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Exploration of Ethnomathematics in Kobhung Madura

Ulfi Syamsiyatul Maghfiroh^{1*}, Moh. Zayyadi¹ , Sri Indriati Hasanah¹ 

¹Mathematics Education Study Program, Faculty of Teacher Training and Education, Universitas Madura

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ABSTRACT

The integration of education and culture is one of the rapidly developing fields of mathematics research today, especially through studies of traditional architecture such as Madurese *kobhung*. This study aims to describe the forms and patterns of ethnomathematics contained in the *kobhung* structures of the Madurese community. This approach is important because it can help students understand abstract geometric concepts through their connection with Madurese local wisdom. This study aims to describe the mathematical concepts found in the structure and patterns of the Madurese *kobhung* and map out how these concepts can be used in the mathematics learning process. The method used is qualitative research with an ethnographic approach. The research subjects are 10 Madurese informants in Pamekasan and authentic *kobhung* structures as purposive samples. Data collection methods included direct participatory observation in the field, in-depth interviews, visual documentation, and literature study. The main instrument was the researcher as a human instrument. Data analysis followed the Miles and Huberman model, which included data reduction, data presentation, and conclusion drawing with source triangulation validation and reliability through retesting. The results of this study describe Madurese *kobhung* as containing mathematical elements, namely straight/parallel lines, acute/obtuse/right angles, flat shapes (rectangles, isosceles triangles, trapezoids), congruence, geometric transformations, and the Pythagorean theorem in the *pracik* structure. The ethnomathematical study of *kobhung* in geometry learning shows that this traditional architecture can be used as a context for mathematics learning, so that the material taught becomes more contextual and has cultural meaning. This study is still limited to identifying ethnomathematical elements in the Madurese *kobhung* structure and has not examined its application and effectiveness in classroom learning. Therefore, the researchers recommend further research on its implementation in mathematics classroom learning.



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Corresponding Author:

Ulfi Syamsiyatul Maghfiroh,

Mathematics Education Study Program,

Faculty of Teacher Training and Education,

Universitas Madura,

Jl. Raya Panglegur No. Km 3.5, Barat, Panglegur, Tlanakan Subdistrict, Pamekasan Regency, East Java 69371, Indonesia

Email: syamsiyatulmaghfiroh@gmail.com

Introduction

Madura Island is known as a region with a rich culture, traditions, and strong local wisdom. One of the cultural legacies that remains intact to this day is kobhung, an open building that serves as a place for gathering, discussion, family deliberation, receiving guests, and carrying out social and religious activities for the community. Kobhung is an important part of the social structure of Madurese society, as it is a space that reflects harmonious social relations, openness, and respect for guests. According to [Hasan \(2008\)](#), kobhung is a traditional Madurese building in the form of a stage or open space without walls that is used as a place for social interaction and a symbol of family honor. Furthermore, [Ahmad & Kholis \(2021\)](#) explain that kobhung not only functions as a space for social activities, but also has philosophical value that describes the character of the Madurese people, who are religious, egalitarian, and prioritize togetherness.

In addition to being a social space and a place for religious activities, Madurese kobhung also contains various mathematical concepts that have been traditionally passed down and applied in the daily lives of the local community. The open and simple but sturdy structure of kobhung uses geometric principles such as symmetry, similarity, and repeating patterns, which are the main elements in its creation ([Hasan, 2008](#)). These elements do not appear by chance, but contain local wisdom values that reflect the systematic and aesthetic thinking of the Madurese people ([Hasan, 2008](#)). Ethnomathematics recognizes that mathematical concepts such as angular geometry, circles, straight and curved lines, symmetry, reflection, dilation, translation, and rotation are applied by the Madurese people in their cultural activities, which can be the basis for similar explorations in traditional artifacts such as kobhung ([Fajriyeh & Zayyadi, 2023](#)). Thus, kobhung is not only a cultural artifact, but also a representation of mathematical thinking practices in a traditional cultural context.

The study of the relationship between culture and mathematics is commonly referred to as ethnomathematics. This approach was first introduced by [D'ambrosio \(1985\)](#), who defined ethnomathematics as the study of how people in different cultures understand, interpret, and use mathematics in the context of their lives. This approach emphasizes that mathematics is not just a collection of abstract symbols and formulas, but also a reflection of cultural practices and values. Through the exploration of ethnomathematics, mathematics learning can be contextualized with real life, while strengthening the character and cultural identity of students. In the context of modern learning, ethnomathematics serves as a bridge between conceptual knowledge and contextual meaning. The application of ethnomathematics in learning allows students to construct knowledge in depth, not just memorize procedures, because they learn to understand the relationship between mathematical concepts and real cultural experiences ([Putri et al., 2024](#)). This approach fosters critical and reflective thinking skills, as well as an appreciation for the relationship between mathematics and local cultural values.

In line with this view, research by [Hasanah et al. \(2024\)](#) shows that the cultural characteristics of Madura have great potential as a source for developing context-based mathematics learning. Hasanah et al.'s findings show that cultural elements such as spatial layout, symbols, and traditional Madurese building forms contain mathematical principles that can be used as sources for contextual learning. Another study conducted by [Zayyadi \(2017\)](#) shows that the motifs and patterns on Madurese batik contain representations of mathematical concepts such as translation, symmetry, , and rotation. These geometric patterns are not only aesthetically valuable but also reflect the systematic thinking patterns of the Madurese people. These research results reinforce the importance of exploring other cultural structures such as kobhung, which until now have not been widely studied from an ethnomathematics perspective.

Although previous studies have identified the potential of Madurese culture as a source of mathematics learning, studies on the mathematical elements in kobhung are still very limited. Therefore, this study was conducted with the aim of describing various mathematical concepts found in the structure, patterns, and spatial layout of Madurese kobhung, as well as explaining the application of these concepts in mathematics learning in schools. In this study, an exploratory qualitative approach was used with data collection techniques including observation, in-depth interviews, and visual documentation of the shape and structure of kobhung in various regions of Madura. This approach was chosen because it is able to explore the meanings and mathematical values implied in the cultural context in depth.

Referring to the above description, the purpose of this study is to describe the mathematical concepts found in the structure, patterns, and spatial layout of Madurese kobhung, as well as to explain how these concepts can be utilized in the mathematics learning process in schools. This exploration is expected to play a role in the development of learning resources based on local culture, while also enriching the study of ethnomathematics in Indonesia.

Method

Type of Research

This research uses qualitative research with an ethnographic approach. The ethnographic approach was chosen to describe, explain, and analyze in depth the cultural elements of the Madurese community. Through a qualitative ethnographic approach that focuses on participatory observation and in-depth interviews with craftsmen and kobhung users, researchers can understand the structure, form, patterns, and meaning of mathematics reflected in the design and construction of kobhung as part of cultural heritage. In determining informants, the researcher paid attention to specific criteria in order to obtain individuals who had in-depth knowledge related to kobhung, including its history, building form, and the values contained therein. The selection of appropriate informants was very important because not everyone at the research location could provide valid and relevant data about kobhung.

Subject

As a qualitative study with an ethnographic approach, the main instrument in this study was the researcher himself, who acted as a human instrument. The researcher interacted directly with the data sources and the research environment, so he could not be replaced by other instruments. The research subjects are 10 Madurese informants in Pamekasan who were selected based on specific criteria, namely individuals who have knowledge and experience related to kobhung as a building where Madurese people prayed in the past.

Instruments

We used interview guidelines as instruments to answer the research questions. The interview guidelines are shown in [Table 1](#).

Table 1. Interview Guide

No	Aspect	Indicators	Interview Questions
1	Culture	History related to Kobhung Madura	1. What are the historical events related to Kobhung Madura?
		Characteristics of Kobhung Madura	2. Describe the characteristics of Kobhung Madura!
			3. What are the differences between the main parts of Kobhung Madura?
		Classification of Kobhung Madura building types	4. What are the classifications of Kobhung Madura building types?
			5. Does each type of Kobhung Madura building have its own meaning?
		The relationship between Kobhung Madura and social values	6. Does Kobhung Madura have a relationship with the social values of the Madurese people?
			7. How is the relationship between the social values of the Madurese community and the existence of Kobhung Madura?
		The social influence of the existence of Kobhung Madura	8. How does society influence the existence of Kobhung Madura?
			9. What is the design pattern of Kobhung Madura?
		The Design of Kobhung Madura	10. What meanings are contained in the design of Kobhung Madura?
11. What are the mathematical concepts contained in Kobhung Madura?			
2	Mathematics	Mathematical concepts in Kobhung Madura	12. What is the history of mathematical concepts in Kobhung Madura?
			13. What are the geometric concepts in Kobhung Madura?
		Geometric concepts	14. Which parts of Kobhung Madura contain geometric concepts?

Data Collection

This study used data collection methods in the form of observation, documentation, and interviews. Observation was carried out by thoroughly observing parts of Kobhung Madura as a place of worship for the Madurese people in the past to identify cultural aspects that contain ethnomathematical concepts. Documentation in this study was carried out by taking photos of Kobhung Madura. The images documented by the author himself serve as tools to strengthen the researcher's arguments and as concrete visual evidence related to the ethnomathematical concepts contained in the Madura kobhung. This study used semi-structured interviews with a previously prepared interview guide. The interviewees were five traditional leaders and five

elders of the Madurese community who were selected because of their in-depth knowledge of the ritual functions and symbolic meanings of kobhung as places of prayer in the past. These interviews were conducted with the aim of obtaining information about the concept of ethnomathematics in Madurese kobhung and understanding the names and functions of each Madurese kobhung building as a place of worship.

Data Analysis

Data analysis in this study refers to the framework Miles et al., (2014) which consists of three stages: data reduction, data presentation, and conclusion drawing. Data reduction was carried out by focusing on core elements relevant to the research theme and emerging patterns, resulting in a sharper and more focused description through systematic data coding, including open, axial, and selective coding to identify patterns of Madurese Kobhung ethnomathematics. Data presentation is arranged in tables, matrices, and diagrams to facilitate the reader's understanding of the findings. The final stage is verification and drawing conclusions based on the relationships between the analyzed data patterns.

Research Results

Kobhung Madura, located in Pamekasan, will be examined using an ethnomathematics (mathematics in culture) approach, based on direct observation and interviews with 10 informants (5 traditional leaders + 5 elders). Kobhung Madura is a traditional place of worship for the Madurese people, which has high cultural value and local wisdom. Kobhung not only functions as a spiritual place but is also rich in ethnomathematics concepts that show the relationship between culture and mathematics in the daily lives of the Madurese people (Fathorrozy et al., 2025).

The spatial layout of Kobhung Madura consists of several main parts, namely a central room for worship, a complementary area in the form of seating and an altar, and an open space for ritual activities. The central room is usually rectangular in shape with a specific orientation that considers the direction of the wind, indicating the existence of a concept of geometry and spatial orientation that has been known for generations, similar to the complex geometric patterns in traditional Madurese settlements such as tanean lanjhang, which involve symmetry and proportion (Ahmad & Kholis, 2021).

The roof structure of the Madurese Kobhung is a distinctive pyramid shape with a specific angle of inclination, calculated based on the principles of symmetry and balance. The roof is supported by wooden pillars known as "soko," which number four or more and serve as the main supports of the building. These pillars are arranged in a regular square pattern, demonstrating an understanding of shape and spatial measurement in Madurese culture, including architectural elements such as rectangular geometric doors and stairs, as well as stilt houses with bamboo floors (Hotimah & Salma, 2023).

Kobhung buildings are usually constructed using teak wood or bamboo, assembled using traditional jointing techniques without nails, involving accurate calculations of size and proportion to ensure a sturdy and harmonious structure. The floor features simple geometric patterns created from an arrangement of stones or wood, illustrating the application of mathematical concepts through motifs and designs.

In Kobhung, the length, width, and height of the building and its parts are measured using local units that have been passed down from generation to generation, such as "sepak" and "dheg." The use of these units involves estimation and comparison, demonstrating the sophistication of the traditional Madurese measurement system. In addition, the empty space between the roof structure and the supporting pillars serves to regulate the circulation of wind

and light entering the Kobhung, demonstrating the application of mathematical concepts in adapting to the surrounding environment.

Through ethnomathematics exploration of Madurese kobhung, it can be seen how the Madurese people integrate cultural values with mathematical concepts, both in terms of space, shape, size, and proportion, thereby creating a building that is rich in symbolism and functionality. The purpose of ethnomathematics exploration of Madurese kobhung is to identify mathematical concepts that exist in the structure and patterns of Madurese traditional places of worship. In Kobhung Madura, geometric concepts such as flat shapes, angles, lines, symmetry, and measurement are found to be part of everyday cultural practices. As explained by [Zayyadi & Subaidi \(2017\)](#), the application of mathematical values in Madurese culture is reflected in traditional building patterns that contain the principles of symmetry, similarity, and balance. This shows that the Madurese people had an intuitive understanding of geometric concepts and proportions long before they were introduced through formal education.

According to [Iffah et al. \(2025\)](#), ethnomathematics studies the relationship between culture and mathematics, where local traditions and cultural objects contain mathematical values that can be used as learning materials. This is in line with the opinion of [Cahyani et al. \(2025\)](#) in this study, that the mathematical concepts found in Madurese Kobhung can be used as a contextual learning resource and enrich students' perspectives on mathematics. Learning can become more meaningful by linking academic material to cultural heritage that is close to their experiences. The following are some parts of the Kobhung Madura building that contain geometric concepts:

Kobhung Roof



Figure 1. Front part of the Kobhung roof



Figure 2. Side view of the Kobhung roof

There are several prominent ethnomathematical elements on the kobhung roof. First, acute angles are visible at the peak of the roof, while obtuse angles appear at the intersection of the roof with the walls or support pillars. Second, flat shapes dominate the design; when viewed from the front or rear, the main roof is trapezoidal, while from the side it is isosceles triangular, which is the main element of the construction and appearance of the roof structure. Third, congruence is reflected in the arrangement of tiles and wooden frames that are uniform in size and shape, forming a congruent pattern that creates a neat and harmonious impression. Fourth, geometric transformation is evident in the reflective symmetry of the roof, which reflects the symmetrical relationship between front and back as well as right and left.

Front Emper (Porch) Roof



Figure 3. Front Emper Roof

The front porch roof features several distinctive ethnomathematical elements. Its shape usually protrudes forward and is a low parallelogram or rectangle when viewed from below. The corners of the porch roof form obtuse angles with the floor, accompanied by triangular elements on the lower roof supports. Congruence can be seen in the symmetrical proportions of the porch and its roof, with the left and right sides being of equal length and width. In addition, geometric transformation is reflected in the structure of the porch and lower roof, which are often translations of existing series of support pillars and roof panels.

Floor and Base



Figure 4. Kobhung Floor

There are several prominent ethnomathematical elements on the floor and base. The main flat structure consists of rectangular boards arranged to fill the entire base of the building. Congruence is reflected in the uniform size of the floorboards, which are congruent with each other. Straight lines are formed from the arrangement of parallel boards, forming parallel rows. In addition, right angles appear at the intersection of the boards and the supporting posts at each corner of the building.

Walls or Tabing



Figure 5. Side wall of the kobhung



Figure 6. Back wall of the kobhung

There are several ethnomathematical elements on the walls or tabing. The main flat structures are square or rectangular panels arranged around the building. Congruence can be

seen from the uniform size of the wall/tabing panels, which are congruent with each other. Parallel horizontal and vertical lines are created from woven bamboo or wood on the tabing. Right angles appear at each intersection between panels and between panels and posts, while symmetry is reflected in the even arrangement of the walls/tabing on the left and right sides as well as the front and back of the building.

Kolong/Lower Part of Kobhung



Figure 7. Front space



Figure 8. Side space



Figure 9. Rear space



Figure 10. Illustration of a rectangular prism

In the kolong or the lower part of the kobhung, there are several distinctive ethnomathematical elements. The kolong is a spatial structure in the form of an empty space under the floor that is often used for storing wood, farming tools, or livestock, thus demonstrating the concept of spatial volume. The kolong area is shaped like a box or block that matches the shape of the floor above it.

Supporting Pillar



Figure 11. Kobhung support pillars



Figure 12. Illustration of a block structure

The support pillars of a kobhung house contain ethnomathematical elements. They are rectangular prisms or right prisms that support the upper floor. All pillars are the same height, length, and shape, making them congruent. The pillars are arranged vertically in parallel with right angles to the floor or base beams. The position of the pillars shows a pattern of symmetry and translation between rows on the lower side. The size and location of the pillars are proportional to the dimensions of the building for balance and stability.

Porch/Veranda



Figure 13. Kobhung Porch

The porch of a kobhung house contains ethnomathematical elements. The porch floor is rectangular or trapezoidal in shape and protrudes forward. The porch panels or boards are the same size, making them congruent. The wooden panels are arranged parallel to the right angles at the intersection of the pillars. The porch is symmetrical on the left and right sides. The size and shape of the porch are proportional to the main building to create harmony.

Supporting Posts (Pracik)



Figure 14. Front part of the pracik



Figure 15. Middle part of the pracik

There are ethnomathematical elements in the pracik of a kobhung house. The support pillars are located on parallel lines as the building structure. The pracik has right angles, acute angles, and obtuse angles at the joints of the wooden beams. Right-angled triangles are found in the design of the pracik supports. The Pythagorean theorem is applied in measuring these right-angled triangles. The pillars are shaped like beams as three-dimensional shapes. All pillars are the same shape and size, making them congruent. The pillars are formed through the translation and reflection of similar elements.

Side Supports (Erang-erang)



Figure 16. Side supports

There are ethnomathematical elements in the side supports of the kobhung house. The erang-erang supports have right angles, acute angles, and obtuse angles. They are shaped like right-angled triangles. The Pythagorean theorem is used in the construction and measurement of these triangles. The support wood is shaped like a block as a solid figure. All supports are the same shape and size so that they are congruent. The supports are formed through translation and reflection.

Window

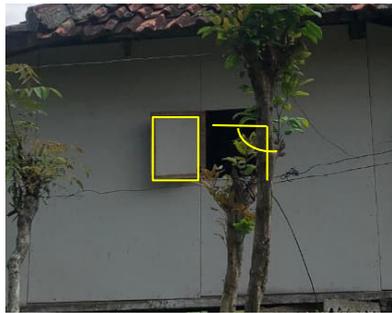


Figure 17. Kobhung Window

There are ethnomathematical elements in the windows of a kobhung house. Each corner of the window frame forms a 90° right angle. The shape of the frame and window opening is a square or rectangle. The Pythagorean theorem is used to calculate the length of the diagonal of a square or rectangular window. The window frame made of wooden beams forms a narrow rectangular prism. Windows of the same size are congruent. Two symmetrical windows on the left and right are produced through translation of position and reflection of the vertical plane.

Interior of the Kobhung



Figure 18. Interior of the Kobhung

The interior of the kobhung house contains ethnomathematical elements. The interior area is shaped like a rectangular plane and a triangle at the base of the roof. The floor, space, and panel arrangements are made the same size so that they are congruent and orderly. The interior structure consists of straight floorboards and right angles at the meeting points of the room sides. The interior forms a space for gathering, worship, or guests that illustrates the concept of volume and spatial layout.

Interior roof of Kobhung



Figure 19. Kobhung interior roof

The interior roof of a kobhung house contains ethnomathematical elements. The roof area forms a rectangular or triangular flat shape at the base of the roof. The wooden beams and battens are made to the same size so that they are congruent and regular. The roof structure consists of straight lines of beams and right angles at the meeting points of the frame.

Table 2. Ethnomathematical Elements Found in the Kobhung Madura

Kobhung Building Components	Ethnomathematical Elements	Reference Image
Kobhung Roof	<ul style="list-style-type: none"> - Sharp angle at the peak, - a blunt angle at the junction of the roof and the pillar, - flat trapezoidal and isosceles triangular structures, - congruence of tiles and frame, - reflective symmetry 	Figure 1 and Figure 2
Front Porch Roof	<ul style="list-style-type: none"> - Parallelogram/rectangular shape, - obtuse angles and triangles on the supports, - congruence, - symmetry, - translation transformation 	Figure 3
Floor and Base	<ul style="list-style-type: none"> - Flat rectangular board, - congruent to the size of the board, - parallel lines, - right angles at the intersection of the boards and posts 	Figure 4
Wall/Fence	<ul style="list-style-type: none"> - Flat square/rectangular structure, - congruent panels, - horizontal and vertical woven lines, - right angles, - symmetry 	Figure 5 and Figure 6
Under	<ul style="list-style-type: none"> - Block/box space construction, - concept of spatial volume - Build a block/prism space, - congruent support pole size, 	Figure 7, 8, 9, 10
Supporting pillars	<ul style="list-style-type: none"> - vertical lines, - right angles, - symmetry and translation of the support column pattern, - proportions of size and position 	Figure 11 and Figure 12
Porch/Veranda	<ul style="list-style-type: none"> - Rectangular/trapezoidal flat structure, - congruent boards, 	Figure 13

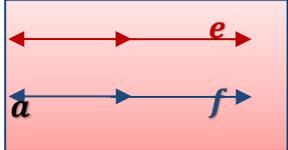
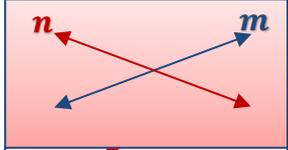
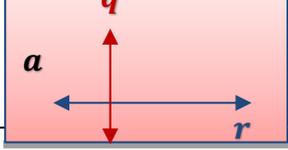
Kobhung Building Components	Ethnomathematical Elements	Reference Image
Pracik (Supporting Pole)	<ul style="list-style-type: none"> - parallel lines, - right angles, - left-right symmetry, - proportions of shape and size - Parallel lines, - right angles, acute angles, obtuse angles, - right-angled triangle, - Pythagorean theorem, - congruent, - translation and reflection 	Figure 14 and Figure 15
Side Support	<ul style="list-style-type: none"> - Right angle, acute angle, obtuse angle, - right-angled triangle, - Pythagorean theorem, - cuboid, - congruence, - translation and reflection 	Figure 16
Window	<ul style="list-style-type: none"> - Right angle, - square/rectangular plane figure, - Pythagorean theorem for measuring diagonals, - cuboid, - congruent, - translation and reflection 	Figure 17
Interior	<ul style="list-style-type: none"> - Construct a rectangle/triangle, - congruent floor and panel arrangements, - straight lines, - right angles, - volume of space 	Figure 18
Interior roof	<ul style="list-style-type: none"> - Rectangular/triangular flat structure, - Congruent beams and wooden rafters, - straight lines, - right angles 	Figure 19

The material on mathematical concepts found in Kobhung buildings will be explained below.

Line

A line is a continuous arrangement of points extending indefinitely in both directions. Lines are usually represented by lowercase letters such as *a*, *b*, or *c*, and are depicted as straight lines with arrows at both ends to indicate that their length is infinite. In geometry, a line has only one dimension, namely length, without width or height. According to Solikin (2017), a line is a geometric object that has no starting point or end point and can be extended indefinitely. Lines are also classified into straight lines and curved lines, each of which has a role in various geometric concepts and mathematical applications.

Table 3. Types of Lines

Image of Two Lines Located on a Plane α	Explanation
	Lines e and f are two parallel lines
	Lines i and j are two intersecting lines
	Lines m and n are two intersecting lines
	Lines q and r are two intersecting lines at right angles

Explanation:

- \times The notation for two intersecting lines is
- \parallel The notation for two parallel lines is
- \perp The notation for two lines that intersect at right angles

Angle

An angle is the space formed by two lines or rays that meet at the same point, called the vertex. Angles are measured in degrees, which indicate the size of the opening between the two lines. In mathematics, angles are considered the basis for understanding the geometric relationship between lines and planes (Adha et al., 2023). The concept of angles includes types such as acute angles, right angles, and obtuse angles, each of which has a different degree measurement. The use of the concept of angles is not limited to theory, but is also widely applied in daily activities and other fields of science.

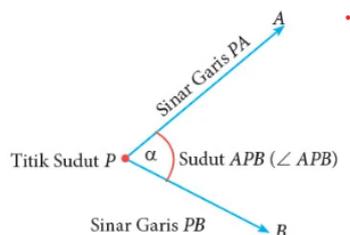
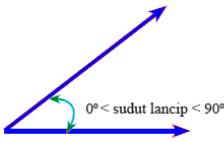
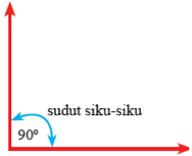
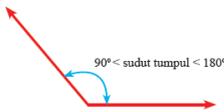
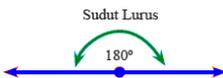


Figure 20. Angle formed by two rays

$\angle APB$ can also be called $\angle P$, and the size of the angle P is denoted by $m\angle P$. The size of a full rotation is 360° .

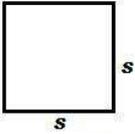
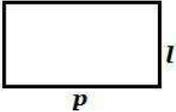
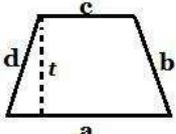
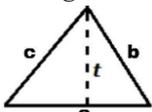
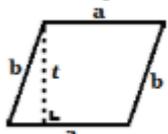
Table 4. Types of Angles

Angle Diagram	Description
	Acute Angle: the angle size is between 0° and 90°
	Right Angle: the angle measure is 90°
	Obtuse Angle: the angle measure is between 90° and 180°
	Straight Angle: the angle measure is 180°

Plane Figures

A plane figure is a figure with a flat surface that has two dimensions, namely length and width, without height or thickness. The types include length and width, but do not have height or thickness dimensions. The types include squares, rectangles, triangles, circles, parallelograms, trapezoids, rhombuses, and kites (Prakoso & Rahmatunnisa, 2019). The flat shapes found in traditional kobhung houses in Madura include quadrilaterals and triangles. Quadrilaterals are flat shapes that have four sides, such as rectangles, squares, parallelograms, and trapezoids. Triangles have three sides with a total of 180° angles, for example, equilateral triangles, isosceles triangles, and right-angled triangles. In addition, there are also parallelograms, which are often found in kobhung ornaments and structures, which have parallel sides and opposite angles of equal size. These flat shapes are important elements in the design and strength of kobhung architecture, which is part of the distinctive and functional traditional Madurese prayer room.

Table 5. Formulas for the Perimeter and Area of Flat Shapes

Flat Shape Diagram	Perimeter	Area
Square 	$K = 4 \times s$	$L = s \times s$
Rectangle 	$K = 2(p + l)$	$L = p \times l$
Trapezoid 	$K = a + b + c + d$	$L = \frac{1}{2} \times (a + c) \times t$
Triangle 	$K = a + b + c$	$L = \frac{1}{2} \times a \times t$
Parallelogram 	$K = 2a + 2b$	$L = a \times t$

Pythagoras' Theorem

According to the Pythagorean Theorem, in a right triangle, the square of the length of the hypotenuse is equal to the sum of the squares of the other two sides (Marasabessy, 2021). The Pythagorean Theorem can be formulated as follows: For $\triangle ABC$, if $\angle C$ is the right angle, then $c^2 = a^2 + b^2$

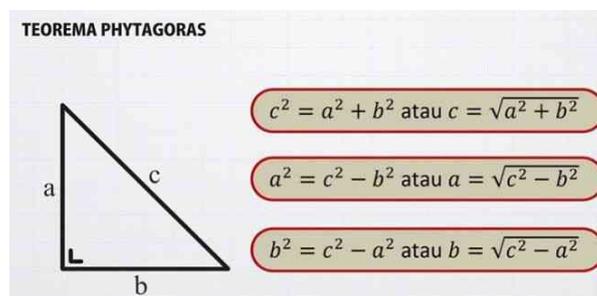


Figure 21. Pythagorean Theorem

Spatial Figures

A solid figure is a three-dimensional shape that has space inside it and is bounded by its sides. This figure has length, width, and height, so it has volume (Pangestu & Ruqoyyah, 2023). One of the solid figures found in traditional Madurese kobhung houses is a block. According

to the Ministry of Education and Culture (2017), the surface area of a block is the sum of the areas of all the sides that bound the block, with each pair of opposite sides having the same area. Meanwhile, the volume of a block indicates the maximum space that can be filled by its contents.

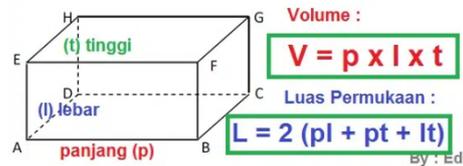


Figure 22. Formula for the surface area and volume of a block

Congruence

Congruent is a term for the relationship between two shapes or objects that have the same shape and size. Two flat shapes are congruent if the corresponding sides have the same length and the corresponding angles have the same size (Safitri, 2020). The symbol for congruence in mathematics is \cong .

Two polygons are congruent if they meet two conditions, namely:

- Corresponding sides have the same length.
- Corresponding angles have the same measure.

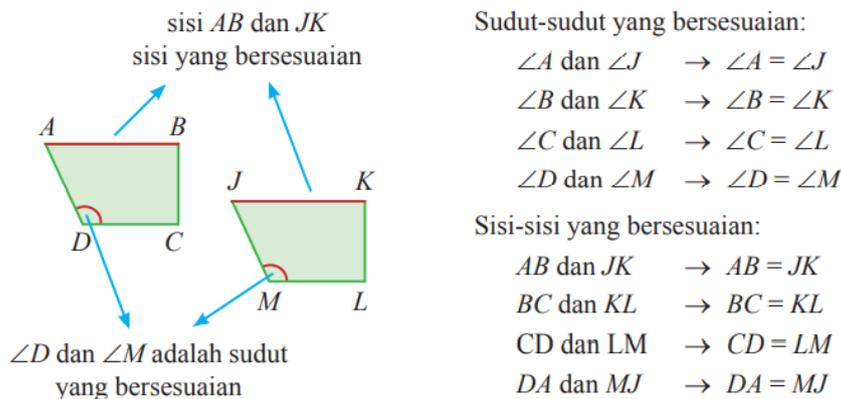


Figure 23. Congruence

If the figures $ABCD$ and $JKLM$ meet both conditions, then they are congruent, denoted by $ABCD \cong JKLM$. Conversely, if one of the conditions is not met, then the two figures are not congruent, denoted by $ABCD \not\cong JKLM$.

Geometric Transformation

Geometric transformations are processes that change the position, shape, or size of a geometric figure on a plane or in space without altering its fundamental properties. Types of geometric transformations include translation (shift), rotation (turn), reflection (mirroring), and dilation (enlargement or reduction) (Fachrunnisa & Sari, 2023).

- Translation (Shift) is the shifting of all points of a shape by the same distance and direction without changing the shape and size of the shape.
- Rotation is the turning of a shape around a specific point (center of rotation) by a specific angle.

3. Reflection is the result of a shape being reflected across a specific line (line of reflection), forming an image that is symmetrical to the original.
4. Dilation (Enlargement or Reduction) is a change in the size of a shape by a certain scale factor, either enlarging or reducing it, but keeping the shape the same.

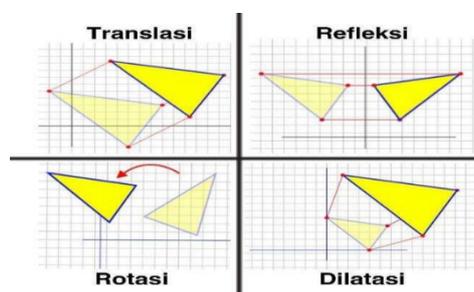


Figure 24. Geometric Transformation

In this study conducted by the researcher, ethnomathematics was found in Madura kobhung. However, from the research conducted, there are still students who do not know these ethnomathematics elements. Therefore, an educator must be able to package mathematics learning, one of which is with Madura kobhung, so that students are interested in learning mathematics and have benefits in the field of geometry.

Discussion

Specifically, based on the results of research conducted in Pamekasan, it was found that Madurese kobhung contains mathematical elements, namely straight/parallel lines, acute/obtuse/right angles, flat shapes, congruence, geometric transformations, and the Pythagorean theorem. These findings are in line with Zayyadi's (2017) research on Madurese batik, which contains symmetry, translation, and geometric patterns. Similarly, in Madurese society, they have applied mathematical concepts in traditional architecture such as kobhung, which reflects local wisdom through the design and function of the building.

The Kobhung Madura, as the traditional house of the Madurese people, has a structure rich in geometric elements. The roof of the kobhung features trapezoidal and isosceles triangular shapes; the supporting pillars exhibit congruence; and the pracik structure incorporates the Pythagorean theorem. Furthermore, aspects of shape congruence and geometric transformations such as translation and reflection are clearly evident in the arrangement of the kobhung's ornaments and construction. Symmetrical lines, angles, and patterns of flat shapes (rectangles, triangles) and simple spaces are not merely aesthetic decorations, but authentic geometric representations that have been passed down from generation to generation. This richness is also reflected in the historic Indo-European-style houses in Ragung Village, with rectangles on the windows, circles, and pyramidal and tubular shapes (Putri & Zayyadi, 2023). These symbols are still preserved today, strengthening the relationship between mathematics and Madurese cultural identity.

These empirical findings reinforce the ethnomathematics approach, which bridges abstract mathematics with everyday cultural contexts to make learning more meaningful and contextual (Sopyan, 2022). According to Susanto et al. (2022), ethnomathematics developed from the cultural activities of communities as a learning approach that connects local culture with mathematical concepts. This is in line with research on traditional Madurese houses (rumah adat tanean-lanjang) which identified flat shapes such as rectangles, trapezoids, and real triangles (Sari et al., 2022). Thus, the sacredness and function of kobhung are closely related to

mathematical concepts, such as measuring the perimeter, area of flat shapes, and volume of wooden blocks.

In mathematics learning, Madurese kobhung, which students often see in their daily lives, can be used as contextual apersepsi material to introduce geometry topics, such as parallel lines, acute angles, flat shapes, congruence, and transformations. This local wisdom also strengthens cultural identity, fostering love and pride that shape character and ethics (Hasanah et al., 2024). Students learn that geometric shapes are not just formulas, but have real functions, such as the stability of structures through the Pythagorean theorem. For further study, the material can be presented through project-based learning with direct visits to kobhung, allowing students to observe, touch, and discover concepts intuitively—thereby increasing motivation, active engagement, and holistic understanding towards sustainable education.

Conclusion

Based on the results of data analysis from direct observation, visual documentation, and interviews with 10 informants in Pamekasan, it was found that Madurese kobhung contain various mathematical concepts that are fully integrated into their physical structure (). The kobhung roof is trapezoidal and isosceles triangular with a 45° acute angle slope, the supporting pillars (soko) show congruence of four points forming a square, the pracik structure applies the Pythagorean theorem through right-angled triangles, and the roof frame contains parallel straight lines, 135° obtuse angles, bilateral symmetry, translation transformations in wood carvings, and rectangular and parallelogram shapes in the bamboo floor joints. These geometric concepts inherent in the structural elements of kobhung can be used as a medium for contextual learning to introduce lines, angles, flat shapes, congruence, transformations, and the Pythagorean theorem to students, making learning meaningful because it comes from familiar local cultural heritage. This study is still limited to identifying ethnomathematical elements in the structure of Madurese kobhung and has not examined its application and effectiveness in classroom learning. Therefore, the researchers recommend further research on its implementation in mathematics classroom learning.

Conflict of Interest

The author declares no conflict of interest.

Authors' Contributions

U.S.M. contributed to understanding the proposed research idea and collecting the data. The other two authors (M.Z. and S.I.H.) actively contributed to the development of the theoretical framework, methodology design, data organization and analysis, discussion of the findings, and approval of the final version of the manuscript. All authors confirm that they have read and approved the final version of this paper. The contribution proportions to the conceptualization, drafting, and revision of this manuscript are as follows: U.S.M.: 40%; M.Z.: 30%; and S.I.H.: 30%.

Data Availability Statement

The author declares that data supporting the results of this study will be made available by the corresponding author, [U.S.M.], upon reasonable request.

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Author Biographies

	<p>Ulfi Syamsiyatul Maghfiroh is an undergraduate student in the Department of Mathematics Education, Faculty of Teacher Training and Education, Universitas Madura, Indonesia. Email: syamsiyatulmaghfiroh@gmail.com</p>
	<p>Moh. Zayyadi is a lecturer in the Department of Mathematics Education, Faculty of Teacher Training and Education, Universitas Madura, Indonesia. Email: zayyadi@unira.ac.id</p>



Sri Indriati Hasanah is a lecturer in the Department of Mathematics Education, Faculty of Teacher Training and Education, Universitas Madura, Indonesia.
Email: indriati_math@unira.ac.id