

Application Of Geometry In Planning And Building Design In Modern Architecture

Firdi Agniyal Qolbi¹⁾, Nadira Zahra Humaira²⁾, Najma Syamsia Fasya³⁾, Wahyunengsih⁴⁾

Departemen of Matematics Study Program, Syarif Hidayatullah State Islamic University of Jakarta, Jl. Ir H. Juanda No.95, Ciputat, Kec. Ciputat Tim., South Tangerang City, Banten 15412, Indonesia. Phone: +62 21 7401925.

Email: ¹⁾firdiagniyal@gmail.com; ²⁾nzhraira@gmail.com; ³⁾najmafasya@gmail.com;
⁴⁾wahyu.nengsih@uinjkt.ac.id

Diterima 17 Agustus 2025 Disetujui 31 Desember 2025

Abstract

This study explores the application of geometry in building planning and design in modern architecture. In applying geometry in building planning, researchers examine public opinion on the role of geometric elements in increasing architectural value. This study uses a descriptive quantitative method by distributing questionnaires to collect data from 39 respondents. Geometric shapes in building design have become the basis of architectural design, and this study explores the application of geometry in building planning and design in modern architecture. In applying geometry in building planning, researchers examine public opinion on the role of geometric elements in increasing architectural value. This study uses a descriptive quantitative method by distributing questionnaires to collect data from 39 respondents. Geometric shapes in building design have become the basis of architectural design, creating a building with aesthetic and functional value. These findings reveal that geometric design is essential in creating harmony, efficiency, and visual appeal of modern buildings. To strengthen the data from the questionnaire, the researcher also used a qualitative method using an online interview instrument with three people with an architectural background. Respondents agreed that applying geometric concepts contributes to architectural structures' distinct identity and modernity. To strengthen the data from the questionnaire, the researcher also used a qualitative method using an online interview instrument with three people with an architectural background. Furthermore, respondents agreed that applying geometric concepts contributes to the distinct identity and modernity of architectural structures. This study highlights the critical role of geometry in bridging technical design with artistic expression in contemporary architecture.

Keywords: Building Design, Geometry, Geometric Elements, Modern Architecture, Public Perception.

INTRODUCTION

Applying geometry in architecture is the basis of structure and an essential factor in creating visually engaging and comfortable buildings. The relationship between geometry and the visual attractiveness of architectural design is profound, as geometry serves as a fundamental element in shaping architectural forms and areas (González-Pérez et al., 2024). In addition, geometry is an essential variable in energy efficiency and comfort, and building form significantly impacts overall performance, so geometry is a primary concern in architectural design (Kistelegdi et al., 2022).

The evolution of geometry and architectural structures reflects the dynamic development of the times. Experts state that using metal as a structural component enables architects and engineers to create new forms and functions previously impossible to realize with conventional materials, significantly transforming the geometry of modern architecture and engineering (Rueda Márquez de la Plata & Cruz Franco, 2022). The influence of geometric principles continued in architectural design into the Renaissance and beyond, as architects sought to rediscover and reinterpret the classical heritage of previous generations; this evolution

reflects the ongoing relationship between geometry and architectural practice, which continues to adapt to changing contexts without abandoning its basic principles (De Naeyer, 2021).

These geometric patterns draw people's attention and inspire various reactions because of their distinctive shapes and purposes. Multiple elements, like growth and adjustment, frequently shape how individuals assess these patterns from an artistic perspective. These elements are deeply connected with geometry-based design, as seen in the form and configuration of an architectural form, which can affect one's emotional and aesthetic perception. (Othman & Ali, 2021). Unique architectural designs often reflect cultural and aesthetic values, potentially attracting public attention; on the other hand, the application of geometric logic in the design process allows architects to produce forms that not only meet functional standards but are also in line with public expectations of aesthetics and innovation (Yang, 2022).

Over the past few years, the application of geometric shapes in building planning and design has become a primary focus in modern architecture. Several studies have addressed these geometric forms' technical, structural, and aesthetic aspects, generally from the perspective of professionals such as architects and engineers. However, there is still a lack of research that explores how the general public responds to or assesses the application of these geometric forms in everyday life. Meanwhile, public acceptance of building design is also an essential factor in the success of modern and functional urban space planning. Therefore, this research addresses these shortcomings by examining people's perspectives of geometric shapes in contemporary architecture and analyzing how the public anticipates these designs visually while accepting them functionally and culturally within their city environment.

This research intends to majorly impact architectural design practice by incorporating community perspectives as a key factor in creating spaces that professionals find efficient, aesthetically pleasing, and that the community widely accepts. Thus, the results of this research guide serve as a reference for architects and urban planners in creating more responsive designs that are contextual to social and cultural needs.

METHODS

This researcher uses a quantitative descriptive approach to describe and analyze the extent to which the principles of modern architectural geometry are applied in building design, as well as their impact on spatial quality and efficiency. The focus is on key principles of contemporary architecture, such as the use of basic geometric forms, elements of lines and volumes, impressions of symmetry, grid systems, and structural honesty (Wicaksono, 2020). This contemporary emphasizes the importance of spatial functionality and building mass in shaping and concentrating space, where pure geometric forms are considered advantageous for efficient space distribution (Ruhiat, 2023).

In investigating this research, participants involved the general public with an architectural background and those without. The Data collection instrument used a questionnaire, with 39 respondents completing it online via the Google Form platform. The questionnaire consisted of closed (multiple choice and Likert scale) and semi-open questions designed to explore public perceptions of applying geometric principles in modern architectural planning and design. To supplement the questionnaire data, semi-structured interviews were conducted online with several selected participants, particularly those with experience or knowledge in architectural design. The data collection method chosen by this researcher integrates quantitative and qualitative insights to develop valid findings so that the scope of this study offers a more comprehensive understanding of the experience (Tesis.id, 2023). Although the primary design of this research is quantitative, the qualitative data served as complementary evidence that enriched the interpretation of the results.

The researcher's data collection process lasted approximately three weeks. The researchers save all data obtained, kept confidential, and use it exclusively for academic purposes. The process consists of several key stages, including the preparation of instruments, selection of respondents, a pilot test of the questionnaire, distribution of questionnaires, interviews, data compilation, and initial analysis (Enago Academy, 2023). In the first week, the researcher prepared instruments based on journal references, determined respondent criteria, and developed a semi-structured interview guide. The questionnaire uses closed questions (multiple choice and Likert scale) and semi-open items to accommodate respondent's opinions. In the second week, the researcher tested the questionnaire on three respondents to ensure the questions were clear and relevant to the research objectives. Afterward, the questionnaire was distributed online to the general public, attracting mainly individuals without a formal background in architecture. At the same time, interview participants were selected based on their knowledge of architecture. In the third week, the interviews were conducted online in a semi-

structured manner. Questionnaire responses were collected automatically via Google Forms and organized using Microsoft Excel, while the researcher saved interview data in concise transcripts using a laptop. In the qualitative division, interview, data saturation, and interview criteria were justified (Hansen, 2020).

After the data collection phase, the researcher proceeded to data analysis using descriptive statistics—including frequency, percentage, and mean—processed in Microsoft Excel. The analysis began with data reduction, which involved filtering, organizing, and summarizing information from questionnaires and interviews (ATLAS.ti, 2023). The researchers sorted and categorized the quantitative data into relevant themes and summarized the qualitative responses by identifying key ideas from the participants' answers (Creswell & Creswell, 2023). Only complete and valid data that supported the research objectives were included for further processing (Bans-Akutey & Tiimub, 2021). Researchers use triangulation to increase the reliability and consistency of the results by comparing findings from both instruments (Bhandari, 2022). researchers strengthen it with this method so that the validity and reliability of the research allow cross-verification from various sources (Bhandari, 2023). Triangulation is widely recognized in qualitative research as a method to ensure validity by examining data from multiple perspectives (Nurfajriani et al., 2024). It allows researchers to gain in-depth understanding (Morgan, 2024).

RESULTS

This study obtained data through two methods: questionnaires and interviews. The questionnaire was distributed to 39 respondents with diverse ages and professional backgrounds, primarily students and college students. The questionnaire questions were designed to understand the public's perception of the architectural forms of the past and present and their preferences for modern building design.

In addition, the researchers interviewed three informants to gain insights into their perspectives on the differences in building forms over time and their opinions on the ideal building. The researchers also interviewed three architects and distributed a questionnaire containing 10 closed-ended questions to 39 participants.

A. Questionnaire result

This questionnaire aims to understand the public's views on the design and form of new buildings. It explores respondents' opinions on the differences in building shapes past and present, shapes that are studied attractive and comfortable, and preferences for design styles such as minimalist or futuristic. Additionally, the researchers asked respondents to describe their ideal building shape and design. Researchers use the results of this questionnaire to observe current trends in architectural design that are in demand.

Ultimately, architects, urban designers, and policymakers can use the findings from this study as a profitable source of insight into designing visually attractive environments that are consistent with the aspirations and preferences of the people who dwell in them. By aligning architectural designs with societal demands, future developments can be more eco-friendly, inclusive, and responsive to functional and emotional aspects of people's lives within built environments.

Table 1. Questionnaire results summary

Question	Summary of Dominant Answer	Number (Estimated from 39 Respondent)
Gender	Women	± 27 people
Work	Student	± 32 people
Are the shapes of buildings from ancient times different from those of today?	Yes, different	± 34 people
What kind of modern building do you see?	Irregular but artistic	± 20 people
Do you like asymmetrical buildings?	Depending on the design	± 25 people
Can the shape of a building convey meaning?	Yes	± 36 people
What kind of building design do you like?	Modern and minimalist	± 28 people
What does your dream building look like?	Modern, comfortable, minimalist and functional	Varied answers (written narratively)

If you could build your dream building in the future, what would that building be like?	Liking symmetrical and simple shapes	Varied answers (written narratively)
What do you think about the shape and geometric design?	Geometric shapes and designs that are symmetrical because they give a neat and balanced impression	Varied answers (written narratively)

The majority of respondents are women aged under 20, mostly students. They consider that buildings of old and now are significantly different, with irregular yet artistic modern designs being a favorite. Most agree that the form of the building can convey meaning. The preferred designs are contemporary and minimalistic, with a desire for aesthetic yet functional structures, such as cozy homes and futuristic buildings.

B. Interview results

Based on the interviews conducted with three informants with a background in architecture, Researchers gathered various views regarding the shapes and designs of contemporary buildings. This interview aims to complement the questionnaire results with professional perspectives, particularly related to the development of building forms, the influence of design on function, and the favored current design trends. The interviews were conducted with three informants with a background in architecture, showing three photos with six questions for each image.

Image 1



Image 2



Image 3



Image 1. Masjid Raya Sumatera Barat

Informant 1	Informant 2	Informant 3
The great mosque of Sumatera is an iconic building with an interesting design that combines Neo-vernacular and modern Islamic styles. Its geometric shape is efficient for a spacious worship space, although it affects construction costs. Urban planners can implement this design in large cities by making local adjustments. The unconventional shape attracts public attention and enhances appreciation for architecture. In addition to being comfortable, this building also serves as a place of worship and religious tourism.	This mosque building appears attractive and unique, with an unusual shape and introspective local culture in a modern style. Technically, its design requires more complicated structural and material planning, which impacts construction damages. Nevertheless, modern technology can overcome this objection. Such forms can be applied in major cities in Indonesia, especially those wanting to highlight their cultural identity. Community responses may vary, but generally, they are positive if the function and comfort are	This building is interesting because it reflects the characteristics of Minangkabau culture. Technically, simple geometric shapes can be efficient in terms of structure and materials due to their uniform façade patterns. The strength of the building is more determined by the quality of the materials and the structural system than by the geometry itself. Although architects do not commonly implement such forms entirely in large cities, they often incorporate elements like the roof as cultural symbols. Unconventional visuals

	maintained. If designed well, Geometric shapes can enhance lighting, circulation, and acoustics.	can attract public attention and potentially become a tourist attraction. In terms of functionality and comfort, geometric shapes still have an influence.
--	--	--

Image 2. The Cube Building Birmingham

Informant 1	Informant 2	Informant 3
The building with this geometric shape looks interesting and sturdy and has a strong visual appeal. Technically, its structure is not complicated, but using materials such as glass and a secondary skin requires careful planning. This shape is cost-effective and strong, although its impacts, such as light and heat pollution, still need to be considered. Urban planners can apply designs like this in major Indonesian cities by making appropriate adjustments. The public generally responds positively to modern and unconventional designs. The geometric shape supports space flexibility and natural lighting in terms of functionality and comfort.	This building looks attractive and futuristic, but the geometric shapes and complex ornaments demand special construction techniques and materials that are not always efficient in structure and cost. Nevertheless, architects can apply basic shapes like cubes in major Indonesian cities, incorporating climate adaptations to ensure structural strength and environmental suitability. Visually, buildings like this attract attention, especially from the younger generation, although they may face criticism from more conservative circles. Geometric shapes can influence comfort; however, interior designers can still achieve functionality and comfort by implementing appropriate design strategies.	This building looks attractive and dynamic due to the repetition of geometric shapes, although technically, they are inefficient in structure or material as they only beautify the facade. Such geometry does not affect the strength of the building, but it does impact the increase in construction costs. Its application remains feasible in major cities in Indonesia as a symbolic element. The public's response tends to be neutral because the shape is unrelated to cultural values. Functionally, this form does not affect comfort and only serves as an aesthetic element.

Image 3. The Gherkin

Informant 1	Informant 2	Informant 3
This building has a dynamic shape and engaging visuals, although structurally and materially, it requires complex calculations, mainly because of the use of curves and glass. Its geometric form greatly influences the strength and cost of construction. While urban planners can apply this design in major Indonesian cities, they must carefully plan to minimize	This spiral building looks unique, futuristic, and elegant. Technically, the spiral shape is very efficient in facing wind pressure, distributing loads, and supporting natural lighting and ventilation. Although the construction costs are high due to the design and special materials, the structure provides additional strength. Architects could apply designs like this in large	This building looks attractive, sturdy, and dynamic. Technically, the geometric shapes used are very efficient in structure and materials, although construction costs are high because they fall into high-rise buildings. This form is very suitable to be implemented in major cities of Indonesia, especially those prone to earthquakes. The public accepts the unconventional visual of the

environmental impacts, such as heat generated by glass materials. Public response can vary, depending on perceptions of the unconventional design. In terms of function, this shape can affect comfort and spatial arrangement, but it can still be optimized to remain functional and appealing.	Indonesian cities, turning them into landmarks. The community tends to respond positively, even though some may feel it's foreign. This shape can be very comfortable in terms of function if it applies green building principles, although the interior layout may require adjustments.	building due to the uniqueness and beauty of its facade. Moreover, the geometric shapes also appreciate the comfort and functionality of the building through lighting, views, and structural efficiency.
---	---	---

According to the responses from 3 sources regarding the first photo, the Great Mosque of Sumatera is a building that combines modern design with touches of local culture, particularly Minangkabau culture, through its unique and unconventional geometric forms. Although this design requires more complex and expensive structural planning and materials, it can offer advantages in terms of comfort, lighting, acoustics, and circulation if well designed. Additionally, its attractive form can enhance public appreciation for architecture and has the potential to become a religious tourism object. Overall, such a design can be applied in major Indonesian cities with local adjustments, although with special attention to costs and user comfort.

The building with geometric shapes in image 2 has a strong visual appeal and appears modern and futuristic. Technically, these shapes vary in efficiency—some are simple and efficient, while others are complex and require special materials and techniques, which can increase construction costs. Although they do not directly impact structural strength, architects often use geometric elements to beautify facades and create a distinctive visual identity. Their application in Indonesia's large cities is feasible, especially as symbols of modernity, although public responses can vary depending on cultural preferences and aesthetic values. Functionally, these shapes can support natural lighting and spatial flexibility, but comfort still depends on the appropriate interior design.

The building in picture 3 has a dynamic, unique, and futuristic geometric shape. It provides visual appeal and structural efficiency, especially when facing wind pressure and supporting natural lighting and ventilation. Although the construction costs and technical planning are high, this form is suitable for application in major cities in Indonesia, including earthquake-prone areas, with adjustments to the climate and eco-friendly principles. The public's response is generally positive towards unconventional designs, and proper spatial planning can still optimize the comfort and functionality of the building through proper spatial planning.

The results of the questionnaire and interviews announce a match in views between respondents and informants regarding modern geometric building design. Most respondents, predominantly women under 20 years old, favored modern, minimalist, and aesthetic designs and believed that the shape of buildings can convey meaning. That aligns with the informants' opinions, who evaluated that the buildings in the three images possess visual appeal, strong identity, and cultural value, especially at the Grand Mosque of Sumatera. Although geometric shapes often require high costs and technical planning, many architects still consider such buildings functional and comfortable if designed well. Both the respondents and informants believe such designs are feasible to be implemented in large cities in Indonesia with adjustments to the climate and culture. In conclusion, both aesthetically and functionally, modern geometric building designs received positive responses from both parties.

The results of the questionnaires and interviews also support each other in assessing the design of modern geometric buildings. The respondents, the majority of whom are young women, favor modern, unique, and aesthetic designs that are still functional. That aligns with the informants' opinions, who consider the geometric shapes in the three buildings to be interesting, possess cultural value and visual identity, and remain comfortable and efficient when designed well. Although it requires specific costs and planning, such designs and factors are considered feasible to implement in major cities in Indonesia. Both results indicate that the form of the building can convey meaning and have a positive impact on its function as well as the community's response.

Finding
Based on the questionnaire and interviews, the researchers found that the design of modern geometric buildings strongly appeals to most respondents, primarily young women under 20, and most are students. They prefer modern, minimalist, and artistic building designs, with a preference for aesthetically pleasing yet functional buildings, such as comfortable homes or futuristic structures. The respondents also agree that the shape of a building can convey meaning. Futuristic.

The results of interviews with three sources indicate that the building design, as seen in the first photo (Grand Mosque of West Sumatra), which blends modern elements with local Minangkabau culture, has the potential to provide comfort, good lighting, acoustics, and circulation if designed properly. Although it requires technical planning and high costs, such designs can enhance public appreciation for architecture and potentially become religious tourism objects. The sources also stated that buildings with geometric designs are in the second and third images; although structural efficiency and materials vary, the design remains functional and visually appealing. Remain visually appealing and suitable for implementation in major Indonesian cities, with adjustments for climate and local needs.

Overall, the findings show that modern geometric designs, although more complex and expensive, are actively pursued by Young people seeking aesthetics and functionality. These items have the potential to be implemented in major cities in Indonesia. The general public reacts positively to unconventional designs, although this response varies depending on cultural backgrounds and individual aesthetic values.

CONCLUSION

Based on the findings of this study, researchers can conclude that geometric shapes in modern architecture—ranging from symmetrical and asymmetrical to irregular forms—are positively received by the public, provided that comfort, functionality, and aesthetic value researchers consider. The results announced that the public discerns geometric designs as visually attractive, significant, and influential in forming an ergonomic environment. These findings directly address the research objective of exploring public perceptions of geometric design in urban environments. In addition, this research contributes to the field of architecture by emphasizing the importance of incorporating public acceptance into the design process so that architectural outcomes can better reflect the needs and expectations of users.

ACKNOWLEDGEMENT

We would like to express our deepest gratitude to Dr Wahyunengsih, M.Pd., who has helped us complete this research. We also express our appreciation to all participants who have provided responses to the questionnaire and to all students and architectural practitioners who are willing to take the time to be interviewed. Their contributions were invaluable and enriched the content and results of the research. This research did not receive funding from any party.

REFERENCES

- González-Pérez, Fco.-J., Avellaneda-López, O.-F., Christodoulou, M. A., & Giménez-Mateu, L. (2024). Geometric Parameters to Enhance the Perception of Architectural Spaces. *Prostor*, 32(1(67)), 60–73. [https://doi.org/10.31522/p.32.1\(67\).6](https://doi.org/10.31522/p.32.1(67).6)
- Kisteleghi, I., Horváth, K. R., Storcz, T., & Ercsey, Z. (2022). Building Geometry as a Variable in Energy, Comfort, and Environmental Design Optimization—A Review from the Perspective of Architects. *Buildings*, 12(1), 69. <https://doi.org/10.3390/buildings12010069>
- Rueda Márquez de la Plata, A., & Cruz Franco, P. A. (2022). Analysis of the First Metallic Works That Represented a Geometric Innovation in Their Architectural Application: The Origin of the Architecture-Engineering Dichotomy. *Superalloys*, 13(1), 32. <https://doi.org/10.3390/met13010032>
- De Naeyer, A. F. (2021). *Architectural Design Canons from Middle Ages and Before: An Inspiration for Modern Sustainable Construction*. IntechOpen. <https://doi.org/10.5772/INTECHOPEN.95391>
- Othman, L. K., & Ali, A. F. (2021). The Effect of Architectural Forms on Aesthetic Response : Study Case. *Science*, 136–151. <https://doi.org/10.24017/SCIENCE.2020.2.11>
- Yang, Y. (2022). A Study of the Morphological Design of Architecture from a Geometric Logic Perspective. *Security and Communication Networks*, 2022, 1–11. <https://doi.org/10.1155/2022/8140350>
- Wicaksono, MRT (2020). *Kajian arsitektur modern pada infrastruktur sekolah keberbakatan olahraga (sko)*. 3 (2), 252–260. <https://doi.org/10.17509/JAZ.V3I2.24683>
- Mohammad Ichwandardi Ruhiat, MI (2023). *Penerapan prinsip desain arsitektur modern Tadao Ando pada rancangan sambas islamic center*. 3 (1), 411-421. https://scholar.google.com/scholar?hl=id&as_sdt=0%2C5&q=penerapan+geometri+dalam+perencanaan+pembangunan+arsitektur+modern+menggunakan+metode+desain+deskriptif+Ruhiatkuanntitaf+&btnG=#d=gs_qabs&t=1745912637868&u=%23p%3D_OM7VhWCcS0J

- Tesis.id. (2023). Kombinasi Metode: Konsep, Jenis, dan Aplikasinya dalam Penelitian. Diakses dari <https://tesis.id/blog/kombinasi-metode-konsep-jenis-dan-aplikasinya-dalam-penelitian/>
- Enago Academy. (2023). Planning Your Data Collection: Designing methods for effective research. Diakses dari <https://www.enago.com/academy/data-collection/>
- Hansen, S. (2020). *Qualitative Research Methods in Human Geography*. Oxford University Press.
- ATLAS.ti. (2023). Data Organization in Research: Methods, Reduction & Coding. Diakses dari <https://atlasti.com/guides/qualitative-research-guide-part-2/data-organization>
- Creswell, J. W., & Creswell, J. D. (2023). *Research design: Qualitative, quantitative, and mixed methods approaches* (6th ed.). SAGE Publications.
- Bans-Akutey, A., & Tiimub, B. M. (2021). Triangulation in research. ResearchGate. https://www.researchgate.net/publication/355425953_Triangulation_in_Research
- Bhandari, P. (2022). Triangulation in Research: Guide, Types, Examples. Scribbr. Diakses dari <https://www.scribbr.com/methodology/triangulation/>
- Bhandari, P. (2023, June 22). Triangulation in research: Guide, types, examples. Scribbr. <https://www.scribbr.com/methodology/triangulation/>
- Nurfajriani, W. V., Ilhami, M. W., Mahendra, A., Afgani, M. W., & Sirodj, R. A. (2024). Triangulasi Data Dalam Analisis Data Kualitatif. *Jurnal Ilmiah Wahana Pendidikan*, 10(17), 826-833. <https://doi.org/10.5281/zenodo.13929272>
- Morgan, H. (2024). Using triangulation and crystallization to make qualitative studies trustworthy and rigorous. *The Qualitative Report*, 29(7), 1844–1856. <https://nsuworks.nova.edu/tqr/vol29/iss7/4/>