SANGKALEMO: THE ELEMENTARY SCHOOL TEACHER EDUCATION JOURNAL
2025, Vol. 4, No. 2, Hal. 89 – 104
2828-0520 (E-ISSN)
https://doi.org/10.37304/sangkalemo.v4i2.19222

Exploration Of Ethnomathematics At Sipamutung Temple In Siparau Village

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ABSTRACT

This research aims to identify and interpret the mathematical elements found in the architecture of Sipamutung Temple in Siparau village. The background of this problem focuses on the importance of understanding the relationship between culture and mathematics, especially in the context of local cultural heritage. The method used in this research is ethnography with a descriptive approach, which includes observation, documentation, and literature exploration. The results showed that the floor plan of Sipamutung Temple was designed with various complexities that reflect the level of mathematical development of the local community. The research uncovered the concept of flat shapes such as square, rectangle and trapezoid in the temple structure, as well as the application of geometry principles in its design. The conclusion of this study emphasizes the importance of appreciating the sociocultural relevance of mathematics and practices in local cultures, as well as the need for efforts to preserve existing cultural heritage. It is hoped that the results of this research can provide the community with a better understanding of the mathematical concepts contained in Sipamutung Temple and increase awareness of the cultural values that exist around it

Article History
Reviewed: January 01, 2024
Accepted:July 24, 2025

Keywords
Ethnomathematics;
Sipamutung Temple;
Mathematics education;
Local culture

INTRODUCTION

Sipamutung Temple is located in Siparau Village, Central Barumun Subdistrict, Padang Lawas Regency, surrounded by a series of low hills around the banks of the Barumun River (Mendrofa & Hastuti, 2023). Sipamutung Temple (Biaro Sipamutung) is one of the Buddhist temples of the Pannai Kingdom in the Padang Lawas Temple Complex. Administratively, the temple is located iHan Siparau Village, Central Barumun District, Padanglawas Regency, North Sumatra Province (North Sumatra Invest, 2024). About 40 kilometers from the capital of Padanglawas Regency, Sibuhuan or about 70 kilometers from Padangsidimpuan City and 400 kilometers from Medan, the capital of North Sumatra Province. Geographically, Sipamutung Temple is located on the banks of the Barumun River that cuts through the Padanglawas lowlands (Hasil et al., n.d.). The building is thought to have

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been built in the 11th century, by the remains of the Classical Period (the period of Hindu-Buddhist influence from the 5th to the 15th century (Izza et al., 2021).

To reach the temple, the asphalt road only reaches Binanga Village and passes through a 3km village road. Then climb the suspension bridge over the Barumun River. The temple complex is 250 meters from the edge of the Barumun River (Perret & Surachman, 2014). Some opinions say that the location is the starting point of the origin of ancient humans entering the Padanglawas region and its surroundings, because at that time travel could only be passed by sea and river (Nasoichah et al., 2018).

Sipamutung Temple is a relic of the Pannai Kingdom that shows the influence of Hindu and Buddhist culture (Situs et al., 2023). According to the acting regent of Padang Lawas, Dr. Edy Junaedi Harahap, this temple is the second oldest temple in the archipelago after Borobudur and is estimated to have been built at the same time as Prambanan Temple (Soleh, 2024). Sipamutung Temple is the largest temple in the Padang lawas Temple Complex. Sipamutung Temple is generally made of brick and has a land area of 6000 square meters and a temple area of 74 x 74 meters surrounded by brick walls. The Sipamutung Temple complex consists of 1 main building and 6 ancillary temples and 16 stupas. The main building has an area of 11 x 11 meters and a height of 13 meters consisting of the foot, body, and roof. The ancillary temples around the main temple are mandapa-shaped with a rectangular plan measuring 10.25 X 9.9 meters in area and 1.15 meters in height.

Figure 1. Sipamutung Temple, Siparau Village.

Mathematics is a subject that is seen as free of values and culture, as a result there is a view that mathematics education does not need to consider the growing diversity in the student population (Supriadi et al., 2016). Until recently, mathematics learning was seen as a

stand-alone subject, meaning that it is free from other values and cultures, so there is no need to consider the growing diversity in the learner population, which is an inaccurate perspective. Ethnomathematics objects are cultural objects that contain mathematical concepts in a particular society (Amirah & Budiarto, 2022). As Bishop argues, ethnomathematics objects are used for mathematical activities such as counting, locating, measuring, designing, playing and explaining. The object of ethnomathematics can be in the form of traditional games, traditional crafts, artifacts, and activities (actions) in the form of culture (Abi, 2017).

Today ethnomathematics has become a field of research on the relationship between Barton defines ethnomathematics as a field of research that examines or examines the ways in which people from different cultures understand, articulate and use cultural concepts and practices in their lives, and by researchers this is described as mathematics (Sopamena, 2018).Ethnomathematics is mathematics applied by certain cultural groups. That means ethnomathematics is not just talking about ethnicity or tribe. Because the teaching of mathematics in schools and the mathematics that children find in their daily lives are very different, it is very necessary for mathematics learning to provide content / bridge between mathematics in the daily world based on local culture and school mathematics (Abi, 2017). By conducting ethnomathematics research, ethnomathematics researchers will better understand how people from different cultures think, work and relate to others in their own culture and the world around them. Ethnomathematics helps people to understand activities in other cultures, and more importantly helps them to understand how they can relate to their own culture. In other words, ethnomathematics makes people know, understand and appreciate mathematics or mathematical knowledge that exists and develops in various cultural groups and how it relates to the mathematics learned in schools. In this case ethnomathematics helps to know, appreciate and maintain the culture from which we come and where we are (Siregar et al. 2025).

It is hoped that the ethnomathematics of the Sipamutung Temple as an icon of Padang lawasa will not be forgotten or even lost along with the times, and it is hoped that students and the community can recognize the culture around the Sipamutung Temple and temple buildings and it is hoped that student motivation and learning outcomes can increase. And this research has the advantage that only this research examines ethnomathematics at Sipamutung Temple, while other studies only examine its history and archeology. Based on the background of the problems that have been stated, the problem formulation in this study is whether there are elements (concepts) of Ethnomathematics in Sipamutung Temple. The purpose of this research is to reveal and describe the mathematical concepts hidden behind the architecture of

Sipamutung Temple. By identifying and analyzing the mathematical elements contained in the design and construction of the temple, it is expected to understand more deeply the sophistication of the mathematical knowledge of the community in the past.

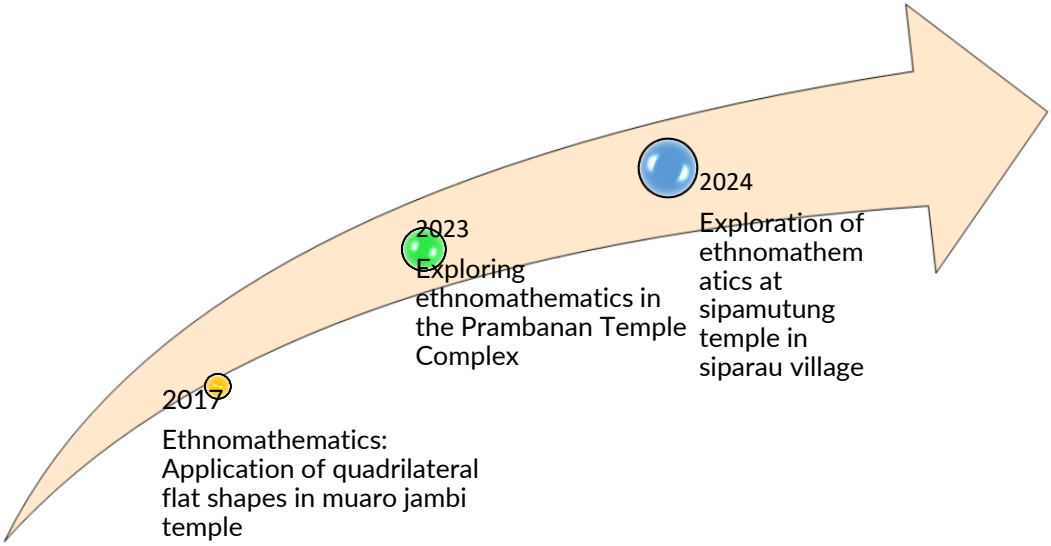


Figure 2. Research roadmap

Previous research on the exploration of ethnomathematics in the Three Trimurti Temples was conducted by who explored ethnomathematics in the Prambanan Temple Complex (Wulantina et al., 2023). The conclusion (Hardiarti, 2017) of this research is that in this temple area, the concept of rectangular flat shapes can be found in several parts of the temple, including the square, rectangle, parallelogram, trapezoid and irregular quadrilateral. The two studies have differences with this research, namely in the object of research and also the ethnomathematics elements observed. Until now, there has been no research that tries to explore the mathematical elements of Sipamutung Temple, Thus this study aims to explore and find out the elements of ethnomathematics in the Sipamutung Temple, Siparau Village

METHODS OF RESEARCH

This research uses a qualitative approach with descriptive methods. The qualitative method was chosen to explore and understand complex phenomena related to the object of research in depth and comprehensively. The research location was determined at Sipamutung Temple located in Siparau Village. The selection of this location was based on the potential and uniqueness of the archaeological site to be studied in the research.

Data collection techniques were carried out through three main stages. First, direct observation was conducted to carefully observe the condition and characteristics of Sipamutung Temple. This observation allows researchers to collect empirical data directly and

accurately. Documentation became the second technique in data collection. Documentation was conducted through three media, namely: Taking photos to record the structural and architectural details of the temple Making sketches or supporting images Video recording to obtain dynamic and comprehensive visual documentation In addition to observation and documentation, this research also uses literature studies. Literature study was conducted to collect secondary data from various scientific references, books, journals, and literature sources relevant to the research topic.

Data analysis was conducted in a qualitative descriptive manner. The analysis process began with organizing data from observations, documentation, and literature studies. The collected data were then interpreted and described in depth to produce meaningful research findings. The special focus in this research is the identification and analysis of mathematical concepts that may be contained in the construction of Sipamutung Temple. The researcher will conduct a systematic study to explore patterns, structures, and mathematical elements contained in the design and construction of the temple

RESULT AND DISCUSSION

Main Biaro and Ancillary Biaro

The main biaro is made of bricks facing east with a square plan measuring 11 X 11 meters and 13 meters high. Vertically, the profile of the biaro consists of batur, kaki, badan, and atap biaro. The batur is 2.25 meters high, the foot of the biaro is 1.25 m high. There is an ascending staircase on the viewer on the east side. The visible profile of the biaro legs is rectangular and clapper-sided.

The body of the biaro is rectangular with an entrance on the east side, the lower and upper Kumai of the biaro are flat (*patta*). There are no statues found in the chamber of the biaro. The roof of the biaro is a three-storied rectangle. In its original form, the lowest level on each side is decorated with five stupas, the second level on each side is decorated with four stupas, and the top level is one stupa that is larger than the stupas below.

However, due to the damage suffered, the roof of this biaro only has 7 stupa fragments left, namely on the roof of the north side. Meanwhile, the peak of the roof is no longer there.

a. Perwara Biaro A

Biaro Perwara A is located 4 meters to the east of the main biaro. The building is rectangular in plan with a size of 10.25 X 9.90 meters, 1.15 meters high. The building is made of brick in the form of a batur pendopo (*mandapa*).

b. Biaro Perwara B

Biaro Perwara B is located 5 meters to the north of Biaro Induk, made of sandstone, rectangular in plan, and has entrance stairs on all four sides. Biaro perwara B measures 11.60 X 10.60 meters, with a height of 2.10 meters, in the form of the "foot" part of the biaro where the profile of the lower kumai is clearly visible, which is very similar to the profile of Central Javanese temples. The lower kumai consists of a flat ledge (patta), a padma ledge and a semicircular ledge (*kumuda*) (Suleiman 1976: 20). There are umpak-umpak supporting poles lined up on each side. This suggests that the pillars were made of wood and the roof was made of non-perishable materials. At the top of the biaro there is a lion statue which does not seem to be in situ, as lion statues are usually located on either side of the door as guards.

c. Biaro Perwara C

Biaro Perwara C is located in the south of Biaro Induk, made of bricks in the shape of biaro legs. The biaro has an ascending staircase in the east with 7 steps and at the top there is a kind of altar made of *curciform* brick (the *curciform* shape is a further processing of the rectangle into 16 corners).

The foot (lower kumai) of the biaro is decorated with a lotus and a flat (patta) birai.

d. Biaro Perwara D

Biaro Perwara D is located south of Biaro Perwara C, made of brick, in the form of the foot of the biaro. The biaro has an ascending staircase on the east with 8 steps and at the top there is a kind of *curciform* brick altar. The foot of the biaro (lower kumai) is decorated with lotus beams, semicircular beams (*kumuda*) and flat beams (*patta*).

e. Biaro Perwara E

Biaro Perwara F is located to the southeast of the main biaro, made of brick in the form of a 1 meter high *mandapa*, with two stairs in the east and west.

1. Tembol Bata

The perimeter fence around the south, west, north, and east sides of the biaro, made of brick with a width of 1 meter and a height of 50 cm.

2. Gapuran or Entrance

The gate of the biaro is on the east side, only 1 meter high remains, so it is not known whether this gate was originally in the form of paduraksa or bentar temple.

3. Other findings include makara, statue fragments and statues.

The total area of Biaro Si Pamutung is 1 x 2 kilometers. It consists of a biaro complex and an earthen fort surrounding it. The biaro complex is secluded in the middle of a field of weeds and dense shrubs. The courtyard is surrounded by a 49 x 65 meter wall fence, 1.1 meters thick stretching west east with an entrance gate on the east side.

In the courtyard surrounded by a wall fence there is one main building, six ancillary buildings facing east, six small biaro, a gate, and other artifacts such as *Bhairawa* statues made of tufa rock. The buildings are arranged in two rows running east-west. In the back row of the complex stands the main biaro flanked by three small buildings. In the front row are three smaller buildings. A few meters in front of it on the perimeter fence are the ruins of the entrance gate. The main biaro stands on rectilinear feet measuring 11 x 11 meters with a height of 3.1 meters.

The staircase rises on the east side with 15 steps. On the left and right are stair cheeks. The viewer on the staircase rises to the foot of the building protruding to the east for nine meters. The foot of the building has a profile in the form of a faceted frame four and clapper sides.

Above the foot of the building is the foot of the rectilinear building body measuring 8.2 x 8.2 meters and 1.45 meters high. There is a stairway up to the room of the building which is a connection to the stairway up at the foot of the building. There is a passage around the foot of the building body with a 50 cm high fence. The body of the building stands on the foot of the body of the building. The rectilinear body plan measures 5.7 x 5.7 meters with a height of 4.6 meters.

On the east side there is a viewer which is a staircase going up to the room of the building. In some places on the outside of the body of the building there are leaf vine decorations. The decoration surrounds the body of the building. The roof is rectilinear in plan with a side of four meters and three stories. Most of the roof is damaged, with seven stupa fragments remaining on the north side.

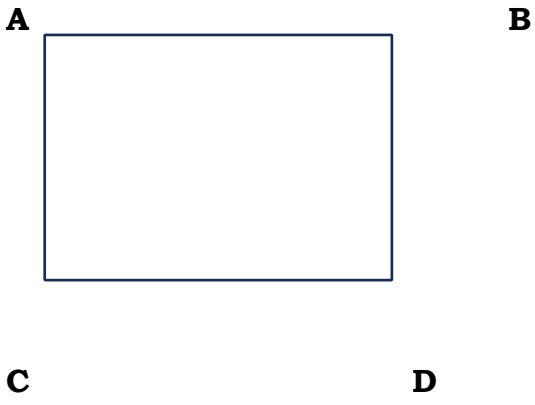
The remaining part (north side) has a stupa decoration on its peak. The remaining roof height is 2.45 meters. Part of the roof is made multilevel at each level there is a floor where a small stupa. In the yard of Biaro Si Pamutung, two large statues with a height of 1.5 meters were found. The statues are *Mahakala* and *Nandiswara* statues and several other statues.

Based on observations and documentation, the Sipamutung temple in Siparau Village has several flat shapes. Thus, efforts must be made now to provide understanding to the community related to mathematical concepts at the Sipamutung temple as follows:

Rectangular and Triangular Flat Shape on Sipamutung Temple

The arround fence of the Sipamutung emple complex is made of an array of brick baIoks. The plan of the fence is square with a size of 74 x 74 meters. Restoration has been carried out, but has not been able to improve the condition of the fence. From the interview results, tshe construction of this perimeter fence has a function as a barrier between the human world and the sacred world where the gods reside. In addition, the fence also serves to protect the temple from bad influences and disturbances from outside

(a)



(b)

Figure 3. (a.) Perimeter fence, (b.) Geometric modeling of perimeter fence

The arround fence n Figure 3.a can be geometrically encoded as shown in the bottom part of Figure 3.b. From the figure, it can be seen that the model is a flat shape that has four sides. Based on this, the researcher further analyzes the concept of rectangular flat shapes on the fence.

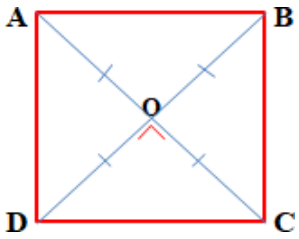


Figure 4. Square concept on the arround fence

` Based on the analysis in Figure 4, it can be concluded that there is a square concept in this arround fence. The properties of a square that can be found in the coding of the keyiIing fence according to Figure 4, are as follows.

1) AB = BC = CD = DA

2) m∠A = m∠B = m∠C = m∠D = 90°

3) AO = OD = BO = OC ⇒AC ⊥BD

4) It has 4 rotary symmetries and 4 fold symmetries, so it can occupy its frame in 8 ways.

Aside from being square, the walls of Sipamutung Temple can also be geometrically modeled so that it can be concluded that there is a rectangular concept on some of the walls of Sipamutung Temple (Figure 5).

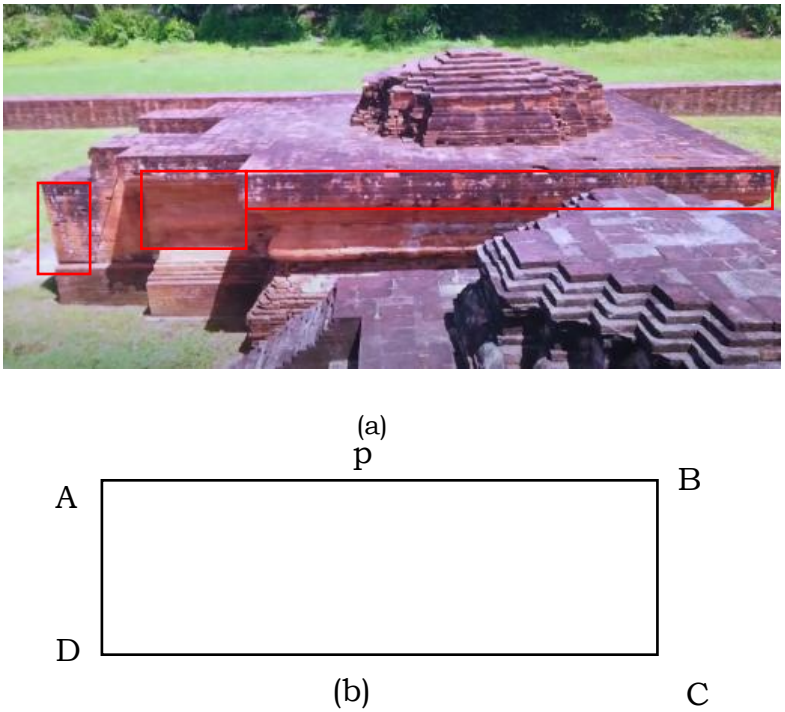


Figure 5. (a.) Sipamutung Temple wall, (b.) Geometric modeling on Sipamutung Temple wall

The wall of Sipamutung Temple in Figure 5.a can be geometrically modeled as in the lower part of Figure 5.b. From the figure, it can be seen that the modeling is in the form of a flat shape that has four sides. Based on this, researchers further analyzed the concept of rectangular flat shapes on the sipamutung temple wall (Figure 6).

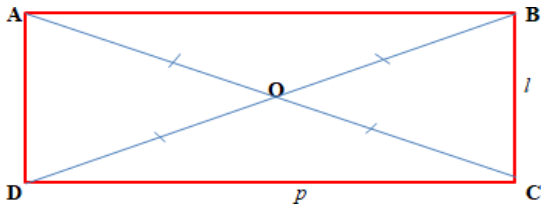


Figure 6. Geometric Concept on Sipamutung Temple wall

Based on the analysis in Figure 6, it can be concluded that there is a concept of rectangles on the walls of the Tuo temple. The properties of rectangles that can be found in the modeling of the Sipamutung temple body according to Figure 6 are as follows

1) AB≠CD;BC≠AD
2) $m\angle A = m\angle B = m\angle C = m\angle D = 90°$
3) AO = OC = BO = OD ⇒AC=BD
4) It has 2 rotary symmetries and 2 fold symmetries, so it can occupy its frame in 4 ways.

Not only the walls of Sipamutung Temple, some other parts of the Sipamutung temple area also have a rectangular concept. Some of them, namely the rectangular concept on the ancient bricks that make up the temple body, temple walls, steps, and Umpak Batu. In addition to the square and rectangular concepts in the Sipamutung Temple temple area, other rectangular flat concepts can also be found in several parts of this temple area.

Figure 7. Temple Step

In the Sipamutung temple area, the concept of another rectangular flat shape can also be found in several parts of this temple area. Figure 8 below shows that there is a trapezoid concept in this temple.

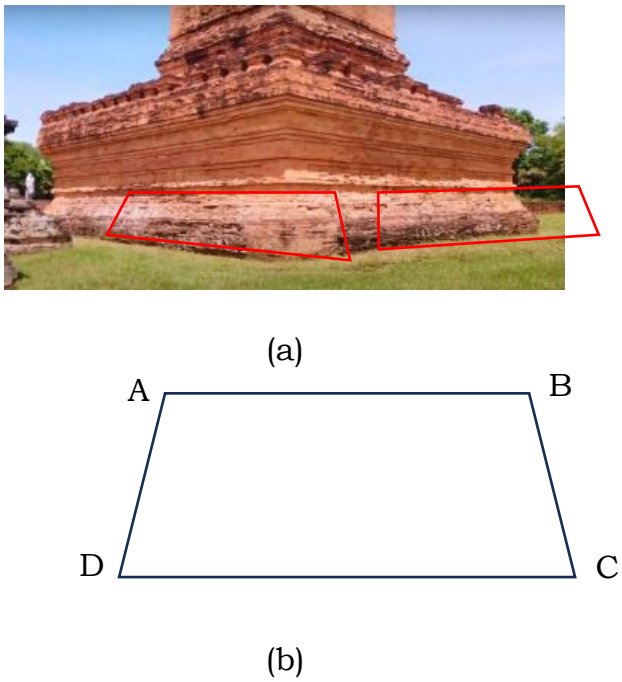


Figure 8. (a.) Sipamutung Temple Wall, (b.) Geometric modeling on ancient brickwork of sipamutung temple wall

The ancient brick arrangement in Figure 8.a can be geometrically modeled as shown at the bottom of Figure 8.b. From the figure, it can be seen that the modeling is a flat shape that has four sides. Based on this, the concept of rectangular flat shapes in the ancient brick arrangement was analyzed (Figure 9).

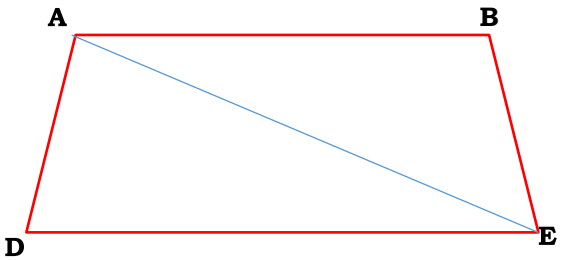


Figure 9. The trapezoidal concept in the ancient stone arrangement of the Sipamutung Temple wall

Based on the analysis in Figure 9, it can be concluded that there is a concept of trapezoid in the ancient brick arrangement. There are also trapezoidal properties that can be found in the modeling of the ancient brick arrangement according to Figure 9, which are as follows.

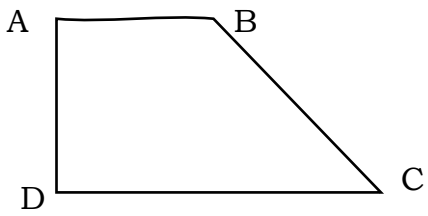
1) AB// CD (pair of sides)

2) $m\angle A+m\angle D = 180°$, $m\angle B+m\angle C = 180°$

3) $m\angle A +m\angle B +m\angle C +m\angle D = 360°$.

The concept of quadrilateral flat shapes in the form of a square, rectangle, and trapezoid is a regular quadrilateral flat shape. The Sipamutung temple area not only, as the concept of regular quadrilateral flat shapes, researchers also found that there is the concept of irregular quadrilateral flat shapes in some parts of the Sipamutung temple.

(a)



(b)

Figure 10. (a.) The arrangement of bricks on the stairs of Tuo Temple

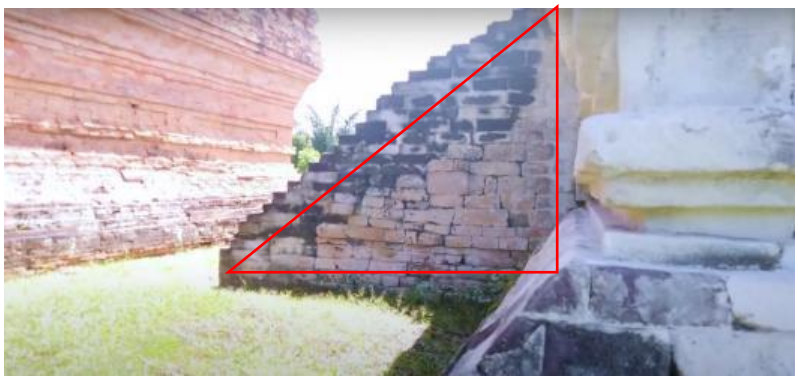
(b.) The geometry of the ancient stone arrangement of the Tuo temple staircase

The ancient brick arrangement in Figure 10.a can be geometrically modeled as shown at the bottom of Figure 10.b. From the figure, it can be seen that the modeling is in the form of a flat shape that has four sides. Based on this, the concept of rectangular flat shapes in the ancient brick arrangement was analyzed. Based on the analysis of the memo deIan in Figure 10, it can be concluded that there is a concept of an irregular quadrilateral in the ancient brick arrangement. The properties of the irregular quadrilateral that can be found in the modeling of the ancient brick arrangement according to Figure 8 are as follows.

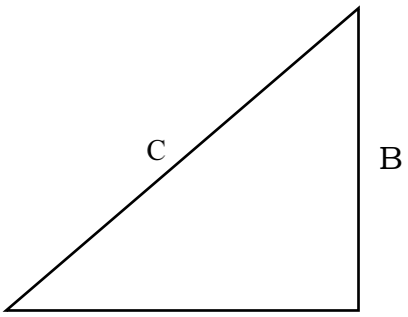
1) AB ≠ BC ≠ CD ≠ AD

2) $m\angle A \neq m\angle B \neq m\angle C \neq m\angle D$

In the Muara Takus temple area, not only did we find the concept of a quadrilateral but we also found the concept of a triangle. This can be seen from the shape of the ancient brick arrangement on the stairs of the Youngest Temple, as shown in Figure 11.



(a)



(b)

Figure 11. (a.) Brick arrangement on the stairs Sipamutung Temple (b.) Geometry modeling of ancient brick arrangement on the stairs of Sipamutung Temple

The ancient brick arrangement in Figure 11.a can be geometrically modeled as shown at the bottom of Figure 11.b. From the figure, it can be seen that the modeling is in the form of a flat shape that has three sides. Based on this, the researcher further analyzed the concept of triangular flat shapes in the ancient brick arrangement. Based on the analysis of the model in Figure 11, it can be concluded that there is a right triangle concept in the ancient brick arrangement. The properties of a right triangle that can be found in the ancient brick arrangement in Figure 11 are as follows.

1) AB ⊥ BC

2) $m\angle B = 90°$, $m\angle A + m\angle C = 90°$

3) Phytagoras theorem: $c^2 = a^2 + b^2$

Lines and Angles

In Figure 10, it can be seen that the Tuo Temple contains the concept of lines and angles, where several lines are parallel, intersecting, intersecting, and also crossing.

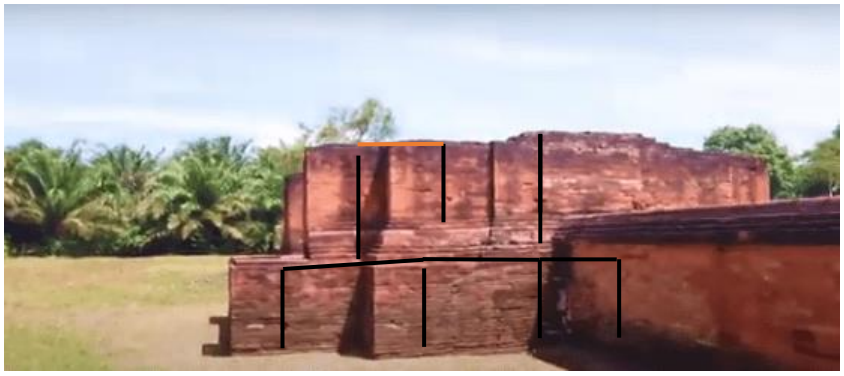


Figure.12. Sipamutung Temple Batur Wall

In addition, there is a relationship between angles, namely when two parallel lines are cut by a line

CONCLUSION

Mathematics and culture are two things that are interrelated. Mathematics in culture is known as ethnomathematics. We can find mathematical concepts in a particular culture, one of which is the Sipamutung temple. In this temple area, the concept of flat buildings can be found in several parts of the temple, including quadrilaterals (square, rectangle, trapezoid and

irregular quadrilateral) and triangles (right triangle), as well as lines and su dut in several parts of the temple. Thus, learning mathematics not only becomes more interesting but also more meaningful for students. It can also open up opportunities for further research on how art and culture can be used as effective learning tools in mathematics education. This shows that ethnomathematics is an interesting topic for further research, especially regarding the relationship between cultural heritage sites around us and the philosophical values and mathematical concepts they contain. Teachers can utilize the mathematical concepts in the Muaro Takus temple as a concrete source of mathematics learning. Ethnomathematical objects around us can also be utilized for innovative teaching.

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