JARME **Journal of Authentic Research on Mathematics Education**
Volume 5, No. 1, January 2023
https://doi.org/ 10.37058/jarme. v5i1.5692 **e-ISSN 2655-7762**

MATHEMATICAL AESTHETICS OF JEPARA'S CARVING

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ARTICLE INFO

Article history:

Received: Oct 25, 2022
Revised: Des 26, 2022
Accepted: Jan 09, 2023

Keywords:

Mathematical Aesthetics, Etnomathematics, Jepara's Carving.

ABSTRACT

Jepara's carving is a work of art with a mathematical concept of aesthetic value. Mathematical aesthetics refers to the relationship between mathematics and aesthetic values, namely the beauty of mathematics integrated with the art of Jepara's carving. The qualitative descriptive method is used to describe aesthetics and mathematical concepts in Jepara's carving and the relationship between the two focuses of the study. Data were collected using semi-structured interviews, non-participatory observation, and documentation. The research subjects consisted of two informants: art and culture teachers and Jepara's carving artisans. The data were analyzed using the Miles and Huberman model, which consisted of the following stages: data reduction, data presentation, and conclusion drawing. The results showed that: (1) Jepara's carving has aesthetic value, seen from the fulfillment of aesthetic elements, namely: unity, complexity, sincerity, and balance; (2) the process of making Jepara's carving applies the mathematical concept of comparison, which plays an essential role in making Jepara's carving patterns; and (3) there is a collaboration between the application of mathematical concepts and aesthetic theory in creating the term mathematical aesthetics in Jepara's carving which refers to geometric aesthetics, wherein this Jepara's carving motif there is a regularity of patterns dominated by $\frac{1}{4}, \frac{1}{6}$, and $\frac{1}{8}$.

Seni ukir Jepara merupakan karya seni dengan konsep matematis bernilai estetis. Estetika matematis merujuk pada hubungan antara matematika dan nilai-nilai estetika, yaitu pada keindahan matematika yang menyatu dalam seni ukir Jepara. Metode deskriptif kualitatif digunakan untuk mendeskripsikan estetika dan konsep matematika pada seni ukir Jepara, serta hubungan di antara kedua fokus kajian tersebut. Data dikumpulkan dengan teknik wawancara semi-terstruktur, observasi non-partisipatif, dan dokumentasi. Subjek penelitian terdiri dari dua informan, yaitu guru seni rupa dan budaya, dan pengrajin ukiran Jepara. Data dianalisis dengan model Miles dan Huberman, yang terdiri dari tahapan: reduksi data, penyajian data, dan penarikan kesimpulan. Hasil penelitian menunjukkan bahwa: (1) seni ukir Jepara memiliki nilai estetika, dilihat dari terpenuhinya unsur-unsur estetika yaitu kesatuan, kerumitan, kesungguhan, dan keseimbangan; (2) proses pembuatan seni ukir Jepara mengaplikasikan konsep matematika mengenai perbandingan yang berperan penting dalam pembuatan pola motif ukiran Jepara; dan (3) adanya kolaborasi antara pengaplikasian konsep matematika dan teori estetika dalam menciptakan istilah estetika matematis pada seni ukir Jepara yang merujuk pada estetika geometris, dimana pada pola motif ukiran Jepara ini terdapat keteraturan pola yang didominasi oleh pola $\frac{1}{4}, \frac{1}{6}$, *dan* $\frac{1}{8}$.

How to Cite:

Utami, R. N. F., Muhtadi, D. & Hermanto, R. (2023). Mathematical Aesthetics of Jepara's Carving. *Journal of Authentic Research on Mathematics Education,* ***5***(1), 1-10. https://doi.org/10.37058/jarme.v5i1.5692

1. INTRODUCTION

The art of carving is one of many works of art developed in various regions in Indonesia. The famous area for its carvings in Jepara Regency is Jepara's carving art. Jepara is Indonesia's leading wood carving-producing area, known since ancient times (Soepratno, 2004). Jepara carving is a typical Indonesian fine art made using a medium's scratch, cut, or engraving techniques. The creation and development of this work of art have an exciting uniqueness so that its existence cannot be denied and become the identity of Jepara Regency.

Jepara's carving development originated during Queen Kalinyamat, around the 15th century to the 16th century AD. At that time, Queen Kalinyamat ordered a royal minister named Sungging Badarduwung, who had carving skills, to make carvings on the Mantingan Mosque and Jirat Tomb, namely the tomb of her husband, Sultan Hadlirin (Nangoy and Sofiana, 2013:260) since then, carving in Jepara has continued to develop during the Kartini era until today's modern era (Gustami, 2000; Nangoy & Sofiana, 2013).

Jepara's carving products certainly have aesthetic value as a work of art. Aesthetics is a science that studies all things about art and beauty, as well as human responses to art and beauty (Depdiknas, 2008: 401; Djelantik, 2004: 7). Aesthetics are integrated into work, one of which is the work of Jepara carvings. This work is the result of human thinking activity and is poured into the form of an object or object, which in the process of making it, requires thought accompanied by the unification of other elements to formwork with structured concepts and patterns. This pattern shapes the object into a work of art with aesthetic value. This object is part of the reality of life, where the five senses capture everything that is in the environment,

Humans can feel an object's beauty and aesthetics; for example, they are amazed at the object of the Egyptian Pyramids, which shows the Egyptians' progress in mathematics, geometry, and architecture at that time (Umar, 2009:213). The existence of an object viewed based on geometric regularity indicates that a work's beauty or aesthetics depends on its elements' proportions (Steadman, 1983:134). In this context, transformation methods in geometry can be applied to develop creativity and innovation in producing a work of art (Mochsen, 2005:69-83).

Geometry is closely related to the rules of geometry and forms (Depdiknas, 2008:473; Zainul, 2018). Mathematics measures and describes an object's form (Nasution, 1980). These mathematical activities are integrated into carving, such as carving Jepara's carvings (Utami et al., 2021). Carving is carried out by scratching, incising, and carving to make paintings on wood (Depdiknas, 2008:1773). Jepara's carving is created through this activity full of aesthetic values. This explains that mathematics has aesthetic value when viewed in terms of the beauty of the Jepara carving object, which was built with a regular,

structured pattern, and also shows a relationship between mathematics and aesthetics. Because mathematics is a science about patterns and relationships, a mindset, an art, a language, or a tool (Fahrurrozi & Hamdi, 2017; Reys, 1984)

The essence of mathematics is the ability of the human mind to catch patterns to solve a problem by utilizing simple equipment (Utami et al., 2020). In everyday life, humans can make a work of art by using mathematical concepts in perfecting their work, such as the concept of a plane, comparison, and geometry. Sudirman, Rosyadi, and Lestari (2017) revealed that in the Indramayu batik motif, translation and reflection are used in the transformation geometry and the concept of tessellation. In this case, mathematics is seen from two points of view, namely the point of view of pure mathematics (pure mathematics), where mathematics is art and creativity,

Someone who understands the field of mathematics and applies his knowledge can produce an object as a work that its beauty can enjoy. This shows that mathematics and art have a close relationship because they are activities where both support each other to create a beautiful work of art. Objects that are works of art with mathematical concepts as the basis for thinking show that in the reality of everyday life, mathematics has been applied in human life, which is carried out to fulfill life needs and help humans in carrying out their life activities (Utami et al., 2021). The object as a work that is integrated into the culture of a particular society, especially the art community, is closely related to ethnomathematics,

This connection between mathematics and aesthetics creates the term mathematical aesthetics, which denotes the beauty of mathematics from an aesthetic point of view. This mathematical aesthetic is integrated with human activities and works, where mathematics is inherent in human life wherever they are. Mathematical aesthetics can be seen in several works of art, one of which is Jepara's carving. This article discusses aesthetics and mathematical concepts in Jepara's carving and the relationship between the two study focuses.

2. METHODS

This study uses a qualitative descriptive method, carried out in natural or natural conditions, and the data collected, and the analysis is qualitative (Sugiyono, 2019). In addition, this study also uses an ethnographic approach to describe, analyze, and conclude the elements of a cultural group, such as patterns of behavior, beliefs, and language that develop from one time to the next (Creswell, Pancasari, & Fawaid, 2016).

The data sources in this research are Jepara's carving artisans and art and culture teachers who understand art and culture and act as informants. Indicators of aesthetic elements guide data regarding aesthetic elements embedded in Jepara's carving products according to Beardsley and Gie (1976), namely: (1) Unity, namely the fulfillment of elements that refer to the quality of complementary relationships between parts of the artwork; (2) Complexity, namely the complexity of the forms and motifs of the carving art so that the work is not simple but rich in elements and elements in it; (3) Seriousness, namely the existence of certain qualities that stand out and are serious, and (4) Balance, namely the stability shown by the object of art so that it has the same attraction on each

side. The data was collected through semi-structured interviews, non-participatory observations, and documentation, with the researcher acting as the main instrument.

The results of data collection are then analyzed using the Miles and Huberman model (in Sugiyono, 2019), which consists of the following stages: (1) data reduction is carried out by summarizing the results of interviews and classifying data into several categories of aesthetic elements, (2) data display is carried out by presenting data from interviews, observations, and documentation in the form of descriptions and charts regarding mathematical aesthetics, and (3) drawing conclusions (conclusion drawing) that are concluding these data by revealing the mathematical aesthetics of Jepara's carving.

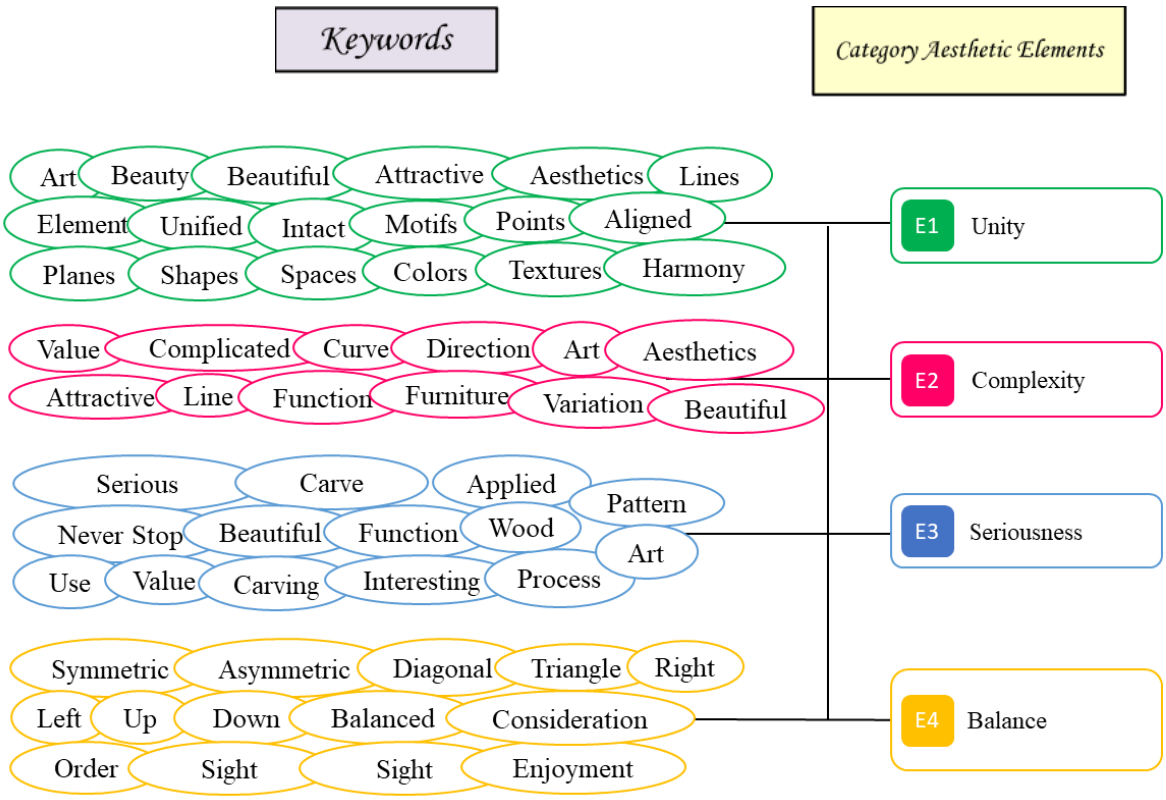
3. RESULT AND DISCUSSION

Aesthetic value is related to beauty that can be seen with the eye. An object is said to have aesthetic value if it meets some aesthetic qualities or elements. In other words, aesthetics is certain essential qualities in a thing, object, or work. Based on the data obtained from interviews with informants, the researchers made several categories related to the elements, principles, or theories of aesthetic form in Jepara's carving by identifying various keywords collected from statements expressed by informants in interviews. The researchers made the following coding to make it easier to categorize keywords.

Table 1. Categorization of Aesthetic Elements in Jepara's Carving Based on the Interview Results

No.	Category Aesthetic Elements	Code
1.	Unity (Unity)	E1
2.	Complexity	E2
3.	Seriousness	E3
4.	Balance (Balance)	E4

Based on the coding in Table 1, which is adjusted to the notes from the interviews, a categorization chart of aesthetic elements in Jepara's carving is obtained as follows.



Picture 1. Keyword and Category Chart of Aesthetic Elements in Jepara's Carving

Some of the keywords expressed by the informant during the interview are related or lead to several categories of aesthetic elements, principles, or theories, including (1) unity identified from the keywords "art, beauty, beautiful, attractive, aesthetics, lines, elements, unified, intact, motifs, points, aligned, planes, shapes, spaces, colors, textures, and harmony," (2) the complexity identified from the keywords "value, complicated, curve, direction, art, aesthetic, attractive, line, function, furniture, variety, and beautiful," (3) seriousness identified from the keywords "serious, carve, applied, never stop, beautiful, function, wood, pattern, use, value, carving, interesting, and process, as well as (4) balance identified from the keywords "symmetric, asymmetric, diagonal, triangle, right, left, up, down, balance, consideration, order, sight, sight, and enjoyment."

Jepara's carving as an aesthetic product from one of the fields of art studies has several quality elements that shape it into a work of art. Here are some explanations about Jepara's carving quality or aesthetic elements.

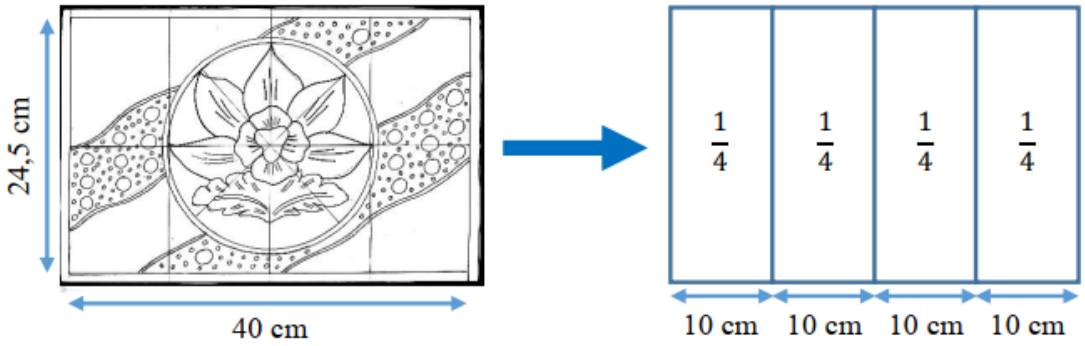
Table 2. A Study of Aesthetic Elements in Jepara's Carving

No.	Carving Motif	Aesthetic Elements Study
1.	Animal Naturalist Motif	***Unity:*** All components of the fish, namely the head, eyes, fins, scales, and tail, blend and complement each other to produce a cohesive composition of koi fish motifs.

		***Complexity:*** The prominent head component, convex circular eyes, fins with finely lined motifs, regular scales, and tail with straight and tortuous lines give off a waving impression that composes it into a work of art with complexity. ***Seriousness:*** Visualization of the shape of a live and real fish shows the seriousness with the appearance of the tail and fins waving to resemble the movement of a fish swimming in water. ***Balance:*** Having an asymmetrical balance, the left and right spaces of the carving both look full, and the composition remains balanced
2.	Naturalist Motifs of Plants 	***Unity:*** The components, namely stem leaves, sunflower crown, tulip flower buds, and stems, blend and complement each other to produce a beautiful and coherent composition of plant motifs. ***Complexity:*** The visual elements feature multi-directional curved lines, perfect leaf planes and shapes, uneven surfaces, brown tones with derivatives, and dark light showing contradicting elements and containing subtle differences but displaying complexity. ***Seriousness:*** There is a superior quality (center of interest), namely the sunflower in the middle of the carving, and the visualization of sunflowers, tulips, and leaves shows the impression of life. ***Balance:*** Having asymmetrical balance, the left and right spaces of the carving have the same shape; both look full, and the composition remains balanced.

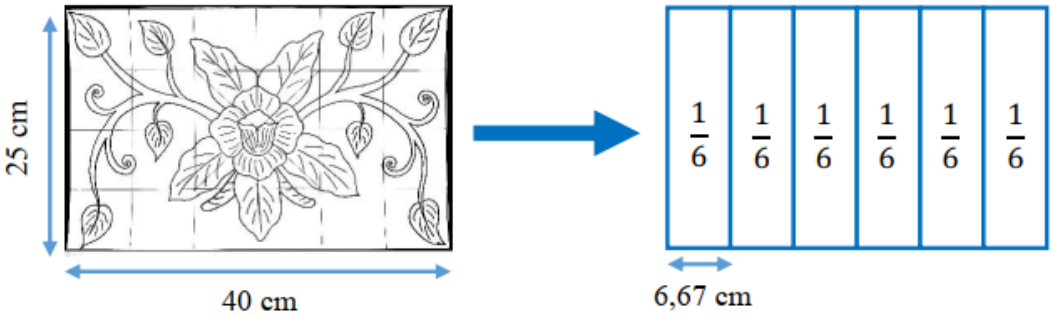
Thus, Jepara's carving works contain several aesthetic elements: unity, complexity, sincerity, and balance. With the fulfillment of these elements, the art of Jepara's carving becomes a work of art that has aesthetic value, the beauty that exists in Jepara's carving cannot be separated from one of the elements or aesthetic principles, namely, the balance, which plays a vital role in the activity of making Jepara's carving patterns. The principle of balance in the carving pattern produces a geometric pattern that is symmetrical or asymmetrical with a balanced composition, and some parts have a fixed ratio or proportion. The proportion in question compares a part with the whole part of the motif.

The concepts of symmetrical, asymmetrical balance and comparisons are closely related to mathematics, where the balance in the geometric patterns of Jepara's carvings results in pattern regularity. The regularities of the patterns in Jepara's carving motifs produce a mathematical aesthetic term called geometric aesthetics. Here are some regularities of geometric patterns in Jepara's carving motifs.



Picture 1. Regularity of Patterns $\frac{1}{4}$ in Jepara's carving motifs

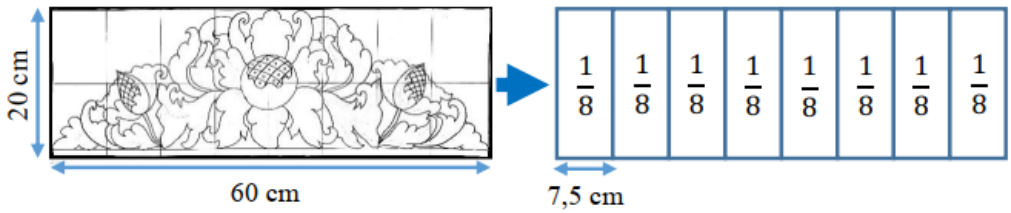
The first regularity is a pattern. To create a balanced pattern, artisans use vertical, horizontal, or diagonal lines to place each point on the motif to make it look balanced. In this pattern, the craftsman divides the pattern paper measuring 40 cm × 25.5 cm into four parts so that each part has a proportion of $\frac{1}{4}$ of the entire motif length, with the width of each part being 40:4=10 cm. The first pattern consists of two main shapes: the circle shape and the diagonal area shape. The circle shape is in the middle of the motif, with a floral motif. While the shape of the diagonal area is in a crossed position behind the circle shape. The two forms have their respective proportions. The circle shape occupies two parts, so the proportion is. While the shape of the diagonal area also occupies two parts, namely the right and left of the circle, the proportion is $= \frac{1}{4} + \frac{1}{4} = \frac{2}{4} = \frac{1}{2} = \frac{1}{4} + \frac{1}{4} = \frac{2}{4} = \frac{1}{2}$.



Picture 2. Regularity of Patterns $\frac{1}{6}$ in Jepara's carving motifs

The second regularity is a pattern. To make this pattern, artisans again use vertical, horizontal, or diagonal lines to place each point on the motif to make it look balanced. In this pattern, the artisans divide the length of the pattern paper, measuring 40 cm long and 25 cm wide, into six parts so that each part has a proportion $\frac{1}{6}$ of the whole motif with the length of each part is $40 : 6 = 6{,}67\ cm$. This second pattern consists of two main shapes: the shape of the flower and its petals and the leaf tendrils. The shape of the flower and petals is in the middle of the motif, while the leaf tendrils are on the right and left of the flower shape. The two forms have their respective proportions. The shape of the flower

and its petals occupy two parts, so the proportions are. While the shape of the leaf tendrils occupies four parts, so the proportion is $= \frac{1}{6} + \frac{1}{6} = \frac{2}{6} = \frac{1}{3} = \frac{1}{6} + \frac{1}{6} + \frac{1}{6} + \frac{1}{6} = \frac{4}{6} = \frac{2}{3}$.



Picture 3. Regularity of Patterns $\frac{1}{8}$ in Jepara's carving motifs

The third order is the pattern. To make this pattern, the artisans divide the length of the pattern paper, measuring 60 cm long and 20 cm wide, into eight parts so that each part has a proportion $\frac{1}{8}$ of the whole motif with the length of each part is $60 : 8 = 7{,}5\ cm$. The third pattern consists of three main shapes: sunflower, tulip, and leaf tendril. The shape of the sunflower is in the middle of the motif, the shape of the leaf tendrils is on the right and left of the sunflower shape, and the shape of the tulip is on the right and left of the sunflower, which is interspersed with leaf tendrils. The three forms have their respective proportions. The shape of the sunflower occupies two parts, so the proportion is. The shape of the tulip flower occupies two parts, so the proportions are. While the shape of the leaf tendrils occupies four parts, so the proportion is $= \frac{1}{8} + \frac{1}{8} = \frac{2}{8} = \frac{1}{4} = \frac{1}{8} + \frac{1}{8} = \frac{2}{8} = \frac{1}{4} = \frac{1}{8} + \frac{1}{8} + \frac{1}{8} + \frac{1}{8} = \frac{4}{8} = \frac{1}{2}$.

Based on the above discussion, it is found that the aesthetic value of Jepara's carving is created from the application or application of mathematical concepts carried out by carving artisans in making Jepara carving patterns. In this case, the concept in question is compared to give birth to a pattern of motifs. By utilizing the concept of comparison in pattern-making activities, the artisans create carving motifs by paying attention to aesthetic elements: unity, complexity, sincerity, and balance. A collaboration between mathematics and aesthetics in art into a single unit complements each other to create beautiful Jepara carvings. This collaboration between mathematical concepts and aesthetic theory gave birth to the term mathematical aesthetics, which refers to geometric aesthetics, wherein this Jepara's carving pattern is a pattern regularity dominated by the pattern. The regularity of the geometric pattern in this Jepara carving pattern supports the creation of carvings with geometric shapes that meet the principles of symmetrical and asymmetrical balance. The principle of balance becomes an element that plays a vital role in the rules of aesthetic form something. Thus, this collaboration displays the beauty of combining mathematical and aesthetic concepts in Jepara's carving that cannot be separated from every process. The principle of balance becomes an element that plays an essential role in the rules of the aesthetic form of an object. Thus, this collaboration displays the beauty of combining mathematical and aesthetic concepts in Jepara's carving that cannot be separated from every process. The principle of balance becomes an element that plays an essential role in the rules of the aesthetic form of an object. Thus, this

collaboration displays the beauty of the combination of mathematical and aesthetic concepts in Jepara's carving that cannot be separated from every process $\frac{1}{4}, \frac{1}{6}, \frac{1}{8}. \frac{1}{4}, \frac{1}{6}, \frac{1}{8}$.

4. CONCLUSION

Based on the results of research on mathematical aesthetics in Jepara's carving, the following conclusions can be drawn: (1) Jepara's carving has aesthetic value, seen from the fulfillment of aesthetic elements, namely unity, complexity, sincerity, and balance; (2) The process of making Jepara's carvings applies the mathematical concept of comparison which plays an essential role in making Jepara's carving patterns; And (3) there is a collaboration between the application of mathematical concepts and aesthetic theory into a single unit that complements each other to give birth to the term mathematical aesthetics in Jepara's carving which refers to geometric aesthetics, wherein this Jepara's carving motif there is a regular pattern which is dominated by patterns $\frac{1}{4}$, $\frac{1}{6}$, and $\frac{1}{8}$.

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