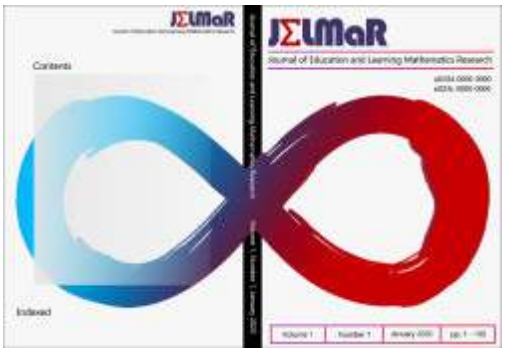

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Exploring Ethnomathematics In Saint Joseph Catholic Church, Jember

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***Abstract**: Mathematics is often perceived as an abstract science detached from daily life, whereas in reality, it grows and develops within the culture of society. The ethnomathematics approach seeks to reveal how mathematical concept, especially geometry, manifest within cultural practices and architectural works. This study aims to explore the application of geometric concepts in the architecture of Saint Joseph Catholic Church Jember as an integration of mathematics, culture, and spirituality. The research employed a qualitative approach with an ethnographic case study design through participatory observation, interviews, and visual documentation. The result show that various elements of the church building, such as the bell tower, triangular roof, arched windows, pillars, stained glass, and floor mosaics, contain geometric concepts such as plane figures, solid figures, symmetry, similarity, and geometric transformations including reflection, rotation, and translation. Each architectural element demonstrates not only mathematical order but also symbolic meanings such as balance, perfection, and eternity that reflect Catholic faith values. The findings affirm that ethnomathematics serves as a bridge between science, art, and cultural values, making mathematics learning more contextual, meaningful, and grounded in real life.*

***Keyword**: ethnomathematics, geometry, architecture, culture, Saint Joseph Catholic Church Jember*

INTRODUCTION

Mathematics is often regarded as an abstract discipline, separate from everyday life. However, numerous studies have shown that mathematics actually grows and develops within the social and cultural contexts of society. The study of ethnomathematics emerges as an approach that bridges the relationship between mathematics and culture by exploring how mathematical concepts are discovered, applied, and transmitted through community activities. According D'Ambrisio (1985), ethnomathematics is the study of how cultural groups develop and utilize mathematical ideas within social, historical, and pedagogical contexts. This approach emphasizes that mathematics is not merely the result of rational thought confined to academic spaces but is also part of the lived experiences that reflect human cultural practices.

In the Indonesian context, ethnomathematics is often associated with various forms of local wisdom, such as traditional measurement systems, folk games, batik motifs, weaving craft, and vernacular architecture, all of which naturally contain mathematical principles (Winardi & Jupri, 2024). Yudhi & Septiani (2024) state that ethnomathematics functions as a bridge between local culture and formal mathematics taught in schools. Traditional communities may not refer to their activities as "mathematics," yet in practices, they have already applied concepts such as geometry, patterns, symmetry, and ratio. This shows that mathematics is part of the way people think and act in daily life.

The study of ethnomathematics is not only important for the development of mathematical knowledge itself but also carries significant social and cultural value. Astuti & Rozikin (2025) emphasize that the ethnomathematics approach makes mathematics learning more cotextual and meaningful because students can understand mathematical concepts through real phenomena that are close to their own lives. Tobondo (2025) also notes that ethnomathematics helps cultivate a sense of pride in one's own culture while developing students' mathematical reasoning abilities. The scope of ethnomathematics is broad, encompasing architecture, traditional games, calendrical systems, handicrafts, and

various cultural activities containing mathematical elements (Jannah, Wati, & Wulaningtyas, 2025).

One of the most concrete applications of ethnomathematics can be found in the field of architecture. In architectural traditions, mathematical concepts often appear implicitly through the use of geometric principles, proportions, symmetry, and similarity. For example, a study of the traditional house "*Uma Lengge*" revealed the use of body-based measurement systems such as fingers, spans, and cubits, indicating a relationship between size, proportion, and geometry (Islamiati & Purnamansyah, 2024). Meanwhile, research on ancient architecture in Kediri discovered the application of points, lines, angles, and both two and three dimentional shapes in building designs (Karunia & Setianingsih, 2021).

The application of mathematics in architecture is also evident in religious buildings. Faruq (2023), in his study of *Masjid Jami' Sultan Syarif Abdurrahman* in Pontianak, identified geometric forms such as triangles, hexagons, cubes, blocks, pyramids, and cylinders as integral parts of the building's structure. Similarly, Ana & Mariana (2022) showed that the architecture of *Masjid Al-Akbar* in Surabaya contains planar shapes such as squares, rhombuses, and circles, as well as solids like pyramids, cylinders, and spheres. These elements are not merely aesthetic but also serve as symbols of harmony and balance that reflect spiritual values. Thus, religious architecture becomes a tangible representation of the integration between culture, art, and mathematics.

Figure 1. Front View of Saint Joseph Catholic Church Jember

Within this context, Saint Joseph Catholic Church in Jember is an intriguing object of study through the lens of ethnomathematics. The church holds significant historical and cultural value, as it was built during the colonial era and reflects a fusion between European Gothic architecture and local Pendhalungan culture (a mix of Javanese, Madurese, and Osing influences). Distinctive features of the church, such as exposed brick walls, colorful stained glass windows, a tall bell tower, and arched roofs, show the application of geometric concepts including rectangles, triangles, cylinders, and hemispheres. These

elements reveal a balance between religious function, aesthetic beauty, and profound symbolism.

Figure 2. Interior View of Saint Joseph Catholic Church Jember

The structure of the church also demonstrates principles of symmetry and similarity. The circular or polygonal stained glass windows symbolize unity and infinity. The repeating church pillars illustrate the concept of sequences and series, while the domes and roof arches can be examined as applications of parabolic curves. Symmetry, pattern, and proportion are key components in creating harmony and spirituality within the building.

By examining Saint Joseph Catholic Church in Jember through the perspective of ethnomathematics, this study aims to uncover how geometric concepts are implemented in its architecture and ornamentation. This researc contributes not only to the preservation of cultural and religious architectural values but also enriches understanding of the connection between mathematics, culture, and human spirituality. Through this exploration, it is hoped that there will be greater appreciation of mathematics as an integral part of human life and cultural identity.

METHOD

This research employed a qualitative approach with an ethnographic case study design. This approach was chosen because it allows for an in-depth exploration of the symbolic meanings and geometric concepts embedded in the architecture of Saint Joseph Catholic Church in Jember. According to Nurrisa, Hermina, & Norlaila (2025), qualitative research aims to understand social realities in their natural settings, emphasizing subjective meaning and interpretative processes in analyzing phenomena. The case study design was selected because it enables comperhensive investigation of a single object within clearly defined spatial and temporal boundaries, in this case, a church building possessing distinctive cultural and religious values.

This study was conducted at Saint Joseph Catholic Church in Jember, East Java. The location was selected because its architecture exhibits diverse geometric elements, such as curved window and door structures, symmetrical floor patterns, and Gothic as well as Dutch Colonial ornamental design. The subjects of study included architectural elements such as the bell tower, pillars, floor mosaics, stained glass, and altar, which were analyzed

based on their geometric forms and the symbolic values they contain. The research informants consisted of church administrators, the parish priest, and individuals knowledgeable in geometry and architecture, who were able to provide in depth insights into the meanings and geometric structures of the church building.

Data collection was carried out using three primary methods: participatory observation, semi-structured interviews, and visual documentation in the form of photographs. The stages of the research began with pre-field activities, including obtaining research permission and conducting preliminary site visits, followed by field data collection, and concluded with data analysis and verification of the research findings. Observation was used to identify architectural elements that reflect geometric concepts, while interviews aimed to obtain in-depth information regarding the symbolic meanings and architectural background of the church. Visual documentation played an important role as empirical evidence and served as supporting material in the data analysis process.

The research process began with problem identification and a preliminary study conducted through initial observations and a literature review to determine the urgency of exploring geometric concepts in the architecture of Saint Joseph Catholic Church in Jember. Following this, the researcher formulated the objectives and research questions that served as the foundation and and direction of the study. The next stage involved collecting theoretical references and conducting a literature review from various scholarly sources related to ethnomathematics, churc architecture, and the interrelationship between culture and mathematics. Based on this theoretical framework, the researcher developed research instruments, including observation guidelines, interview protocols, and visual documentation formats, whic were used during the data collection process in the field.

Data analysis in this study employed a descriptive qualitative approach, aimed at identifying, interpreting, and describing findings related to geometric concepts found in the architecture and ornaments of Saint Joseph Catholic Church in Jember. The analyzed data included visual documentation, field observation notes, and interview data containing informants' perspectives on the symbolic meanings and cultural values of the church's geometric elements. The analysis process followed the Miles and Huberman, which consists of three main stages: data reduction, data display, and conclusion drawing or verification (Ramdona, Junista, & Gunawan, 2025). In the data reduction stage, the researcher selected and focused on information relevant to the researc objectives. The data display stage involved presenting the findings in the form of descriptive narratives and thematic tables that illustrate the interrelationsips among geometric elements. Meanwhile, the conclution drawing stage was carried out by interpreting the connections between geometric forms, aesthetic values, and symbolic meanings embodied in the church's architecture.

To ensure the validity of the data, method and source triangulation was employed, as recommended by Daruhadi & Sopiati (2024) and Ramdona, Junista, & Gunawan (2025). Triangulation was carried out bya comparing the results of observations, interviews, and documentation to ensure data consistency. Validation was further strengthened through cross-checking with several informants who possessed relevant expertise and knowledge concerning the research object. Through this method, the study is expected to provide a comperhensive depiction of the application of geometric concepts in the architecture and ornaments of Saint Joseph Church in Jember, while also demonstrating the close interrelationship between mathematics, art, culture, and spirituality manifested within the religious building.

RESULT AND DISCUSSION

INTERVIEW FINDINGS

Interviews were conducted with three groups of informants, namely the administrators of Saint Joseph Church in Jember, the parish priest, and a mathematics teacher from one of the junior high schools in Jember. The purpose of these interviews was to obtain a deeper

understanding of the symbolic meanings, cultural values, and the application of geometric concepts present in the church's architecture.

From the interview with the administrators of Saint Joseph Church in Jember, it was revealed that the church has a long history closely related to the development of the Catholic faith in the Jember region. The administrators explained that the church was built during the Dutch colonial period, around the early 20th century, and initially functioned as a place of worship for European-descended Catholics who lived in the area. Over time, the church underwent several renovations and expansions to accommodate the growing number of parishioners while maintaining its historical values and authenticity. The architecture of the church continues to preserve its distinctive Gothic-Colonial style, characterized by a tall bell tower, arched windows, and symmetrical patterns on the walls and floors.

Figure 3. Photographs of the Church Building Over Time

The administrators also explained that the architectural design was not chosen by coincidence, but rather carries deep meaning connected to the history of the spread of Catholicism in the region. The shape of the bell tower, for instance, serves not only as a marker for the Angelus prayer and Mass times, but also as a symbol of the church's presence as a spiritual center for the people of Jember during that period. In addition, the use of stained-glass windows depicting the Crucifixion of Jesus Christ serves as an educational medium and a means of faith reflection for the congregation attending worship. The administrators emphasized that every architectural element of the church embodies both historical and spiritual values, serving as tangible evidence of how the integration of art, culture, and religion has created a meaningful architectural heritage that endures to this day. The information provided by the administrators shows that the existence of Saint Joseph Catholic Church Jember serves not only as a place of worship but also as a historical witness to the development of Catholicism in Jember, in line with the documentation found in the Parish Profile of Saint Joseph Church Jember (Malang, 2018) as well as the views of Singal, Kaunang, & Runtu (2024), who emphasize that Catholic churches built during the colonial era by European missionaries served both as spiritual centers and as symbols of the presence of the Catholic faith in the Dutch East Indies.

The parish priest of Saint Joseph Catholic Church Jember, expressed the view that the architecture of the church hold profound spiritual meaning that cannot be separated from theological values. Every shape and geometric symbol within the building serves to remind the faithful of the greatness and order of God's creation. The use of symmetry in both the interior and exterior design of the church symbolizes the balance between the spiritual and physical realms. The principles of order and proportion in church architecture reflect the harmony of natural laws estabilished by God. In the context of Catholic faith, architecture

is not merely a work of art, but also a medium for contemplation that helps the faithful reflect upon their faith through visual beauty.

The existence of Saint Joseph Catholic Church Jember serves as concrete evidence of the harmonious integration of faith, culture, and architectural art. Every physical element of the building carries a profound religious message, allowing the congregation to experience God's presence not only through prayer but also through the spiritual beauty of architecture rich in symbolic meaning. This aligns with the view of Simanjuntak & Samosir (2023), who state that church buildings are concrete representations of the faith of congregation, manifested through geometric tructures that embody religious symbolism.

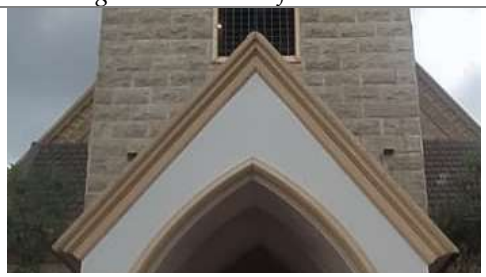
The mathematics teacher interviewed provided an educational perspective on the geometric elements found in the church's architecture. The Saint Joseph Catholic Church Jember, serves as a real-life example of the application of geometric concepts in everyday life. Shapes such as triangles, rectangles, circles, and cubes can be found throughout various parts of the church, from the roof and pillars to the floors and stained-glass ornaments. These elements reflect the application of the principles of symmetry, proportion, similarity, and geometric transformation.

Understanding geometric concepts through real objects such as the church is believed to help students connect theory with practice. The church's architecture provides a concrete visualization of how geometry is used to create balance and beauty in design. Furthermore, the incorporation of symbolic values into geometric forms enriches the understanding that mathematics is not merely an exact science, but also a language that expresses cultural and spiritual values. This perspective aligns with the study by Hafis & Busrah (2023), which explains that the use of cultural objects in mathematics learning can enchance students' critical thinking skills and foster appreciation for local cultural values.

OBSERVATION AND DOCUMENTATION FINDINGS

Based on the results of observations and documentation, various data and information were obtained as the foundation of study. The observations were conducted directly at Saint Joseph Catholic Church Jember.

Table 1. Identification of Geometric Forms and Concepts in Saint Joseph Catholic Church Jember

No	Architectural Element	Figure	Geometric Shape(s)	Geometric Concept	Symbolic Meaning
1	Main Church Building	 *Figure 4. Interior of the Church*	Rectangle and semicircle	Bilateral symmetry	Stability, balance between the worldly and the spiritual
2	Church Roof	 *Figure 5. Church Roof*	Isosceles triangle	Line symmetry and similarity	Symbolizes the Trinity and the relationship between humanity and God

3	Bell Tower		Triangular prism and cuboid	Solid geometry, proportion	Symbol of prayer and eternity

Figure 6. Bell Tower

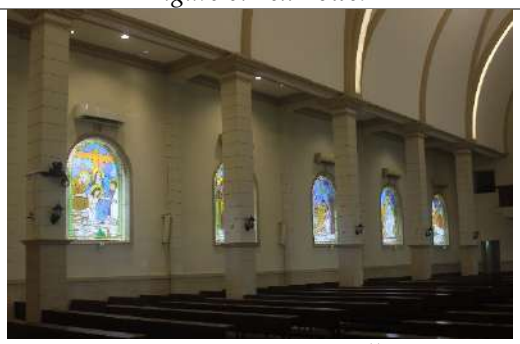
4	Supporting Pillars		Cuboid	Solid geometry, proportion, translation	Strength of faith and structural balance

Figure 7. Supporting Pillars

5	Stained-glass Frame		Rectangle and semicircle	Translation	Perfection

Figure 8. Stained-glass 1

6	Stained-glass		Circle, triangle, rectangle	Rotation and translation	Perfection, spiritual harmony

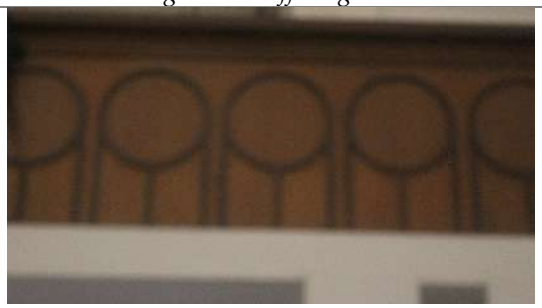
Figure 9. Stained-glass 2

7	Main Door		Semicircle, square, rectangle	Line symmetry, reflection	Openness of heart; gateway to God's house

Figure 10. Main Door

8	Side Door		Square, rectangle, right trapesium	Line symmetry, reflection, translation	Openness of heart; gateway to God's house

Figure 11. Side Door

9	Floor Mosaic		Square, polygon, circle	Reflection, rotational symmetry, translation	The path toward light and salvation
		Figure 12. Floor Mosaic			
10	Altar		Cuboid, sphere, cylinder	Symmetry, proportion	Sacred centre and spiritual balance
		Figure 13. Altar			
11	Offering Box		Square pyramid, cuboid	Solid geometry	The faithful heart open to God's grace
		Figure 14. Offering Box			
12	Balcony Railing		Circle, square	Translation, line symmetry	Eternity, perfection, and the divine presence
		Figure 15. Balcony Railing			

13	Tabernacle		Square, rectangle, cylinder, hemisphere, cuboid, semicircle	Line symmetry, reflection	Wholeness, stability, and divine perfection present among the faithful

Figure 16. Tabernacle

14	Altar Cloth Lace		Rhombus, circle, triangle, hexagon, line, point	Translation, rotation, line and rotational symmetry	Eternity and the divine order of creation

Figure 17. Altar Cloth Lace

The findings of the study show that the architecture of Saint Joseph Catholic Church Jember contains a wide range of geometric concepts harmoniously integrated into its structure and ornamentation. Observation results revealed that almost every part of the building reflects mathematical order through its form, proportion, and symmetry. Architectural elements such as the bell tower, pillars, roof, arched windows, floor mosaics, stained glass, and altar demonstrate the application of geometric concepts including plane and solid figures, symmetry, proportion, and geometric transformations.

The roof of the church, shaped as an isosceles triangle, symbolizes the Trinity (Father, Son, and Holy Spirit) and represents balance and perfection. A similar study by Harahap & Suparni (2023) found that triangular forms in religious architecture are often chosen for their philosophical meaning, representing the spiritual relationship between heaven and earth. Meanwhile, the frames of the stained glass windows and main doors are designed with semicircular and elliptical arches, typical of Gothic and Dutch Colonial architecture. These structures apply concepts of rotational symmetry and reflection, carrying spiritual significance as gateways to the house of God. The stained glass windows are adorned with hexagonal, octagonal, and circular patterns symbolizing perfection and eternity. These recurring motifs exemplify geometric transformations such as rotation and translation, producing both visual and symbolic harmony (Wulan, Inayah, Khusnah, & Rohmatin, 2021).

The findings reinforce the idea that mathematics, particularly geometry, is closely related to culture and spirituality. The architecture of Saint Joseph Catholic Church Jember serves as a tangible embodiment of geometric concepts that are not only structural but also rich in symbolic meaning. The geometric patterns found in the church building represent the relationship between humanity, God, and the universe, tranlated into visual architectural forms. Thus, the church's design exemplifies how geometry functions as a bridge between science, art, and faith, integrating aesthetic beauty with profound spiritual significance.

CONCLUSION

Based on the results of the study, it can be concluded that the architecture of Saint Joseph Catholic Church Jember embodies various geometric concepts realized through its forms, structures, and decorative elements. Architectural components such as the bell tower, arched windows, floor mosaics, and pillars reflect the application of geometric principles, including plane and solid figures, symmetry, similarity, proportion, and geometric transformation such as translation, reflection, and rotation. The circular forms found in the stained-glass windows symbolize divine perfection and eternity, while the repetitive floor patterns represent order and spiritual harmony, reflecting the religious values embedded within the church's architecture.

The application of these geometric concepts serves not only a structural and aesthetic purpose, but also conveys deep symbolic and spiritual meaning. The geometric symbols illustrate how Catholic faith and spiritual philosophy are expressed through visual forms rich in meaning. These findings affirm that mathematics, particularly geometry, is not merely an abstract discipline, but an integral part of human culture and spiritual expression. This aligns with perspective of D'Ambrisio (1985), who asserts that ethnomathematics serves as a bridge for understanding how mathematical concepts are developed and lived within cultural contexts.

Interviews with informants also rainforced these findings: the curch administrators interpreted geometric elements as symbols of divine beauty and greatness, while the mathematics teacher viewed the church as a contextual medium for teaching geometry. Together, these insight reveal a close interconnection among mathematics, culture, and spirituality, showing that mathematics education can be revitalized through cultural and locally meaningful approaches.

The following suggestions are proposed based on the results of this study. First, for future researchers, it is recommended to broaden the study of ethnomathematics to include other religious buildings such as mosques, temples, or monasteries in order to enrich the understanding of the interrelationship among culture, religion, and mathematics. Further research may also explore more complex mathematical aspects, such as fractals, ratios, or Fibonacci proportions, in the design of religious architecture. Second, for educational institutions, the results of this study can serve as an inspirational resource for teachers and lecturers to connect mathematics learning with real life contexts, helping students understand that mathematics play an important role in culture and surrounding environment. Third, for church administrators and cultural practitioners, the findings of this study may serve as a basis for preserving the architectural values and geometric symbolism present in the church building as part of local cultural and historical heritage. Lastly, for the government and educational institutions, it is hoped tat studies such as this will receive greater support through policies and the development of cultural based curricula that integrate science, art, and local wisdom as contextual learning resources for students at various educational levels.

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