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WELCOME SPEECH FROM THE CHAIRMAN

RISM 17th International Surveying Conference for Undergraduates (ISCU 2025)

بسم الله الرحمن الرحيم السلام

عليكم ورحمة الله وبركاته

Greetings to all,

It is with great pleasure that I welcome you to the 17th RISM International Surveying Conference for Undergraduates (ISCU 2025), themed *"Embracing Construction Revolution 4.0: Transforming Malaysia's Built Environment."* On behalf of the Royal Institution of Surveyors Malaysia (RISM), I also wish to express our sincere appreciation to Universiti Teknologi MARA (UiTM), Perak Campus, for graciously hosting this significant event.

As we navigate the era of the Fourth Industrial Revolution (IR4.0)—or in our context, Construction Revolution 4.0 (CR4.0)—we are witnessing transformative advancements across the global construction sector. Technologies such as Building Information Modelling (BIM), the Internet of Things (IoT), artificial intelligence (AI), robotics, big data analytics, and cloud computing are redefining the way we build, manage, and interact with our built environment. For Malaysia, embracing CR4.0 is a strategic imperative to achieve our socio-economic and environmental goals.

This conference serves as a vital platform to unite surveying undergraduates from various disciplines, fostering critical dialogue on industry challenges, enhancing professional networking, and preparing a new generation of talent for the rapidly evolving construction landscape. It is also an opportunity for employers to engage with and inspire our future professionals.

I would like to extend my heartfelt thanks to all industry speakers, paper presenters, judges, and participants for their time, contributions, and support in making ISCU 2025 a success. I also commend the organising committee for curating a meaningful and dynamic conference experience.

May the knowledge gained, connections formed, and ideas exchanged during this event inspire all participants to lead and innovate in their future endeavours.

Wishing everyone a productive and memorable conference.

Prof. Ts Sr Dr. Adi Irfan Bin Che Ani'
Chairman, Universities' Partnering Committee
RISM Session 2024/2025
May 2025

WELCOME SPEECH FROM CO-CHAIRMAN

RISM 17th International Surveying Conference for Undergraduates (ISCU 2025)

Bismillahirrahmanirrahim.

السلام عليكم ورحمة الله وبركاته and greetings to all.

It is my great pleasure to welcome everyone to the 17th International Surveyor Conference for Undergraduates (ISCU 2025), proudly hosted by Universiti Teknologi MARA (UiTM) Perak Branch in collaboration with the Royal Institution of Surveyors Malaysia (RISM). This event is a meaningful platform for students in the built environment to share ideas, showcase innovations, and build professional networks. We are honoured by your presence and enthusiastic participation, with 135 accepted papers and 78 poster presentations this year.

UiTM Perak, home to the College of Built Environment, has long been a hub for academic excellence in architecture, planning, and surveying. Our commitment remains strong in nurturing competent graduates who meet industry demands and contribute to nation-building.

While you're here, we invite you to experience the heritage and culture of Perak Tengah from the architectural richness of Rumah Kutai to the historical towns of Pasir Salak, Bota, and Kampung Gajah.

To all presenters and winners, congratulations on your achievements. Let your work today be a catalyst for future success and academic growth. We hope this conference will inspire you to explore new ideas, foster collaboration, and make lasting memories.

My deepest thanks to the Royal Institution of Surveyors Malaysia (RISM) and the organising committee for making this event a success.

We hope your experience here will be rewarding and unforgettable.

Thank you. Selamat datang dan selamat berjaya.

Associates Professor Dr. Nur Hisham Ibrahim, *PMP*
Co-Chairman, Universities' Partnering Committee
RISM Session 2024/2025
May 2025

WELCOME SPEECH FROM THE PROJECT DIRECTOR

RISM 17th International Surveying Conference for Undergraduates 2025

Alhamdulillah, all praise to Allah S.W.T. for His guidance and blessings in making the RISM 17th International Surveying Conference for Undergraduates (ISCU) 2025 a reality.

It is with great honour and gratitude that I welcome all participants, guests, academicians, and industry professionals to this prestigious event, proudly organized under the Royal Institution of Surveyors Malaysia (RISM). This 17th edition of ISCU stands as a proud testament to our collective dedication toward academic excellence, professional collaboration, and youth empowerment in the field of surveying.

I extend my heartfelt appreciation to RISM for its unwavering support, to the hardworking ISCU 2025 Organising Committee, and to all 16 partnering universities across Malaysia for their commitment and contributions. Your efforts have shaped this conference into a dynamic platform for knowledge exchange, innovation, and professional growth.

To the academicians and practitioners present, your insights are invaluable in bridging the gap between academic theory and real-world practice. To our undergraduate participants, your passion, curiosity, and commitment are the very foundation of our future. May this conference not only deepen your academic journey but also ignite a spirit of leadership, integrity, and sustainable thinking.

Let this gathering serve as more than an academic milestone. May it foster lifelong networks, inspire transformative ideas, and chart new directions in our shared professional journey.

Wishing everyone a rewarding and inspiring conference experience.

Sr Dr. Nurul Fadzila Zahari
Project Director
RISM 17th ISCU 2025

THE EFFECTIVENESS OF CONCRETE TOWARDS BUILDING ACOUSTICS IMPROVEMENT & NOISE REDUCTION

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ABSTRACT

Building acoustic is an important consideration in the design, operation and construction of most buildings, and can have a significant impact on health and wellbeing, communication and productivity. Concrete is a common building material which often faces challenges with sound absorption and noise transmission. Therefore, the aim of this research is to identify the most effective type of concrete for enhancing acoustic performance in buildings. By examining various concrete formulations and how its properties influence sound behaviour, this research will offer practical recommendations for concrete selection based on acoustic needs. Research shows that noise pollution, particularly in urban settings, can lead to adverse physical and psychological effects, making the need for enhanced acoustic design in buildings more urgent. Studies indicate that the degree of sound reflection in such modified concretes depends largely on specific aggregate types, pore size and distribution, and other changes in mix composition. By evaluating high-density, lightweight, and porous concrete, the research aims to close the gap between structural and acoustic efficiency. The methodology of this study based on secondary data such as literature reviews, academic report analysis and thematic analysis. Therefore, the aim of this research is to identify the most effective type of concrete for enhancing acoustic performance in buildings. By examining various concrete formulations and how its properties influence sound behavior, this research will offer practical recommendations for concrete selection based on acoustic needs.

Keywords: Acoustic Performance, Building Acoustic, Concrete, Sound Absorption, Noise Reduction.

I. INTRODUCTION

Noise pollution has become a serious environmental problem with serious impacts on human health, affecting individuals both physically and psychologically (Hannan et al., 2020). In response to this, building materials that can help control indoor noise have gained significant interest, especially materials designed to reduce sound energy through absorption. Sound-absorptive material is designed to lower sound reflection by efficiently absorb the sound waves, where it helps in increasing acoustic comfort within the room spaces (Bala and Gupta, 2021). Among construction materials, concrete has traditionally been used to block noise, largely because its dense composition makes it an effective sound reflector. This reflective quality makes concrete useful in reducing the transmission of external noise into a building. However, concrete is limited in its capacity to absorb sound, which means that in confined spaces it may contribute to issues like echo rather than dampening noise (Tie et al., 2020). Due to these limitations, recent studies have focused on modifying the properties of concrete to make it more versatile in acoustic applications.

Standard high-density concrete is known for its excellent sound-blocking properties, reflecting up to 99% of sound energy due to its density and mass. This quality is especially beneficial in urban environments, where noise from traffic and other external sources is a common problem. However, plain concrete's density also makes it a poor sound absorber, which can be a drawback for spaces where internal noise reduction is a priority (Amran et al., 2021). To address this, researchers have investigated ways to modify concrete by incorporating lightweight or porous materials, which absorb and retain sound energy more effectively than dense materials. Such modifications aim to create a concrete mix that balances sound reflection and absorption to control both external and internal noise levels effectively. Further research into concrete composition has highlighted the potential to enhance its sound-absorbing properties by adjusting factors like cement flow and aggregate type. By creating a concrete that is both durable and porous, researchers hope to produce a material that can absorb sound without sacrificing structural strength, allowing it to be used in real-world applications that require both noise control and durability.

The acoustic properties of concrete are defined as its ability to reduce the transmission of sound through it. Concrete which designed for soundproofing to prevent sound from entering or leaving a space by blocking sound transmission with dense, heavy materials, making it ideal for environments where sound leakage is a concern (Surfaces, 2021). Considering this, this study aims to find the best type of concrete for improving acoustic performance by identifying key material properties that impact sound absorption and noise transmission. By focusing on different concrete mixes, this research seeks to help optimize concrete choices in building design for improved indoor sound control and more acoustically comfortable environments.

This research identifies and propose the most effective type of concrete for enhancing acoustic performance in concrete buildings by review and analysing past studies and secondary data on concrete properties. By analysing key material properties such as density, porosity, and aggregate composition, the research looks up to optimize concrete usage to improve sound absorption and reduce noise transmission. Through a review of past research, report studies and standards, this research seeks to recommend effective concrete types for improved sound absorption and noise reduction in building.

II. LITERATURE REVIEW

A. *Building Acoustic*

Acoustics is the scientific study of how sound behaves in different environments. It encompasses essential concepts such as sound waves, frequency, and amplitude, which explain by Erbe *et al.,* 2022 is how sound travels through various materials and mediums. Effective acoustics reduce unwanted noise while improving the clarity of how people speak. By lowering background noise, this improves focus and reduces distractions. The investigational identification of acoustic properties of suitable materials used in the building's construction has remained as an important task gaining greater significance attributable to the need for appropriate materials for structures in locations with high noise levels (Amran et al., 2021). This information improves the field of building acoustics and provides foundations for future advancements in material science.

B. *Factors Affecting Acoustic Performance*

Acoustic comfort is the study of different aspects that affect acoustic comfort and decrease discomfort, not something that gives the occupant a comfortable indoor environment. In addition to the factors affecting acoustic performance, acoustic insulation, absorption, and echo time also affect the acoustic comfort of an occupant as mentioned by Ganesh *et al.,* 2021. Different thickness of porous concrete consists of different levels of sound absorption across different frequencies range. Concrete with thick porosity have potential in absorbing low frequencies sounds effectively based on its increased depth which allows for higher sound waves penetration and dissipation. By that, thinner, porous concrete which contain higher porosity is more effective in absorbing high frequencies sounds, where the shorter wavelengths can be easily trapped within its pore structure (Seddeq, 2009). Hence, Amran *et al.,* 2021 emphasizes that the sound wave energy absorbed and reflected during the propagation of porous concrete of different thicknesses is various, which will cause different absorption effects of the sound.

C. *Impact of Noise Pollution on Building*

According to Adekunle *et al.,* 2021, noise is known to be an undesirable sound while sound is created by vibrating objects and arrives at the listener's ears as waves in the air or other media. Researchers have recently found that noise pollution in the environment negatively affects the health, social, and professional productivity. According to the International Standard Organization's guidelines for hearing limitations, those who are exposed to the highest sound pressures and intensities are more likely to experience long-term health problems like headaches, muscle tension, anxiety, insomnia, exhaustion, resentment, distraction, hearing impairment, communication problems, drug use, relaxation problems, and temporary threshold changes. All of these noise sources have the potential to cause vibrations that could disrupt the comfort and activities of those who live in the built environment.

D. *Characteristic of Concrete*

Different types of concrete such as lightweight, high-density or porous concrete contain different characteristics showcase varying acoustic properties, which can influence its application in construction. Concrete owns some kinds of characteristics that significantly influence its ability in noise reduction includes the density, porosity and aggregate composition. These factors determine whether concrete primarily absorbs, transmits or reflects the sound waves.

Research shows that high-density concrete offers better sound insulation than traditional concrete, especially for low-frequency sounds. This is because heavier materials are better at blocking sound waves, which makes high-density concrete good for soundproofing. Research by Amran *et al.*, 2021 mention that the dense composition of this type of concrete makes it very effective at blocking noise from external sources, such as traffic or industrial activities, which are common issues in cities. On the other hands, porous concrete known for its ability to absorb sound due to its interconnected voids which it allows sound waves to penetrate and dissipate within the material. Shtrepi *et al.,* 2021 emphasize that the efficiency of sound absorption in porous concrete depends on factors such as pore size, thickness and composition distribution which influence its acoustic performance across different sound frequencies.

The aggregate composition also plays an important role in determining the acoustic properties of concrete. According to Amran *et al.,* 2021 research, it is found that lightweight aggregate such as expanded clay and rubberized concrete enhances sound absorption make it suitable for noise reduction application. The lower density of lightweight concrete is a result of the air-filled voids created by these aggregates. These voids not only make the concrete lighter but also give it better sound absorption capabilities than traditional or high-density concrete. Fediuk *et al.,* 2021 discuss the cellular structure of lightweight concrete helps trap sound waves within its voids, which leads to a noticeable reduction in noise levels inside buildings. It is very effective in spaces where maintaining quietness and reducing noise is a priority.

I. Density

Research shows that high-density concrete offers better sound insulation than traditional concrete, especially for low-frequency sounds. This is because heavier materials are better at blocking sound waves, which makes high-density concrete good for soundproofing. For example, the dense composition of this type of concrete makes it very effective at blocking noise from external sources, such as traffic or industrial activities, which are common issues in cities (Amran et al, 2021). However, because it lacks pores, high-density concrete does not absorb sound very well, meaning it is not as good at reducing echoes or improving the sound quality inside a building.

II. Porosity

Yang *et al.* reported the absorption properties depends on the material properties such as the porosity. The porosity decreases as the density increases, but on the other hand, the volume of open pores also increases. The open pore volume of aerated concrete is more than that of foam concrete (Fediuk et al., 2021) . The absorption coefficient of specific porous concrete is best categorized by the ratio of open pores to total porosity. In general, good sound absorption can be obtained by a material that has a high degree of porosity (more than 90%) and a sound absorption coefficient near 1 in a wide frequency band (Atef et al., 2022).

III. Aggregate Size

The aggregate size plays an important role in influencing the acoustic performance of lightweight and porous concrete. There are reported the finer the aggregate size, the greater is the sound absorption of the lightweight aggregate concrete due to the larger surface area of finer size (Tie et al., 2020). It was found that using aggregates with a greater particle size (4–8 mm) produced a higher void ratio. This was explained by the fact that smaller aggregates had a larger surface area. As a result, finer aggregates absorbed more cement paste through the surface micropores, increasing the number of voids in the porous concrete system. However, because the actual pore size of the porous concrete did not change significantly even if the aggregate size varied, the porous concrete made with these aggregate sizes has comparable sound absorption coefficients and NRCs. However, Carbajo *et al.* revealed A narrower pore structure and increased flow resistance were the reasons for the higher sound absorption of the pervious concrete made with smaller aggregate sizes.

E. *Acoustic Properties of Concrete*

Acoustic properties of concrete are essential in construction which influence the way buildings adapt sound transmission and absorption. High density concrete efficiently reflects sound due to its mass, producing substantial sound insulation. Research by Fediuk et al., 2021 studied while this reflection nature can lead to increase of reverberation time within enclosed rooms/ spaces, it may potentially cause acoustic discomfort. For porous concrete which is characterized by its interconnected voids, allows sound waves to penetrate and dissipate within its component where it may reduce noise levels. The efficiency of sound absorption for porous concrete differs with its thickness and pore structure, affecting its performance across various sound frequencies as stated by Shtrepi *et al.,* 2021.

F. *Research Theoretical Framework*

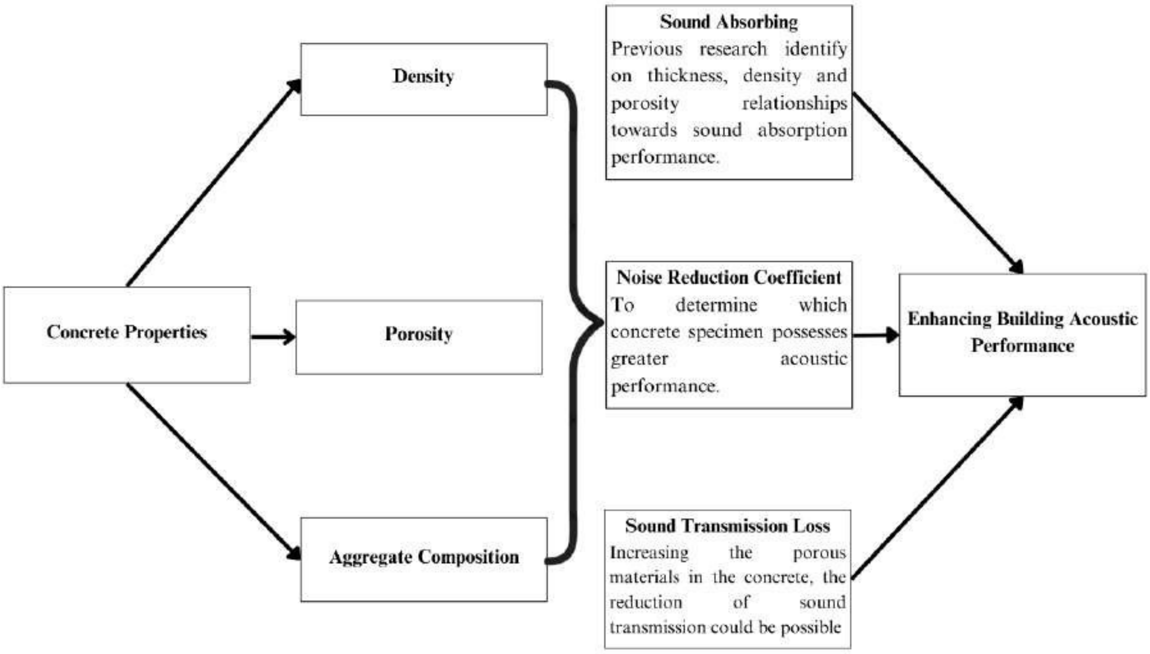

Figure 1.0 The Figure of Theoretical Framework.

Referring to **Figure 1.0** The Figure of Theoretical Framework, the research's theoretical framework focuses on how concrete's physical properties, particularly density, porosity, and aggregate size, influence its acoustic performance. Concrete porosity has a major effect on transmission loss, which is the decrease in sound energy as it passes through a material. Increasing the proportion of porous materials in concrete can effectively reduce sound transmission, whereby enhancing its noise control capabilities (Chalangaran et al., 2021). Porosity plays an important role in trapping sound waves, making it a key variable in optimizing acoustic properties.

However, relying completely on the Sound Absorption Coefficient (SAC) to assess acoustic performance may not be sufficient. The Noise Reduction Coefficient (NRC) provides a more comprehensive measure by averaging SAC values across various frequencies, allowing for better comparisons of acoustic performance among different concrete sample specimens (Kin, 2021). Moreover, findings by Galip et al. (2024) indicate that the thickness of the concrete panels significantly influences density and porosity, leading to higher SAC and NRC values. The aggregate size also contributes to the material's acoustic practices, as larger aggregates tend to create a denser structure, while smaller ones can enhance porosity. These connected variables highlight the significance of assessing concrete's functioning for sound control applications comprehensively.

XXVII. METHODOLOGY

This study uses a comparative systematic analysis literature review to assess the acoustic performance of different concrete types. By using the secondary data from academic sources, key factors are identified through thematic analysis to compare sound absorption and insulation properties across high-density, lightweight and porous concretes. This is a process that allowed to collect relevant evidence to achieve the research aim.

A. Data Collection

I. Secondary Data

In order to provide a comprehensive understanding of the variables affecting building acoustics and the effect of different concrete types to noise reduction, this research use a qualitative approach based on secondary data analysis to review the characteristics of concrete for noise reduction. The research relies on existing studies, literature review, academic reports and thematic analysis to study the knowledge on acoustic properties of concrete. This approach ensures that the research remains connected to theoretical and real-world contexts while improving the validity and dependability of the results by using several types of data sources.

II. Systematic Literature Review

The literature review work as the basis of this research by systematically collecting and reviewing related academic and industry research. The studies of the research include sources such as academic and professional journal article, books and web-based resources. It provides in depth study and investigation of key terms and ideas connected to acoustic, including the properties of sound in construction environments, the factors that influence sound transmission and absorption plus with the method that apply to assess acoustic properties.

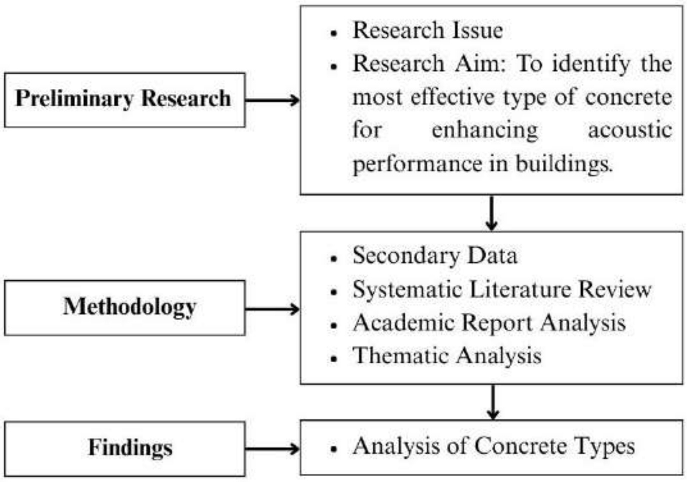

Figure 2.0 Framework of Research Methodology

B. *Data Analysis*

I. Academic Report Analysis

In addition, with literature review, this research also relies on report analysis where case studies, technical reports and experimental findings from previous studies and industry assessment are examined. It works as key part to present and discuss research findings. Form this, the references of standards and guidelines such as ISO (International Organization for Standardization) and ASTM (American Society for Testing and Materials) for measuring the acoustic properties of concrete materials can be achieved.

Table 1.0 Standards for Determining Acoustic Characteristics in Materials

Standard	Measure Characteristic
ISO 10534-2:1998	Sound absorption coefficient α
ISO 10534-2, ASTM E1050 – 12	Sound Transmission Loss (STL)
ISO 10534-2, ASTM E1050	Sound absorption coefficient α

a) *Sound Absorption Result*

Determine which concrete type absorbs the most sound in specific frequency ranges. For example, porous concrete may perform better at high frequencies, while lightweight concrete could be effective across a wider range.

b) *Sound Transmission Result*

Analyse the Sound Transmission Class (STC) results to determine which concrete type offers better sound insulation, especially against low-frequency sounds. High-density concrete is expected to provide superior sound insulation, while lightweight and porous concrete may have lower STC ratings due to the lower mass.

By integrating qualitative insights with quantitative measurements, the research provided a thorough analysis of the acoustic performance of the selected concrete types. These different methods ensured that the research findings were both concluded in expert knowledge and supported by report evidence.

II. Thematic Analysis

Thematic analysis is a method of analysing qualitative data. According to Caulfield, 2019 the researcher closely examines the data to identify common themes which includes topics, ideas and patterns of meaning that come up repeatedly from respondents. Thematic coding was used to extract insights related to significant components influencing the acoustic performance of concrete, such as density, porosity, and structural composition. These themes helped frame the study's discussion and provided a deeper understanding of the expert perspectives on improving sound absorption and noise control in buildings. This analysis also highlighted professional opinions on the practical applications and challenges of using different types of concrete in real-world construction.

XXVIII. FINDINGS

Secondary data complements the primary data by providing theoretical information and context for the research. This data is sourced from academic research, industry reports, and guidelines from organizations like the World Health Organization (WHO) and laboratory standards. By reviewing existing studies on advanced materials of concretes, the research can identify gaps in knowledge and ensure the importance of investigating the specific concrete types selected for this study.

Table 2.0 Analysis of Concrete Types

Type of Concrete	Citation	Enhance Acoustic Performance		Findings.
		Sound Absorption	Sound Insulation	
High-density	Fediuk et al.,2021	x	/	Fediuk *et al.*, found that high-density concrete is effective in blocking external noise due to it mass, which is suitable for highways and urban environments.
	Tie et al., 2020	x	/	Due to its high density, concrete is usually employed as rigid walls in buildings and also as sound barrier in highway (Tie et al., 2020)
	Chintapalli., 2024	x	/	High density materials like magnetite and barite in concrete excel in noise mitigation (Chintapalli, 2024).
Lightweight	Amran et al., 2021	/	/	Amran *et al.,* studied about the lightweight aggregate concrete and found it is balances both sound absorption and insulation.
	Hannan et al. 2020	/	x	Hannan *et al.,* identified that modified concrete in their study is classified in class D which may absorb more than 30% of sound.
	Atef et al. 2022	/	/	Atef *et al.,* stated lightweight materials used to absorb sound because of their porous nature. The insulation characteristics also improved at high frequencies.
Porous	Shtrepi et al., 2021	/	x	Shtrepi et al., analyse that porous concrete absorbs sound well due to its interconnected voids.
	Zhang et al., 2020	/	x	Zhang *et al.,* found that increasing the thickness of porous concrete will increase the sound absorption coefficient of the porous concrete in the full frequency range.
	Galip et al, 2024	/	/	Galip *et al.,* stated when porosity increases, the sound absorption performance of porous concrete increases.

These findings highlight the importance of material selection in building acoustic in noise reduction. The choice of concrete types should align with acoustic requirements; balancing sound insulation and absorption depends in building application purposed.

This study evaluates the effectiveness with which different types of concrete reduce noise transmission and compiles research on the elements affecting a building's acoustic performance. Material density, porosity, aggregate composition, and structural design are important factors that affect acoustic performance. Certain types of concrete with particular density and porosity forms have been discovered to successfully minimize noise while maintaining structural integrity. These materials' potential in a variety of applications has been highlighted by the additional assessment of its acoustic performance through the use of modern testing techniques and simulations. The results support the aim and objectives by suggesting that concrete be chosen with consideration for enhancing acoustic performance in buildings.

CONCLUSION

Optimizing concrete properties perform a sustainable and cost-effective approach to enhancing building acoustic performance and addressing noise reduction challenges in construction. Based on the comparative analysis of different concrete types, the study outlines the high-density concrete is efficient for external noise insulation but low sound absorption where it could lead to increased reverberation indoors. Meanwhile lightweight concrete offers balance of insulation and absorption hence, suitable for residential and commercial building. Porous concrete provides high sound absorption make it ideal for indoor acoustic control. By evaluating high-density, lightweight, and porous concrete, the research aims to close the gap between structural and acoustic efficiency. The findings are expected to provide practical perspectives for developing multifunctional materials that tackle urban noise issues, support sustainability, and minimize reliance on additional soundproofing components. To increase the acoustic performance of concrete, further study can be investigating composite materials that combining high-density and porous concrete to produce both optimum sound insulation and absorption material.

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