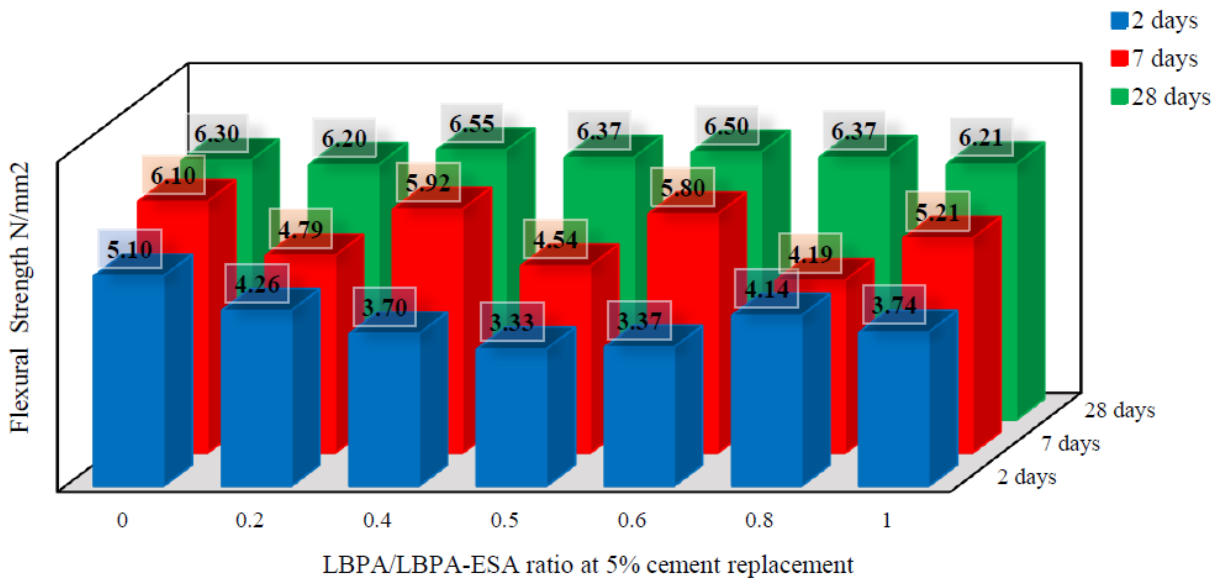

Figure 10 – Variation of SCM content and curing age on the mortar flexural strength at 5 % cement replacement

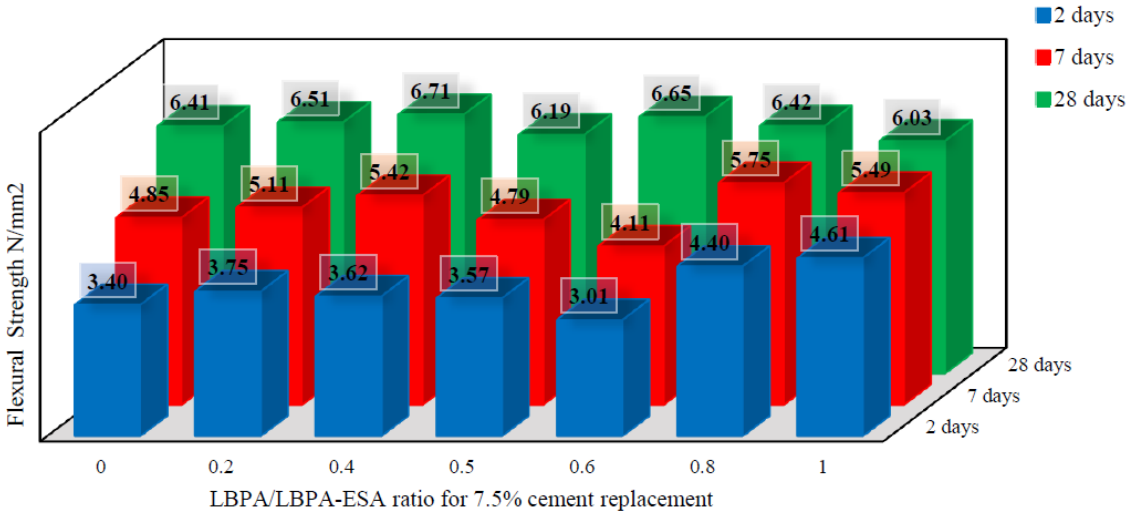

Figure 11 – Variation of SCM content and curing age on the mortar flexural strengths at 7.5 % cement replacement

Figure 12 indicated that despite clinker diminution for 10 wt. % ESA and 10 wt. % LBPA cement blends produced better 28 days flexural strengths of 6.99 N/mm^2 than control while LBPA/LBPA-ESA ratios of 0.2 and 0.8 produced strength slightly close to the control of 6.75 and 6.77 N/mm^2 respectively which despite the clinker diminution. Similarly, it was also seen that the 2 days flexural strength for LBPA/LBPA-ESA ratios of 0.5 and 1 produced improved flexural strengths of 4.76, 4.59 N/mm^2 as against control of 4.46 N/mm^2 respectively while at 7 days flexural strength for 10 wt. % LBPA cement blend obtained an enhanced strength of 6.26 N/mm^2 against 6.13 N/mm^2. This improved strength could be attributed to the pozzolanic activity of the cement blends.

The compressive strength of blended cement was expressed as a percentage of the rate of control cement at the same curing time and illustrated in Figures 13 and 14 for LBPA cement blend and ESA cement blend respectively.

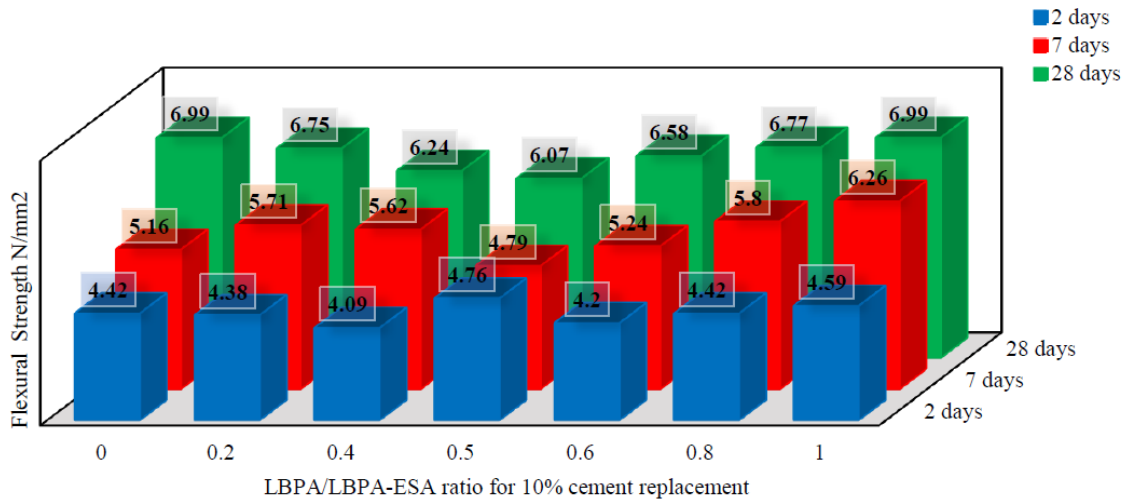

Figure 12 – Variation of SCM content and curing age on the flexural strengths at 10 % cement replacement

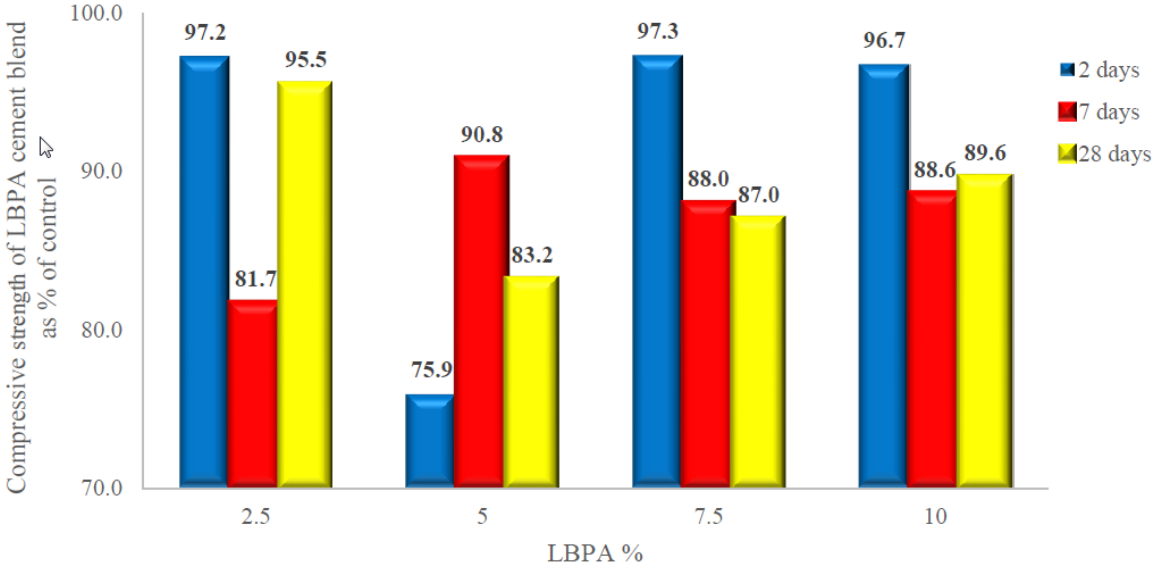

Figure 13 – Compressive Strengths of Blended LBPA as a percentage of control at various ages

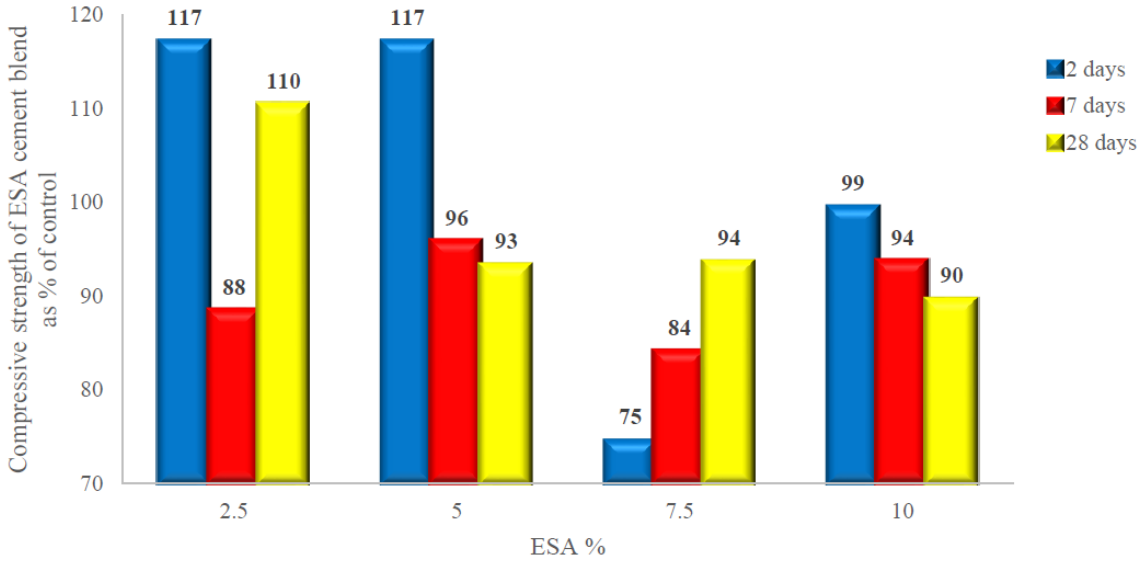

Figure 14 – Compressive Strengths of Blended ESA as a percentage of control at various ages

Cement blended with LBPA for 2.5–10 wt. % at an interval of 2.5 wt. %, all produced mortar strengths lower than those of control at various curing days respectively. It was also seen that cement blended with 10 wt. % LBPA produced up to 90% of the control strength despite clinker diminution is an indication of a pozzolanic reaction between silica present in LBPA and the available CH from cement hydration which is in agreement with [24]. LBPA cement blends of 7.5, 5 and 2.5 wt. % cement replacement produced the best strength of 97.3, 90.8 and 95.5 % of the control strength for 2, 7 and 28 days respectively. Whereas Cement blended with ESA for 2.5–10 wt. % at an interval of 2.5 wt. %, most of the mortar strength produced were lower than those of control except cement blended with 2.5 wt. % and 5 wt. % ESA at 2 days and 2.5 wt. % ESA at 28 days with the best strength of 117, 110, and 117 % respectively. This enhanced strength experienced especially at 2 days could be attributed to the provision of nucleation site, thus accelerating hydration rate which was in agreement with [13] and [26]. ESA cement blends of 2.5 wt. % and 5 wt. % produced strength of 117 % in comparison with control for 2 days, 5 wt. % cement replacement produced the best strength of 96 % for 7 days whereas 2.5 wt. % cement replacement produced the best strength of 110 % for 28 days.

The flexural strengths for LBPA and ESA as a percentage of control are illustrated in Figures 15 and 16 respectively. It could be observed that as the LBPA content was increased from 2.5–5 wt. %, the flexural strength increased compared with control strength beyond which any further increase led to a lower strength at 2 days. A similar trend was also observed at 7 days with 5 wt. % LBPA producing similar strength with control beyond which produced lower flexural strength whereas, for 28 days flexural strength only 2.5 and 10 wt. % LBPA produced enhanced strength despite cement replacement indicating pozzolanic activity. Similarly, the enhanced strength could be attributed to the presence of potassium, thus increase the flexural strength, especially at 28 days. 5 wt. % LBPA cement blend produced the best 2 and 7 days flexural strength while 2.5 wt. % LBPA cement blend produced the best 28 days as illustrated in Figure 15.

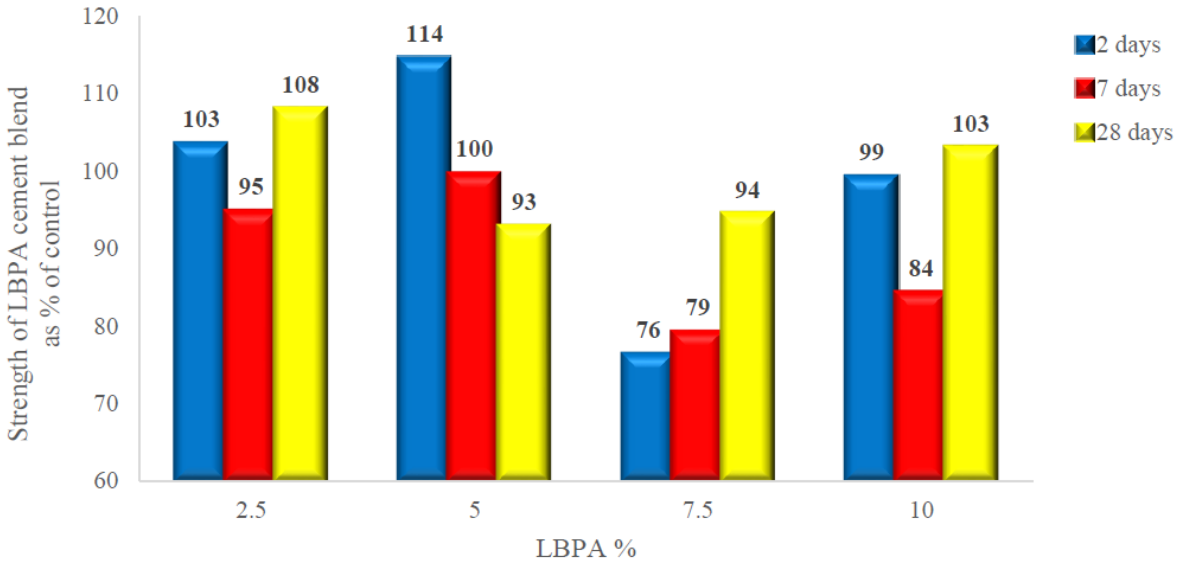

Figure 15 – Flexural Strengths of Blended LBPA as a Percentage of Control at various Ages

The 2 days flexural strength of the ESA cement blend produced enhanced strength at 7.5 wt. % and 10 wt. %. The 7 days strength was seen to increase as the ESA content was increased from 2.5–10 wt. % with only 10 wt. % ESA content producing a better flexural strength than the control. Only 10 wt.% ESA cement blend for 28 days flexural strength produced a better strength than control. This could be attributed to the increased early hydration rate due to the provision of nucleation sites from the availability of CH present in the matrix [26]. Figure 16 indicates that 7.5 and 10 wt. % ESA cement blends both produced the highest flexural strengths at 2 days as a percentage of control at approximately 103 % respectively. It was also observed that 10 wt. % of cement blended with ESA produced the highest flexural strength as a percentage of the control at 7 and 28 days.

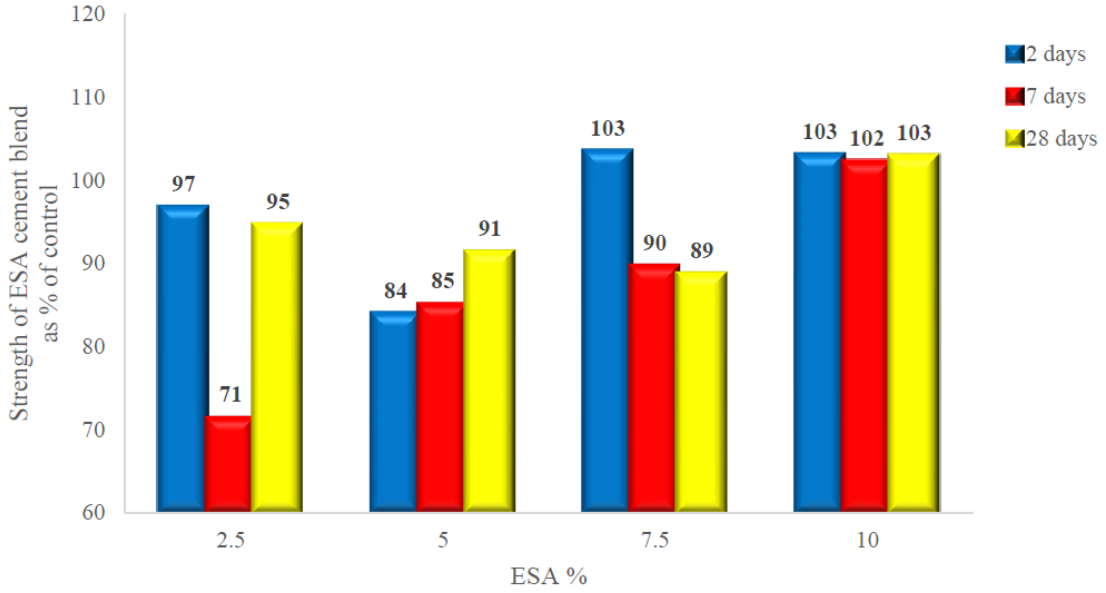

Figure 16 – Flexural Strengths of Blended ESA as a percentage of control at various ages

CONCLUSION

In this study, the potential of blending cement with LBPA and ESA were investigated on the mortar compressive and flexural strength of cement blends and the following conclusions were drawn.

The chemical composition of LBPA did not satisfy one of the requirements specified by ASTM C618 [8] with $SiO_2+Al_2O_3+Fe_2O_3$ of 30.42 wt.% which is less than 50 wt.% but satisfies the other requirements such as SO_3 content of 0.7 wt.% which is less than the maximum of 5 wt.% and LOI of 7.12 wt.% and contains 19.42 wt.% CaO which is within the range of 10-30 wt.% CaO is class C pozzolan. The increase in LBPA content (high potassium content) of cement blends resulted in gradual strength gain (retarder) due to the formation of muscovite $K_2Al_2Si_6Al_4O_{20}(OH)_4$ despite the increased cement replacement with LBPA.

The mortar compressive strength of cement blends at the early age of 2 and 7 days produced better compressive strengths with higher ESA content compared to LBPA especially at LBPA/LBPA-ESA ratio of 0, 0.4 and 0.6 for 2.5 % cement replacement. This better early strength gain could be attributed to the provision of more nucleation sites by the inclusion of ESA, thus accelerating the rate of cement hydration.

On the other hand, the enhanced strengths at 28 days of cement blended with various replacement from 2.5–10 wt. % could be attributed to the pozzolanic reaction between the available lime and reactive silica from LBPA despite clinker diminution which was close to control. It could also be suggested that an increase in potassium content due to increase in LBPA content could lead to a gradual strength gain (retarder) due to the formation of muscovite $K_2Al_2Si_6Al_4O_{20}(OH)_4$.

An increase in the mortar compressive strength of all cement blends was observed as the curing day progressed. It was also observed that most of the blends experienced an enhanced strength gain compared with control strength gain of 23.57 % between 7 and 28 days while most of the cement blends produced enhanced strength gain ranging from 13.35–62.51 % compared to control. This enhanced strength can be related to the pozzolanic activity which is evident despite clinker diminution coupled with the high potassium content from LBPA could be suggested to be the reason for enhanced strength gain, especially at 28 days according to [32].

A decrease in the mortar compressive strength of LBPA cement blends was experienced as the LBPA content was increased from 2.5 to 10 wt.% compared with control strength which was approximately 90 % of the control strength despite cement replacement of LBPA up to 10 wt.%, while an enhanced strength was observed for cement replacement with ESA for 2.5 and 5 wt.% at 2 days which agrees with the provision of nucleation sites resulting in enhanced early strength. The 28 days compressive strength

was seen to diminish as the cement replacement with ESA was increased from 2.5–10 wt.% at an interval of 2.5 wt.%.

An increase in the flexural strength of LBPA cement blends was observed as the LBPA content was increased up to 5 wt. %, beyond which produced lower 2 and 7 days' flexural strengths compared with control strength respectively. Whereas at 2.5 and 10 wt. % cement replacement with LBPA produced enhanced 28 days' strength compared with control. This enhanced strength could be attributed to pozzolanic activity coupled with the presence of potassium ions despite diminution of clinker content resulting in enhanced strength especially at 28 days. A gradual increase in the 7 days flexural strength experienced a gradual increase as the cement was replaced with ESA content from 2.5-10 wt. % with only 10 wt. % ESA content producing a better flexural strength than the control. This could be attributed to the increased early hydration rate due to the provision of nucleation sites from the availability of CH present in the matrix. The 2 days flexural strength of the ESA cement blend produced enhanced strength at 7.5 wt. % and 10 wt. % compared to control whereas, cement blended with 10 wt. % ESA produced a better 28-day flexural strength than control.

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CONFLICT OF INTEREST

The authors declared that they have no conflict of interest.

REFERENCES

1. Adama, A., & Jimoh, Y. (2012). Effect of locust bean pod ash on strength properties of weak soils. *AU Journal of Technology, 16*(1), 21–35.
2. Afizah Asman, N. S., Dullah, S., Lynn Ayog, J., Amaludin, A., Amaludin, H., Lim, C. H., & Baharum, A. (2017). Mechanical Properties of Concrete Using Eggshell Ash and Rice Husk Ash As Partial Replacement Of Cement. *MATEC Web of Conferences, 103*, 01002. doi: 10.1051/matecconf/201710301002
3. Afolayan J. (2017). Experimental Investigation of the Effect of Partial Replacement of Cement in Concrete with Locust Bean Waste Ash. *International Journal of Engineering and Applied Sciences, 5*(12), 42–47.
4. Akpenpuun, T. D., Akinyemi, B. A., Olawale, O., Aladegboye, O. J., & Adesina, O. I. (2019). Physical, mechanical and microstructural characteristics of cement-locust bean pod ash mortar blend. *Journal of Applied Sciences and Environmental Management, 23*(3), 377. doi: 10.4314/jasem.v23i3.1
5. Ali, H., Babatunde, R. I., Ibrahim, A., & B.O, A. (2019). Investigation of Locus Beans Waste Ash as Partial Replacement for Cement in Concrete Structures. *International Journal of Advances in Scientific Research and Engineering, 5*(4), 149–153. doi: 10.31695/ijasre.2019.33133
6. ASTM International. (2001). *Standard Specification for Mortar for Unit Masonry* (ASTM C270-01). doi: 10.1520/c0270-01
7. ASTM International. (2001). *Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete* (ASTM C618-00). doi: 10.1520/c0618-00
8. ASTM International. (2019). *Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete* (ASTM C618-19). doi: 10.1520/c0595_c0595m-19
9. Balamurugan, M., & Santhosh, R. (2017). Influence of Egg Shell Ash on the Properties of Cement. *Imperial Journal of Interdisciplinary Research, 3*(4), 160–165.

10. Black, L. (2016). Low clinker cement as a sustainable construction material. *Sustainability of Construction Materials*, 415–457. doi: 10.1016/b978-0-08-100370-1.00017-2

11. Bonavetti, V. (1998). *Limestone filler cements: Interaction mechanism and its influence on mechanical properties* (Doctoral dissertation), University of Center Buenos Aires State, Argentine.

12. Bonavetti, V. ., Rahhal, V. ., & Irassar, E. . (2001). Studies on the carboaluminate formation in limestone filler-blended cements. *Cement and Concrete Research, 31*(6), 853–859. doi: 10.1016/s0008-8846(01)00491-4

13. De Weerdt, K., Kjellsen, K. O., Sellevold, E., & Justnes, H. (2011). Synergy between fly ash and limestone powder in ternary cements. *Cement and Concrete Composites, 33*(1), 30–38. doi: 10.1016/j.cemconcomp.2010.09.006

14. Fazeera, U., Kamran, S., & Yasmin, H. (2016). Viability of Eggshells ash affecting the setting time of cement. Retrieved from https://zenodo.org/record/1112185#.XpIF1_37TDA

15. Georgescu, M., & Saca, N. (2009). Properties of blended cements with limestone filler and fly ash content. *Scientific Bulletin, Series B, 71*(3), 11–22.

16. Ikumapayi, C. M. (2017). Crystal and microstructure analysis of Pozzolanic properties of bamboo leaf ash and locust beans pod ash blended cement concrete. *Journal of Applied Sciences and Environmental Management, 20*(4), 943. doi: 10.4314/jasem.v20i4.6

17. Ikumapayi, C., & Akingbomire, S. (2018). Effects of Bamboo Leaf and Locust Beans Pod Ashes on Autogenous Shrinkage Strain and Compressive Strength of Mortar. *Journal of engineering and engineering technology, 12*(1), 49–53.

18. Kaya, A. (2010, September). *A study on blended bottom ash cements* (Master's thesis). Retrieved from http://etd.lib.metu.edu.tr/upload/12612504/index.pdf

19. Kumar, P., Vishwakarma, A., & Soni, K. (2016). Laboratory Analysis of Cement Concrete Prepared with EggShells Ash. *International Journal of Advanced Technology for Science & Engineering Research, 1*(6), 16–23.

20. Mtallib, M., & Rabiu, A. (2009). Effects of EggShells Ash (ESA) on The Setting Time of Cement. *Nigerian Journal of Technology, 28*(2), 29–38.

21. Ndububa, E., & Uloko, J. (2018, July). *Locust Bean Pod Ash (LBPA) as a Pozzolanic Material in Concrete*. Retrieved from https://www.researchgate.net/publication/326631966_LOCUST_BEAN_POD_ASH_LBPA_AS_A_POZZOLANIC_MATERIAL_IN_CONCRETE

22. Ojewumi, M., Ayomide, A., Obanla, O., Awolu, O., & Ojewumi, E. (2016). Pozzolanic properties of Waste Agricultural Biomass – African Locust Bean Pod Waste. *World Journal of Environmental Biosciences, 6*(3), 1–7.

23. Okonkwo, U. N., Odiong I. C., & Akpabio, E. E. (2012). The effects of eggshell ash on strength properties of cement-stabilized lateritic. *International Journal of Sustainable Construction Engineering and Technology, 13*(1), 18–25.

24. Olubajo, O., & Osha, O. (2013). Influence of bottom ash and limestone powder on the properties of ternary cement and mortar. *International Journal of Engineering Research and Technology, 2*(7), 1201–1212.

25. Olubajo, O., Osha, O., El- Nafaty, U., & Adamu, H. (2014). Effect of water-cement ratio on the mechanical properties of blended cement containing bottom ash and limestone. *Civil and Environmental Research, 6*(12), 1–9.

26. Olubajo, O., Osha, O., El-Natafty, U., & Adamu, H. (2017). *A study on Coal bottom ash and limestone effects on the hydration and physico-mechanical properties of ternary cement blends* (Doctoral thesis). Abubakar Tafawa Balewa University.

27. Péra, J., Husson, S., & Guilhot, B. (1999). Influence of finely ground limestone on cement hydration. *Cement and Concrete Composites, 21*(2), 99–105. doi: 10.1016/s0958-9465(98)00020-1

28. Ramachandran, V. S., & Chun-Mei, Z. (1986). Thermal analysis of the $3CaO \cdot Al_2O_3$-$CaSO_4 \cdot 2H_2O$-$CaCO_3$-H_2O system. *Thermochimica Acta, 106*, 273–282. doi: 10.1016/0040-6031(86)85139-5

29. Soroka, I., & Setter, N. (1977). The effect of fillers on strength of cement mortars. *Cement and Concrete Research, 7*(4), 449–456. doi: 10.1016/0008-8846(77)90073-4

30. Spelta, J. S. de O., & Galdino, A. G. de S. (2018). Bioceramic composite: hen's eggshell characterization and main applications. *Revista Ifes Ciência, 4*(1), 9–20. doi: 10.36524/ric.v4i1.323

31. Tang, Ran An (2010, November). Compressive Strength of Normal strength Concrete (NSC) Using British Standard, Euro code and non-destructive test approaches (Bachelor's thesis). Retrieved from http://umpir.ump.edu.my/id/eprint/3297/1/TANG_JIAN_AN.PDF

32. Venkateswara, R., Kontham, G., Venkata, R., & Chundupalli, S. (2011). Effect of Potassium Chloride (KCl) on Ordinary Portland Cement (OPC) Concrete. *Research Journal of Chemical Sciences, 1*(2), 103–107.

33. Winton, A. L., Winton, K. G. B., & Lakhotia, R. L. (2003). *Poultry eggs*. Jodhpur: Agrobios.