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ETHNOMATEMATICS EXPLORATION AT SIPAMUTUNG TEMPLE PADANG LAWAS REGENCY IN THE CONCEPT OF BUILDING SPACE

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Abstract

Indonesia is a country rich in culture and historical heritage, one of which is the sipamutung temple located in Padang old regency. This temple not only holds cultural and spiritual values but also contains mathematical concepts that are interested to study in mathematics education. This study aims to explore and describe the mathematical concepts embedded in the architectural structure of sipamutung temple from the perspective of ethnomathematics , particularly focusing on solid geometry. Specifically, the research seeks to identify the application of geometric shapes such as cubes, rectangular prisms, pyramids, cylinders, and spheres in the temple's design, and analyze them in relation to Bishop's six ethnomathematical activities: counting, measuring, designing, locating, explaining, and playing. By doing so, this study contributes to the enrichment of ethnomathematical discourse by demonstrating how cultural artifacts can reflect mathematical thinking and local knowledge systems. This research employs a qualitative method with an ethnographic approach. Data were collected through direct observation, interviews with temple managers, and photographic document of the research objects. The data were analyzed through data reduction, data presentation, and conclusion drawing. The results indicate that the architectural structure of Sipamutung Temple Applies Various Geometric Shapes such as Cubes, Rectangular Prisms, Pyramids, Spheres, and Cylinders. These Geometric Elements are found in the main building, Stairs, Perwara, Inner Chambers, and Temple Ornaments. This study contributes to the development of mathematics learning based on local culture and raises awareness of the importance of cultural heritage preserving. Through an ethnomathematical approach, mathematics learning can be become more contextual, engaging, and meaningful for students.

Keywords: *sipamutung temple, ethnomathematics, solid geometry*

Abstrak

Indonesia adalah negara yang kaya akan budaya dan warisan sejarah, salah satunya adalah Candi Sipamutung yang terletak di Kabupaten Padang. Candi ini tidak hanya memiliki nilai budaya dan spiritual, tetapi juga mengandung konsep matematika yang menarik untuk dipelajari dalam pendidikan matematika. Penelitian ini bertujuan untuk mengeksplorasi dan mendeskripsikan konsep matematika yang tertanam dalam struktur arsitektur Candi Sipamutung dari perspektif etnomatematika, dengan fokus khusus pada geometri ruang. Secara spesifik, penelitian ini berusaha untuk mengidentifikasi penerapan bentuk geometri seperti kubus, prisma persegi panjang, piramida, silinder, dan bola dalam desain candi, serta menganalisisnya dalam kaitannya dengan enam aktivitas etnomatematika Bishop: menghitung, mengukur, merancang, menentukan lokasi, menjelaskan, dan bermain. Dengan demikian, penelitian ini berkontribusi pada pengayaan diskursus etnomatematika dengan menunjukkan bagaimana artefak budaya dapat mencerminkan pemikiran matematis dan sistem pengetahuan lokal. Penelitian ini menggunakan metode kualitatif dengan pendekatan etnografi. Data dikumpulkan melalui observasi langsung, wawancara dengan pengelola candi, dan dokumentasi foto objek penelitian. Data dianalisis melalui reduksi data, penyajian data, dan

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penarikan kesimpulan. Hasil penelitian menunjukkan bahwa struktur arsitektur Candi Sipamutung menerapkan berbagai bentuk geometri seperti kubus, prisma persegi panjang, piramida, bola, dan silinder. Elemen geometri ini ditemukan di bangunan utama, tangga, perwara, ruang dalam, dan ornamen candi. Penelitian ini berkontribusi pada pengembangan pembelajaran matematika berbasis budaya lokal dan meningkatkan kesadaran akan pentingnya pelestarian warisan budaya. Melalui pendekatan etnomatematika, pembelajaran matematika dapat menjadi lebih kontekstual, menarik, dan bermakna bagi siswa.

Kata Kunci: Candi *sipamutung, etnomatematika, geometri*

INTRODUCTION

Indonesia is known as a country that has diversity, marked by the diversity of ethnic groups, culture, religion, language, and customs. In everyday life, culture and education are two inseparable aspects. Both have a very close relationship, one of which is seen in the relationship between culture and mathematical concepts (Safitri, 2023). Mathematics is one of the subjects learned by students from elementary school to high school. Even in college. This proves that mathematics is one of the subjects that plays an important role in everyday life (Yosi & Yahfizham, 2023). Mathematics is one field of study that requires high mentality in the learning process because mathematics is an abstract concept that has been arranged systematically in a structure based on logical reasoning.

However, in its implementation, mathematics is often considered a subject that is full of abstract concepts and is difficult to learn by most students. This assumption often causes a lack of enthusiasm and interest in learning among them (Tio et al., 2025). Learning mathematics is very important, but there are some students who say that learning mathematics is difficult (Siregar & Yahfizham, 2023). Mathematics learning is an activity that involves teachers and students in interactions that aim to recognize and understand the concepts of mathematics together (R. Sari, 2021). Students experience experience using mathematics as a tool to understand or convey information, such as using equations or tables in the mathematical model, which is a simplification of story problems or other mathematical descriptions (Arif & Nim, 2023).

Every student spends more time outside of school than at school. They also gain knowledge outside of formal education, and it happens every day and becomes a habit. The ethnomatematics method connects culture with mathematics a and can be a solution to increasing students' understanding (Aulia & Afri, 2023).

Mathematics is actually an important part that cannot be separated from the daily lives of society, although most people do not realize that they often apply mathematical concepts and principles in their various daily activities (Basmara & Yahfizham, 2024). Mathematics learning associated with cultural elements will make students more interested and able to connect the material learned with their daily experiences. This approach not only helps in strengthening the understanding of concepts, but also plays a role in increasing student motivation and interest in learning (Kambani, 2025).

Mathematics related to culture is commonly called ethnomatematics. Ethnomatematics see how mathematics is used in activities or people's lives. This bridges mathematics with culture (Jayanti & Puspasari, 2020). In line with that, students or teachers must also be familiar with ethnomatemtika, the need for an ethnomatematics approach as an approach in learning mathematics. Because it is realized that ethnomatematics originated and developed from culture, but it is often not realized that mathematics has been used, so that from culture in the form of human activities or vice versa, the application of mathematics in real life is seen (Harahap & Rakhmawati, 2022).

Understanding and integrating the mathematical methods of various cultures can help students solve mathematical problems better. This approach not only enriching students' mathematical knowledge but also building relationships with their cultural context. This can increase the relevance of mathematics learning in daily life and enable the development of more innovative and contextual problem solving methods (Suriani et al., 2024).

Thus, educators will more easily instill cultural values in students, so that cultural values become part of the nation's character (Kristial et al., 2021). Ethnomatematics is the study of how traditional people use mathematics in many ways, such as in their arts and culture (Yusnizar & Yahfizham, 2024). Ethnomatematics helps connect mathematics and culture, especially in learning mathematics (Amirah & Budiarto, 2022).

The purpose of cultural-based learning is to give students information, manage, and find ways of mathematical concepts can be applied in everyday life (Sinaga & Yahfizham, 2023). Ethnomatematics itself, namely to learn how students can understand, manage, and use cultural ideas in solving mathematical problems and practicing them in their own environment (Sulaiman & Nasir, 2020). Each province has a unique culture. Traditional

clothing, traditional houses, and regional specialties and so on. One of the cultural objects that has great potential to be used as material for ethnomatematics studies is temples. The temple as historical relics has architectural, spiritual, and mathematical values in its construction

On the island of Sumatra, especially North Sumatra there are many cultures that are often visited by people or visitors from outside, both traditional houses and other historic places. On this island there are many temple buildings, such as Bahal Portibi Temple, Sipamutung Temple, Tandihat Temple and there are still many temples that are often visited or become tourist attractions by the community. Temple is a building that has high historical value. The temple is a clear proof of the technology of the community at that time which was very extraordinary because of the limited facilities and infrastructure. The function of the temple as a place of worship and a place of burial of the ash of the body, so it can be said that the function of the temple depends on the king who has the ruling at that time (Arifin, 2015).

Padang Lawas Regency many temple buildings such as; Sipamutung Temple, Tandihat Temple, Temple Bako Sangkilon (Mayanti, 2021). The bath walls have various decorations other than as an aesthetic elements also have spiritual values and symbolic meanings that add to the attractiveness of the existence of the temple. Sipamutung Temple, which is located in Siparau Village in Padang Lawas Regency, has high historical and architecture value. This temple functions as a place of worship and cultural symbols of the local community.

Sipamutung Temple displays various geometric forms such as cubes, beams, cylinders, and pyramids in their architectural structure. Sipamutung Temple is categorized as a mathematical object in the context of ethnomathematics because its structure and architectural elements reflect the real application of mathematical concepts, particularly in solid geometry. This building not only holds historical and spiritual values but also represents mathematical activities embedded in the culture of past societies.

According to Bishop (1988) dalam Hanif, there are six universal mathematical activities inherently present in every culture: counting, measuring, designing, locating, explaining, and playing (Siparau, 2025). These activities form the foundation of the ethnomathematical

approach and can be identified in various cultural practices, including the construction of temples .

From the explanation above, attracting the attention of the author to make the culture a form that culture and mathematics have a strong relationship, so that people can understand the culture that is around the temple, as well as mathematical and ethnomatematics aspects contained therein. Researcher conclude the problem formulation of this exposure is how the concept of building space contained in Sipamutung Temple and explain the characteristics and aspects contained therein

Methode

This research is a qualitative research with an ethnographic approach. Qualitative research aims to understand in depth the application of mathematical concepts in the cultural life of society, while the ethnographic approach is used to describe, describe, and analyze cultural elements related to the architecture of Sipamutung Temple. This research focuses on identifying the concept of the geometry of the space found in the structure and ornament of temples. Researchers use data collection techniques through direct observation, interviews with temple managers, as well as photo documentation. Data were analyzed by data reduction techniques, data presentation, and drawing conclusions. This study uses a human instrument, where researchers play a direct role in collecting data in the field.

RESULTS AND DISCUSSION

Padang Lawas Regency holds many historical relics. Archaeological discoveries such as temples, inscriptions, reliefs, and statues come from the Hindu-Buddhist era in Indonesia. Padang Lawas residents call cultural heritage as "BUAO". The word "monastery", mentioned in the Sitopayan inscription, is the source of the name of the local community. Not much different from the material used to build several temples in Java, bricks are used to build a monastery in the Padang Lawas area. Sipamutung Temple is one of the relics of Hindu - Buddhist civilizations in Padang Lawas, Central Barumun District which functions as a religious center in the 11th to 13th century (Tanjung & Ali, 2024). Administratively, this temple is located in Síparau Village, Barumun Tengah District, Padanglawas Regency, North Sumatra. Located about forty kilometers from Sibuhuan, the capital of Padanglawas

Regency, or around seventy kilometers from Padangsidimpuan, and about four hundred kilometers from Medan, the capital of North Sumatra Province.

In the Padang Lawas bathing complex, Sipamutung Temple is the largest. With an area of 6000 square meters, Sipamutung Temple has a brick wall around it, with an area of 74 x 74 meters. The Sipamutung Temple complex consists of one main structure, 2 sculptures of the sculpture of rays with his hands worshiping, 6 Perwara Temple and 16 stupas (Daulay & Maulidiah, 2024). This iconographic art can show the background of a sacred building, components that are directly related to the completeness of this temple building are Kala, Makara, and Relief. Makara is a temple decoration that is usually at the entrance, niche, gate and the end of the stairs. In Sipamutung Makara Temple is located at the end of the stairs. Stupa is a symbol of Buddhism that has important religious values. The physical forms of Sipamutung Temple are inseparable from the concept of mathematical, not only as a culture that is a tourist attraction but the temple can also be used as a means in the introduction of the basic concepts of mathematics in real problems.

Based on the results of observations, documentation, and interviews that researchers conducted at Sipamutung Temple in Siparau Village, Barumun Tengah District, Padang Lawas Regency, it can be concluded that in the architecture of the Sipamutung Temple there is the application of mathematical aspects, especially in the concept of space geometry. This can be seen in the shape, size, and layout of the temple parts in accordance with the principles of geometry **.** Data obtained through direct observation at the location, interviews with the temple manager, as well as visual documentation in the form of photos and field notes. . In an effort to obtain an ethnomatematics description contained in Sipamutung Temple, researchers conduct an analysis of the concept of building space that appears in the structure of the temple building. Bishop (1988) in the book Irma Risdiyanti mentioned six basic activities in ethnomatematics that show the linkages between mathematics and culture that helped this analysis process carried out by processing data that had been collected through interviews, observations, and documentation during research activities. These six aspects include; Calculating, measuring, determining location, designing, playing games and explaining. (Irma & Rully, 2020) and this analysis process is carried out by processing data that has been collected through interviews, observation, and documentation in accordance with ethnomatematics characteristics (Conteltual, Integrative, Specific Local and Transformative) during research activities.

The results of the analysis of interview data conducted researchers with the temple management, Mr. Burhanuddin Nasution around the Sipamutung Temple site.

History of Sipamutung Temple

Researcher : What is the history of the establishment of Sipamutung Temple?

Resource person : Sipamutung Temple was built around the 11th century. This temple was a place for Hindu-Buddhist worship and the center of community religious activities at that time.

Researcher : When was Sipamutung Temple inaugurated as a cultural heritage?

Resource person : Sipamutung Temple was inaugurated as a cultural heritage in 1997 based on the Decree of the Minister of Education and Culture.

Researcher : How long have you been Sipamutung Temple Standing?

Resource person : Sipamutung Temple is estimated to have been established for more than 900 years, namely since around the 11th century, and still established today.

Sipamutung Temple Building Structure (measuring aspect and designing)

Research : What is the area of land used for Sipamutung Temple ?

Resource person : Sipamutung Temple Land Area reaches ± 6,000 m^2

Researcher : What is the size of the Sipamutung Temple building?

Resource persons : Sipamutung Temple Parent Building is around 11 m × 11 m, and the height reaches 13 m.

Researcher : What are the structures contained in Sipamutung Temple?

Resource persons : Parent temple, 6 Perwara (small temples around it), statues, makara, and stupa, rising stairs, batur, and multilevel roofs

In ethnomatematics in the process of building Sipamutung Temple, measuring activities have an important role. This is seen in:

- Uniform brick size → brick shaped like a beam with a long dimension, width, and thickness that is almost the same, so that the compilation of the wall becomes neat and stable. This uniformity shows the concept of the unit long and volume at that time.

- Building Dimensions → Comparison between legs, body, and temple roof shows the application of ratios that make buildings proportional and sturdy.
- Land slope → relatively flat and stable land selection shows a simple understanding of Hana the importance of the stability of the foundation.

Aspect of designing (designing)

The Sipamutung Temple structure is designed by consulting geometric patterns and shapes:

- The main shape of the building: kaki candi (ladder) shaped beams as a basis for supporting. Temple body (parent building) in the form of a combination of cubes and blocks. The temple roof resembles a rectangular pyramid. Stupa or the peak of ornament resembles a tube with the top of half the ball (hemisphere).

Aspect of determining location (locating)

The selection of the location of Sipamutung Temple shows the application of mathematical principles:

- Direction orientation → Temple building facing east, which symbolizes the welcoming sunrise. This orientation shows knowledge about the direction of the wind (bearing).

- Building Layout → Placement The main building and shows a regular pattern that can be explained with the concept of simple coordinates and relative distances.
- Topographic Considerations → Selection of flat land with a slight slope proves awareness of slope and soil stability.

Aspects Explaining (Explaining)

Form and Arrangement C Andi Sipamutung is not only technical, but also has a philosophical meaning In accordance with the results of the interview conducted with Mr. Burhanuddin Nasution:

- Vertical Division → Vertical structure of the temple (foot -body -roof) symbolizes three -layer cosmology (the underworld, the middle world, and the upper world) which is visualized by building three - dimensional space.
- Basic Plan → The philosophical meaning is balance, stability, determination and justice in life
- The form of the pyramid roof → balance, spiritual relationship and relationship with humans.
- Stupa → Strength and balance of the world and the hereafter and the continuity of life that is not interrupted.

The role of Sipamutung Temple as a tourist spot

Researcher : Is there a ticket rate to enter Sipamutung Temple?

Resource persons : Until now, no ticket rates are charged. Visitors can enter the Sipamutung Temple area for free.

Researcher : How many managers of Sipamutung Temple?

Resource persons : The manager of Sipamutung Temple consists of 5 people, namely the caretaker and officers from the Padang Lawas Regency Culture and Tourism Office.

Researcher : Are there anyday limits entering Sipamutung Temple?

Resource persons : There are no restrictions. Sipamutung Temple is open every day at 08.00-17.00 WIB, and can be visited by the general public according to the applicable rules.

- **Observation and Documentation Data Analysis**

Observation and Documentation Tables

NO	Name	Element of building space	Picture
1	Main Building Temple (Parent)	Cube	
2	The ladder of BUAO Perwara	Beam	
3	Perwara	Beam	
4	Inner room	Rectangular pyramid	

5	Kepa1a statue and	Ball	
6	Parent building decoration	Tube	

Based on the results of the study, it can be concluded that Sipamutung Temple is not only a place of worship and cultural heritage, but is also a creative form of human civilization at that time, namely Hindu-Buddhist society. In its design, people in ancient times used the principles of geometry and mathematical measures that were mature in order to achieve beauty, precision, and harmony. This is in accordance with the ethnomatematics approach to learning mathematics based on cultural aspects.

The forms of geometry applied to Sipamutung Temple can also be utilized at this time as a constextual and relevant mathematical learning medium. By understanding the size, shape, and layout of Sipamutung Temple, students can learn about prisms, tubes, pyramids, and balls directly, not only from textbooks. This is in accordance with the statements of D'Ambrosio (1985) and Barton (1996) that ethnomatematics can be a bridge to understand mathematics creatively, applicatively, and according to the context of the local culture . The role of Sipamutung Temple in learning mathematics in the concept of building space. Based on the results of observations made by researchers, found the concept of building space found in Sipamutung Temple including:

1. Cube

Cube is a square -shaped building with a height, width, and length of three dimensions. The cube has the same side, there are 12 ribs, 8 vertices, 4 diagonal sides, 4 diagonal spaces, and 6 diagonal plane in the form of rectangles, cube surface area with rib length or "s" as a unit length, then l = $6\,x\,s^2$ unit area and volume/contents in the cube with the length of the ribs or the "s" side of the length, then v = $s\,x\,s\,x\,s = s^3$

The concept of building space contained in Sipamutung Temple can be seen there is a part of the main building of the temple there is a cube -shaped building. The cube is a three-dimensional space building whose all sides are square and the size of each side is the same. The Sipamutung Temple that can be seen in the form of a cube is the main building of the temple

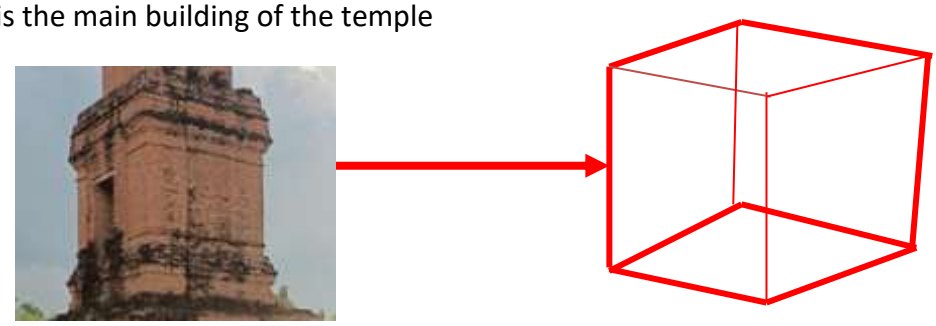

Figure 1. The main building of the temple

2. Beam

Beams are three -dimensional buildings consisting of three rectangular or square parts, with at least one part of different sizes. This beam has six sides, twelve ribs, and eight vertices. Beams have properties, elements, and formulas such as volume, surface area, diagonal plane, and diagonal space. The surface area of the beam is the result of the area of the area of all sides that form the beam. If the length of the beam is symbolized by P, width with L, and height with T, then the surface area of the beam (L) can be calculated by the formula: L = 2 (PL + PT + LT). And the beam volume Suppose "V" states the volume/contents on the beam with a length (p), width (l) and height (t), then: v = p x l x t unit volume

The concept of building space is found in Sipamutung Temple on the stairs of the Sipamutung temple in the form of a beam, which is a rectangular prism. This can be seen in the form of ladder steps consisting of several beams arranged in a packed manner. Perwara Temple is a small temple around the main temple. The building is also in the form of a beam, which is a rectangular prism, but the size of the officer is smaller. So the concept of beams can be seen from the stairs and temples of the temple.

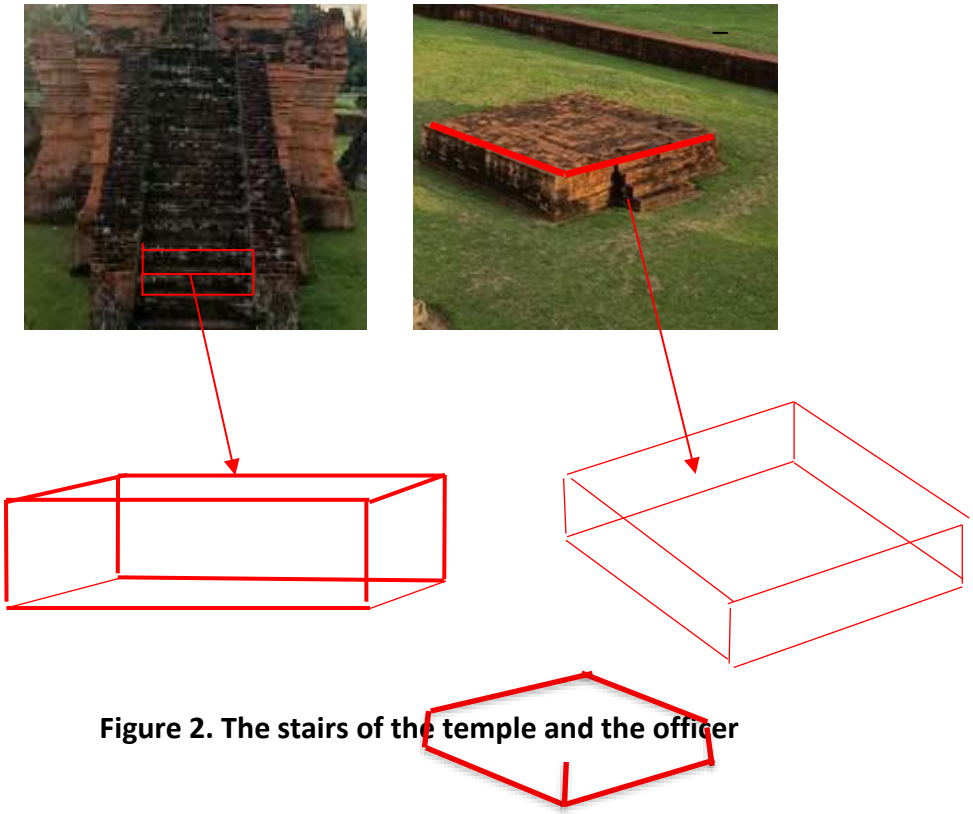

Figure 2. The stairs of the temple and the officer

3. Ball

The ball only has one side and consists of building three-dimensional space with an infinite circle with the same length and centered at one point. The ball is made from a semicircular wake that is rotated one full rotation or 360 degrees in the center line. The ball does not have any ribs or angle.

The center point, radius, diameter, volume, and surface area of the ball are the components. Surface area of the ball = $4\pi r^2$ and volume = $\frac{4}{3}\pi r^2$. Where: $\pi = 3,14\ atau\ \frac{22}{7}$, $\mathrm{r} = \text{jari} - \text{jari bola}$

The concept of the ball can be seen in the Sipamutung temple on the statue, the head of the statue of the gods in the form of a ball and the support of the statue is also shaped like a ball

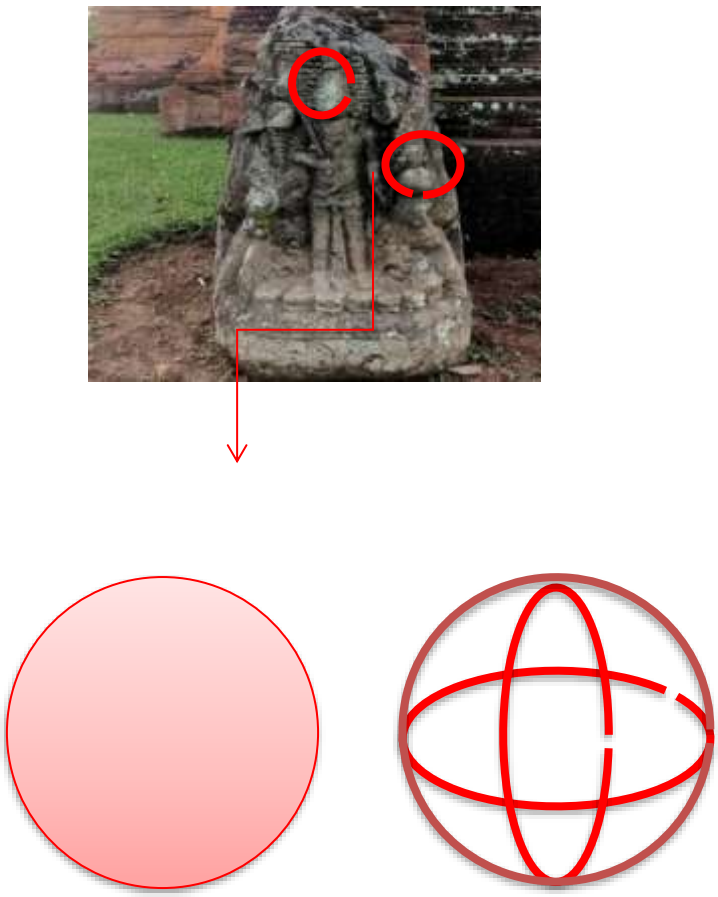

Figure 3. Statue Statue

4. Pyramid

Building a pyramid space is a three-dimensional shape that has a base in the form of n-upright sides in the form of a triangle, where all sides meet at one point. There are several types of pyramids, such as pyramids with a triangular base, rectangular, segraphy, rectangles, to a segile. Each type of pyramid has different elements according to the basic shape or base. The surface area of the pyramid is the total area of the entire surface/ side that forms the pyramid. For example "L"

states the surface area (side) of the pyramid, then: l = 1 x base area + x x area Side upright. And the volume of the pyramid, for example "V", states that the volume/side of the pyramid is "T" t "t", the area of the "la" prism, then: v = $\frac{1}{3}$ la x t.

The concept of building space can be seen in Sipamutung Temple at the top or the top of the Sipamutung Temple monastery room is formed resembling a pyramid. This is evident from the roof of the monastery that leads to one peak point, resulting in a meeting of triangle fields at its peak.

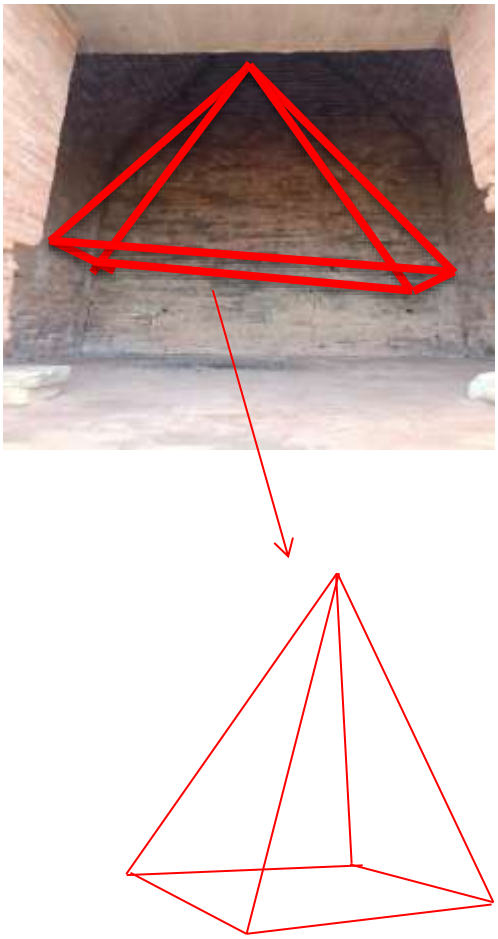

Figure 4. The main building room/ soo

5. Tube

$2\pi r\ (\ r + t\ )\pi = 3{,}14\ atau\ \frac{22}{7}\pi r^2 t\pi = 3{,}14\ atau\ \frac{22}{7}$One type of curved side space is a tube, which is a regular erect prism with a circle -shaped lid and base. The surface area of the tube is formulated l tube = where :, r = fingers of the base (lid), t

= height of the tube (distance from base to lid). And the volume of the tube = where :: r = fingers of base (lid) t = tube height (distance from base to lid)

The top of the Sipamutung temple, which is at the peak or roof, is tube -shaped. This can be seen from the size of the circle on the base and roof, then given a height size

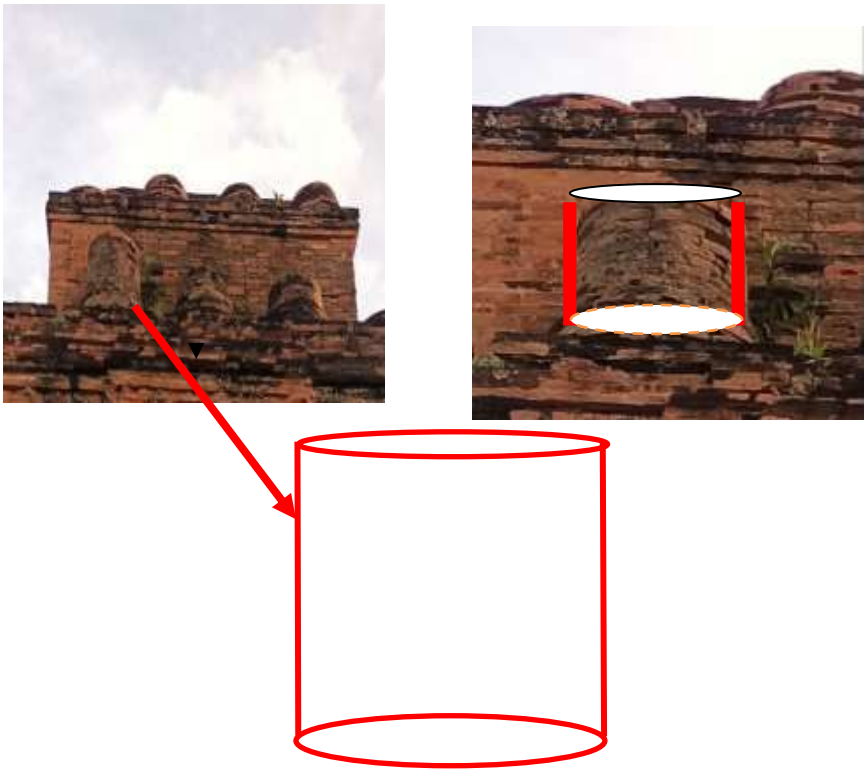

Figure 5. Temple decoration fence

Research contribution

This study provides complete ribusion in three main fields, namely as beriku t :

1. Theoretical contribution
    - This study expanded the study of ethnomatematics theory by examining the application of the concept of building space in the historic building Ca ndi sipamutung. This finding supports the views of D'Ambrosio (1985) and Bishop (1988) that cultural activities such as designing, measuring, and determining the location reflecting mathematical concepts that can be used as learning resources
    - Become an academic reference for subsequent studies that examine the integration between local culture and mathematics learning. And provide a

new understanding of how the concept of building space can be found and utilized in cultural objects

2. Practical contribution
    - Providing alternative materials Teaching Contextual that links mathematics learning with local culture, so that learning becomes more dancing k and meaningful for students. In line with research (Jayanti & Puspasari, 2020). learning that links mathematics with local culture can increase student understanding and motivation.
    - Provide inspiration for mathematics teachers to take advantage of cultural objects around as learning media and help the development of local wisdom -based learning tools that can increase mathematics learning interest
3. Social and cultural contribution
    - Increasing public awareness of the importance of preserving cultural heritage, especially Sipamutung Temple as an asset of education and tourism.
    - Strengthening the identity of local cultural through In Culture in education. So that m provides added value to the regional government and the temple manager in introducing cultural potential as a means of education.

In this study it can be seen that in the architecture of the Sipamutung Temple building there is ethnomatematics. One of them is the concept of building space, there are five elements of building space that can be seen in the shape of the Sipamutung temple. Like the element of the cube in the main building, beams on the stairs and temple officers, the ball on the head of the god in the statue of the statue, the pyramid of the Padang room and the tube on the main building decoration fence.

CONCLUSION

From the results of the research conducted regarding ethnomatematics exploration in Sipamutung Temple Padang Lawas Regency in the concept of building space, it can be concluded that Sipamutung Temple has various forms of building space that reflects mathematical concepts, such as cubes in the main buildings of the temple, beams on the stairs, and temples, pyramids on the roof in the monastery. These forms are a real

representation of Geometry Concepts of Building Space commonly learned in Mathematics .

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