ISSN 2598-2192 (online)

LEKESAN

Interdisciplinary Journal of Asia Pacific Arts

VOLUME 1, ISSUE 2, OCTOBER 2018

Symmetry Analysis of Double-ikat Textile Patterns: Patan Patola and Geringsing

Nyoman Dewi Pebryani

INDONESIA INSTITUTE OF THE ARTS DENPASAR
CENTER OF PUBLISHING
INSTITUTION OF RESEARCH COMMUNITY SERVICE AND EDUCATION DEVELOPMENT

LEKESAN: INTERDISCIPLINARY JOURNAL OF ASIA PASIFIC ARTS
Jurnal.isi-dps.ac.id
ISSN: 2598-2192 (print)

Editorial Office
Indonesia Institute of The Arts Denpasar
Jalan Nusa Indah Denpasar 80235
Phone +62-361-227316 ext 159 Fax +62-361-236100
E-mail : penerbitan@isi-dps.ac.id

LEKESAN: INTERDISCIPLINARY JOURNAL OF ASIA PASIFIC ARTS
Is a peer-reviewed journal

ARTICLE SUBMISSION
Lekesan: interdisciplinary journal of asia pasific arts is published 2 (two) times a year, i.e. april and october. To find out more about the submission process, please visit http://jurnal.isi-dps.ac.id/index.php/lekesan

ARTICLE PROCESSING CHARGES
Every article submitted to Lekesan will not have any 'Article Processing Charges'. This includes submitting, peer-reviewing, editing, publishing, maintaining and archiving, and allows immediate access to the full text versions of the articles

SUBSCRIPTIONS
Lekesan: interdisciplinary journal of asia pasific arts
is available in electronic and print formats. Subscribe to gain access to content from the current year and the entire backlist.
Contact us penerbitan@isi-dps.ac.id

DISCLAIMER
The authors, editors, and publisher will not accept any legal responsibility for any errors or omissions that may have been made in this publication. The publisher makes no warranty, express or implied, with respect to the material contained herein.

All published article are embedded with DOI number affiliated with Crossref DOI prefix 10.31091

Volume 1, Issue 2, October 2018 p59-73

Lekesan: Interdisciplinary Journal of Asia Pasific Arts

Journal homepage http://jurnal.isi-dps.ac.id/index.php/lekesan

Symmetry Analysis of Double-ikat Textile Patterns: Patan Patola and Geringsing

Nyoman Dewi Pebryani[1]

Symmetry analysis of textile patterns, which appear in the *Patan Patola* and *Geringsing* textiles produced by the double ikat technique in India and Indonesia, can provide information about the cultural relationship between ethnic groups. Symmetry is categorized into classes according to the Symmetry Group Theory. This article is based on a study in which eight textile samples were used: four *Patan Patola* textiles and four *Geringsing* textiles collected from an exhibition catalog. Each sample was examined based on the Symmetry Group Theory and divided into three class categories: point symmetry, one-dimensional, and two-dimensional classes. The results indicate high similarities among the symmetry classes of samples from these two ethnic groups, thereby suggesting that the patterns possess a common connection. *Patan Patola* and *Geringsing* textile patterns admitted *pmm2* and *d4*in all samples, indicating intense interactions.

Keywords: symmetry, geringsing, patan patola, double-ikat

[1] Clemson University, USA
npebrya@g.clemson.edu

Article history:
Received 1-8-2018
Received in revise form 30-8-2018
Accepted 29-10-2018
doi: dx.doi.org/10.31091/lekesan.v1i2.493

Introduction

The purpose of this study is to examine the symmetry classes of textiles produced by cultural ethnic groups that still use the double ikat weaving technique. According to Dhamija (2002), the double ikat weaving technique exists in two places in the world: India and Indonesia. The textiles produced using the double ikat weaving technique is called *Patan Patola* in India and *Geringsing* in Indonesia. However, no study has decoded the cultural information of these two textiles through a symmetry analysis, which would provide information on the symmetry preferences from the two ethnic groups.

The patterns created in textiles are outcomes of the cultural knowledge owned by ethnic groups. Since they produce textiles based on the availability of equipment and materials in their surroundings, the patterns that appear in the textiles reflect how the artisans perceive the world around them. In other words, the patterns appearing in the textiles encode cultural information. One way to decode this cultural information is by examining the patterns' symmetries. The Symmetry Group theory can be used to analyze and compare the pattern structures of *Patan Patola* and *Geringsing*, which allowing researchers to interpret the relationship between the two cultures. Based on Engelbratch (1974), the more similarities found in symmetry classes between two textiles patterns, the more likely the patterns have a common connection.

Patan Patola and Geringsing

The word *ikat* means to bind; hence, in the double-ikat technique, both warp and weft threads have to be wrapped and dyed before the threads are woven. Because the process is demanding and time-consuming, not many places have preserved this technique. According to Dhamija (2002), contact between India and Indonesia began as early as the 4th century through Hindu and Buddhist influences, the use of the Sanskrit language, and the trading of textiles. Dating back to ancient times, textiles from India, especially the Patan Patola, were worn by the Indonesian royal family (Dhamija, 2002; Ramseyer,Buhler, 1989; Patolas, 1988). Based on a study by Breguet, he found that blood samples, obtained from a large population of the Tenganan Pegringsingan people, revealed eighteen citizens in the village to possess a special enzyme called *LHD calcuta 1*. This enzyme is a characteristic of the Indian population that is extremely rare outside of this country (as cited in Ramseyer, 1983, p.25). His data suggest the possibility that the ancestors of Tenganan Pegringsingan may indeed have come from India. Based on this information, it could then be assumed that the double-ikat technique had probably transferred to Indonesia from people in India who migrated to the Tenganan Pegringsingan Village.

The assumption that Patan and Tenganan Pegeringsingan are interconnected has motivated research comparing their textiles. After studying both areas for several years, Ramseyer and Buhler exhibited the textiles and created a catalogue in German in 1975. They found that Patan Patola and Geringsing were used for ceremonial purposes in their original areas and that the textiles possessed the same pattern structure, both having borders and body patterns (Buhler&Ramseyer, 1989). A second exhibition entitled The Voyage of Cloth and held at Bank Duta, Indonesia in 1988 was sponsored by the Indonesian textile designer, Iwan Tirta, and the Gujarat State Handicraft and Handloom Development. The catalogue exhibited not only Patan Patola but also all types of textiles from India that had influenced Indonesian textiles. An interesting note from this catalogue is that despite the large quantities of Indian textiles exported to Indonesia over the millennium, Indonesia retained its own traditions.

The study of these textiles has primarily focused on either Geringsing or Patan Patola or on exhibiting both of them in the same catalogue. However, no study has used symmetry analysis to examine their pattern structures.

Symmetry Analysis

A symmetry analysis of the patterns that appear in both textiles will provide new knowledge in the field on how these textiles are connected through geometrical patterns. D.K Washburn, in her study of symmetry analysis, argues that investigating the universal form of symmetry can enable us to understand why certain object-specific features display ethnic identity. Shapiro, in his comparison of African and British patterns, finds that African patterns, unlike British patterns, seem to prefer rotating objects to a position 45 degrees past the perpendicular to the horizontal plane (Shapiro, 1960, pp.17-30). Crowe, in several studies of African art (1971, 1975, 1982), shows respectively that pattern designs can be described systematically by their symmetries, that repeated designs occur frequently on many types of media, and that a number of different motions characterize the designs. As these examples suggest, symmetry analysis is a fundamentally significant method for understanding the cultural information.

A pattern consists of a fundamental unit that is repeated in specific motions, and if a pattern exhibits those motions, it has symmetry. The motions analyzed here include rotation, reflection, translation, and glide reflection. To provide a clearer understanding of symmetry, the images below illustrates a pattern's fundamental unit and symmetry.

Symmetry Group Theory (Woods, 1935; Washburn and Crowe, 1988; Hann, 1991) classifies symmetry patterns into finite groups and infinite groups, with the infinite group being divided into 7 one-dimensional classes and 17 two-dimensional classes. The fundamental unit moves along the axis by one or a combination of several motions,

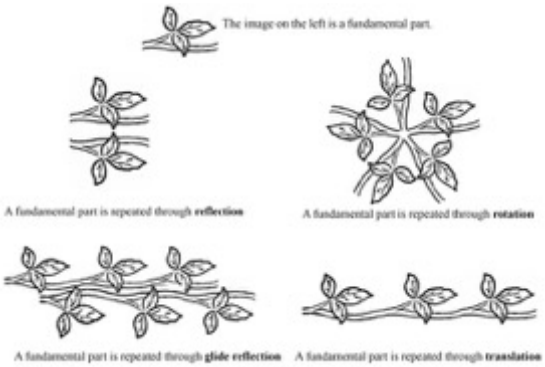


Figure 1. Symmetry motions

and these motion classes are used to describe a specific repeated pattern. Thus, patterns whose parts move about a point axis are called finite because eventually the parts will move full circle to superimpose upon the original starting point. Patterns whose design units move along a line axis are called one-dimensional infinites since their generation in one direction can theoretically be repeated an infinite number of times without superimposing on the original. Likewise, patterns whose design units move along two-line axis are called two-dimensional infinites since their generation in two directions can be repeated an infinite number of times (Washburn, 1983, pp.138).

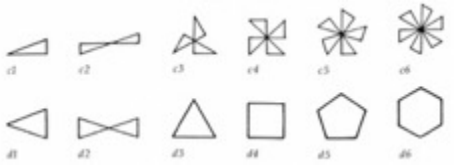


Figure 2. Finite design or Point symmetry, from Woods, 1935, p.200

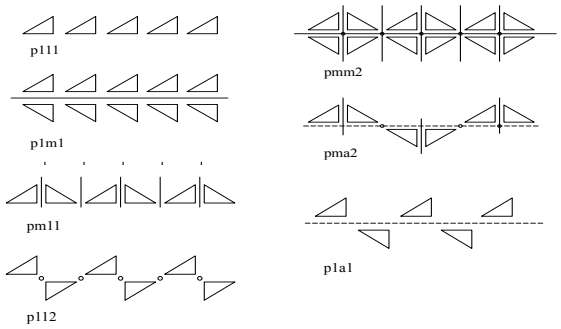


Figure 3. One-dimensional pattern which admits one direction of translation, reproduced from D.K Washburn, 1988, p.59

Pattern Structure

In terms of size, Patan Patola textiles are larger than Geringsing textiles; however, Patan Patola and Geringsing are similar in structure with both textiles having borders and body patterns (as can be seen in the figure 5). In Patan Patola textiles, the border patterns appear as circling the body

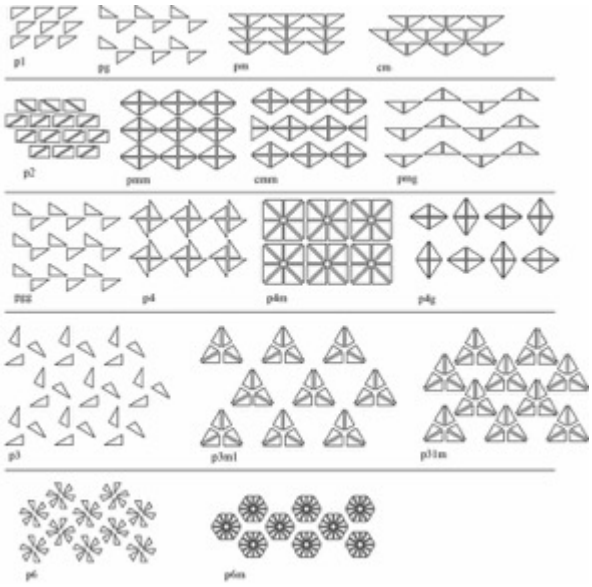


Figure 4. Two-dimensional pattern which admits more than one direction of translation, reproduced from D.K Washburn, 1988, p.61

patterns while, in Geringsing textiles, the border patterns appear at the top and bottom of the body pattern.

The symmetry analysis of the patterns appearing in both Geringsing and Patan Patola textiles is based on the patterns' structures. The border patterns in both textiles are composed from a fundamental unit that repeats in one direction; therefore, the border patterns' analysis used 7 one-dimensional classes. The body patterns for both Gerignsing and Patan Patola textiles consist of fundamental units that repeat in one or more directions; therefore, the body patterns' analysis use both the 7 one-dimensional classes and 17 two-dimensional classes. In addition to that, each fundamental unit of the border and body patterns in both textiles consist of several design units—smaller units of the fundamental unit. These design units rotate and reflect on their axis, and those units were analyzed with dihedral and cyclical point symmetries. Thus, a symmetry analysis was conducted in three sections: the border patterns, the body patterns, and the design units of both the border and body patterns.

Samples

The samples for this study were taken from museum catalogs. The sampling design technique is non-probability with quota sampling—one sample is taken under each category of the Patan Patola and Geringsing found in literature. Buhler (1975, p.221) categorizes Patan Patola into 7 groups, with groups 1-4 related to the pattern structure and groups 5-7 related to the materials used in the textile. So, only the first 4 groups were used as the categories in this study, as shown in the diagram below. Ramseyer (1991, p.119) also divided Geringsing into 4 groups, which are also shown in the diagram below. One sample from these

eight categories were drawn as illustrated in the diagrams below (see diagram 1 & 2 for clarification)

Procedure

A procedure or protocol was set up to analyze the data to reduce subjectivity in analyzing the patterns' structures. The procedure is as follows:

1. Re-draw the patterns. All the samples were redrawn using Computer-Aided Design (CAD) software to obtain a clear visual of the shape. This study focuses only on the shape of the patterns regardless of color or any other elements that support the textiles.
2. Parse the pattern based on border and body patterns. After redrawing the patterns, the analysis began by dividing the patterns into border and body patterns for each sample.
3. Examine the border patterns of Geringsing and Patan Patola. Patan Patola and Geringsing have more than one border pattern, which are assessed with 7 one-dimensional symmetry classes. Then the fundamental units of each border pattern types are examined with point symmetry classes.
4. Examine the body patterns of Geringsing and Patan Patola. The fundamental units of the body patterns of Patan Patola and Geringsing are repeated in one or more direction, so the body patterns are assessed with one-dimensional and two-dimensional symmetry classes. Then, each fundamental unit of both the Patan Patola and Geringsing patterns are then examined with point symmetry classes.
5. Calculate each component of the symmetry classes as percentages based on the appearance in each sample.
6. Compare the appearance of each symmetry in the categories of: border patterns, body patterns, and point symmetry.

Below are the sample images showing the process of analyzing each sample based on this procedure.

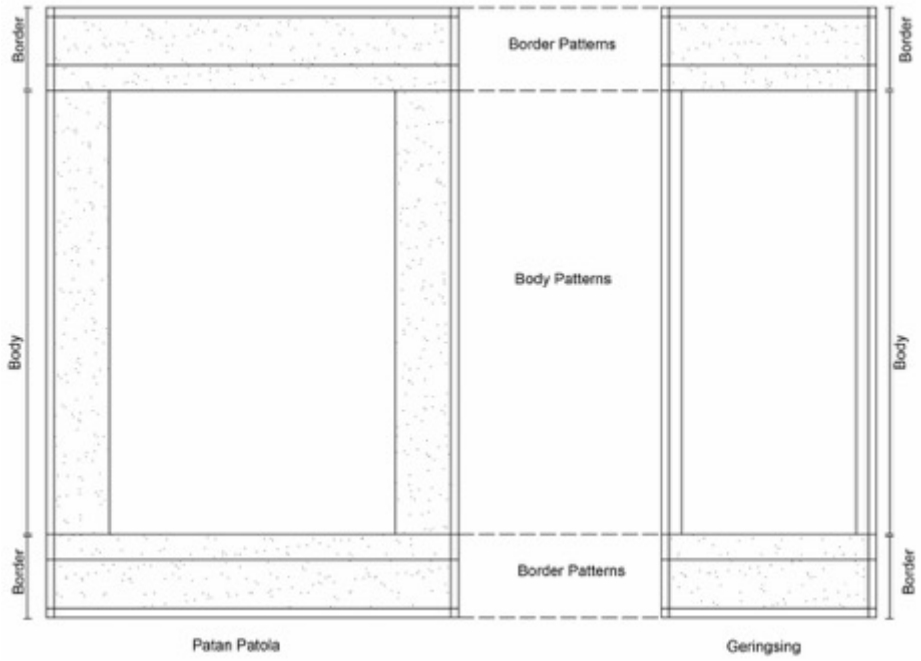
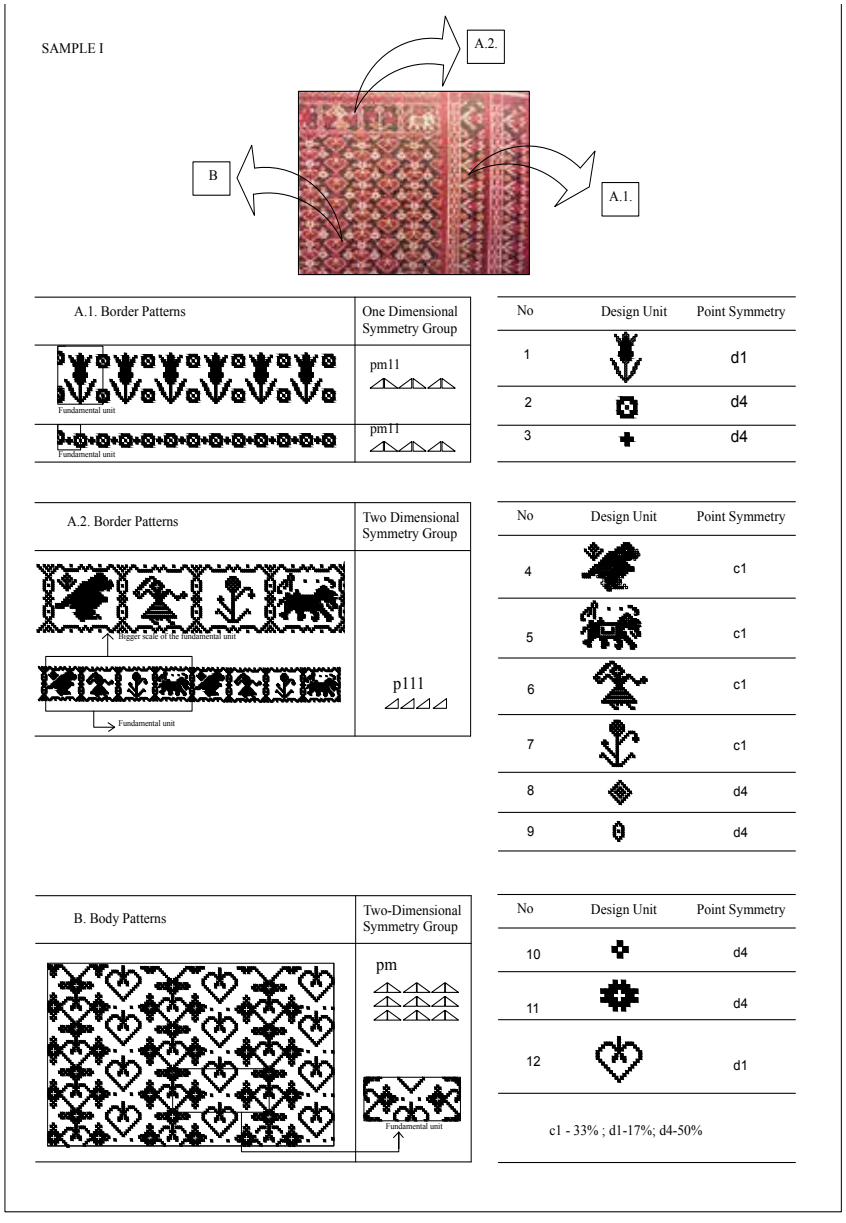


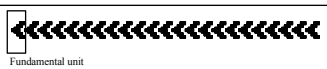
Figure 5. Patterns' structure of Patan Patola and Geringsing

Diagram 1. Samples of Patan Patola

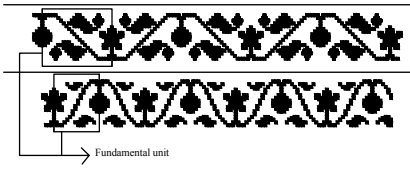
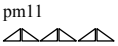
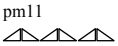
Diagram 2. Samples of Geringsing



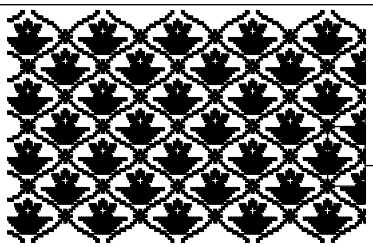
SAMPLE 2

A.1. Border Patterns	One Dimensional Symmetry Group
 Fundamental unit	p111

No	Design Unit	Point Symmetry
1		d1

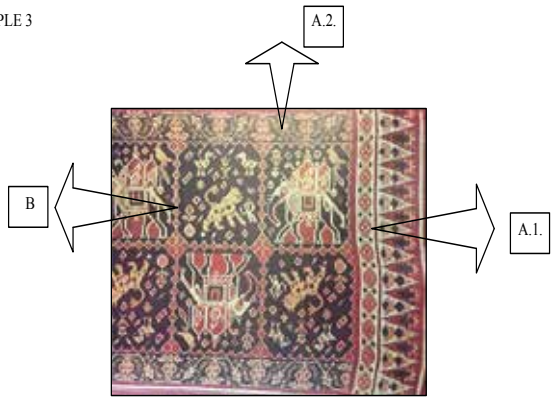
A.2. Border Patterns	One Dimensional Symmetry Group
 Fundamental unit	pm11  pm11 

No	Design Unit	Point Symmetry
2		c1
3		c1
4		d5
5		d4

B. Body Patterns	Two-Dimensional Symmetry Group
	pm   Fundamental unit

No	Design Unit	Point Symmetry
6		d1
7		d5
8		d4
c1-25%; d1-25%; d4-25%; d5-25%		

SAMPLE 3

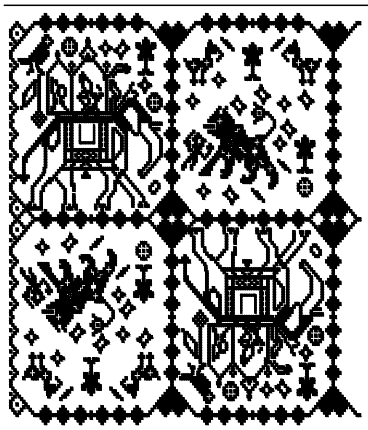


A.1. Border Patterns	One Dimensional Symmetry Group
 Fundamental unit	pm11
 Fundamental unit	pm11

No	Design Unit	Point Symmetry
1		d4
2		d4

A.2. Border Patterns	One Dimensional Symmetry Group
 Fundamental unit	pm11

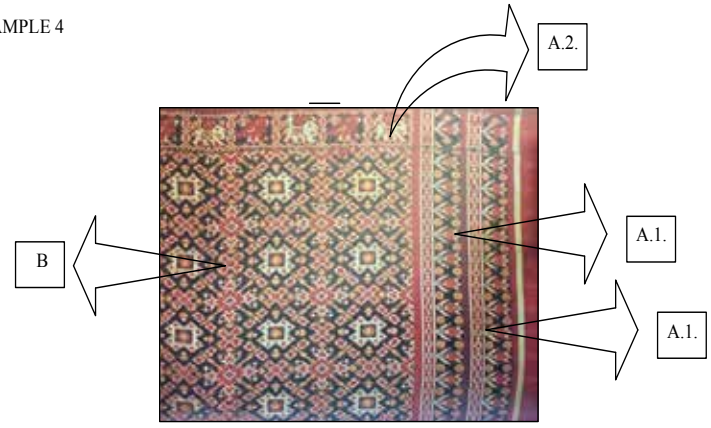
No	Design Unit	Point Symmetry
3		d4
4		c1
5		c1

B. Body Patterns	Two Dimensional Symmetry Group
	p111

No	Design Unit	Point Symmetry
6		d4
7		d4
8		c1
9		d4
10		c1
11		c1
12		c1
13		c1

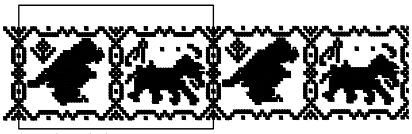
c1-54%; d4-46%

SAMPLE 4

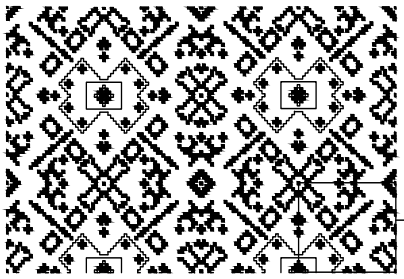


A.1. Border Patterns	One Dimensional Symmetry Group
 Fundamental unit	pm11
 Fundamental unit	pm11

No	Design Unit	Point Symmetry
1		d1
2		d4
3		d4

A.2. Border Patterns	One Dimensional Symmetry Group
 Fundamental unit	p111

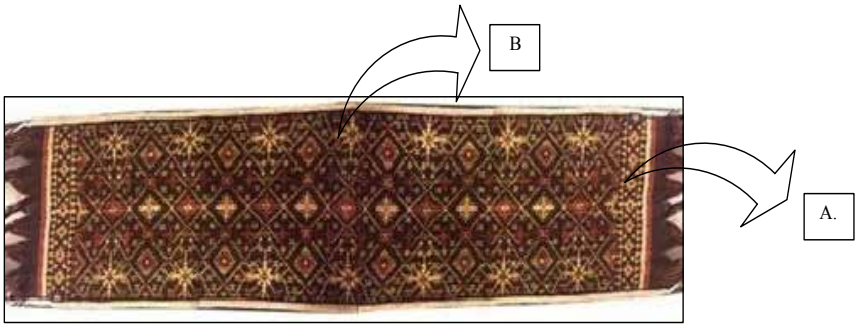
No	Design Unit	Point Symmetry
4		c1
5		c1
6		d4
7		d4

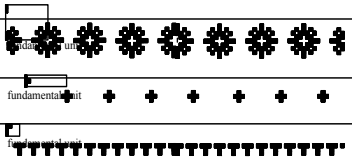
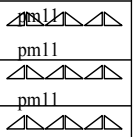
B. Body Patterns	Two-Dimensional Symmetry Group
 Fundamental unit	pmm

No	Design Unit	Point Symmetry
8		d4
9		d4
10		d4
11		d1
12		d4

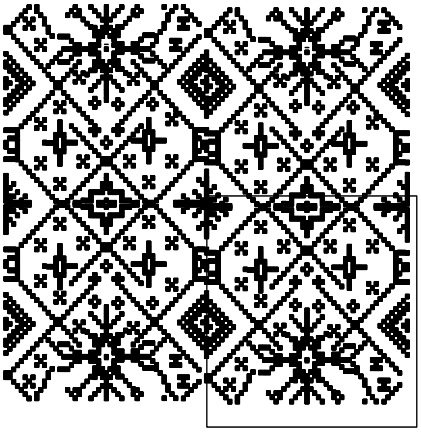
c1-17%; d1-17%; d4-66%

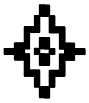
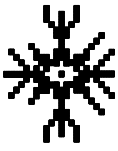
SAMPLE 5



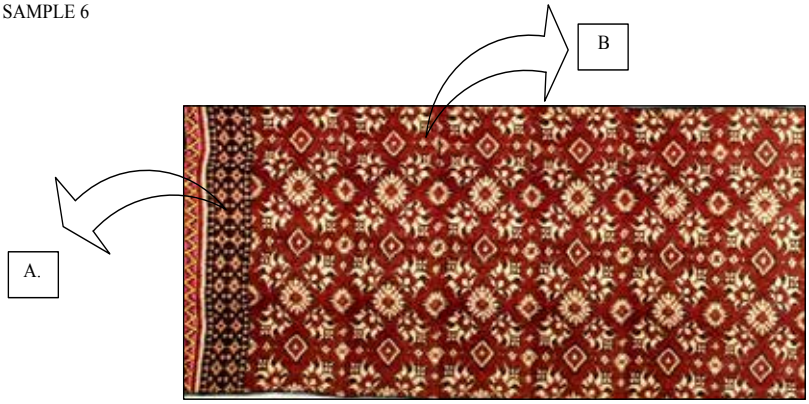
A. Border Patterns	One Dimensional Symmetry Group
	

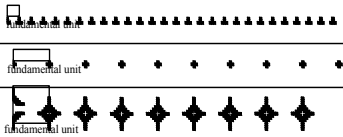
No	Design Unit	Point Symmetry
1		d1
2		d4
3		d4

B. Body Patterns	Two-Dimensional Symmetry Group
	

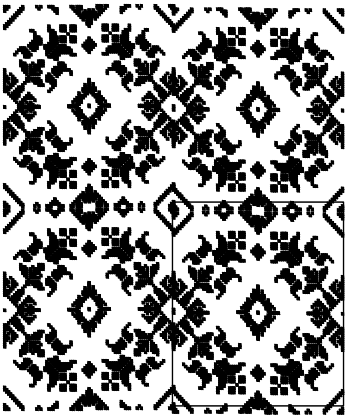
No	Design Unit	Point Symmetry
4		d4
5		d4
6		d4
7		d4
8		d4
9		d4
10		d4
d1-9%; d4-91%		

SAMPLE 6



A. Border Patterns	One-Dimensional Symmetry Group
	pm11
	pm11
	pm11

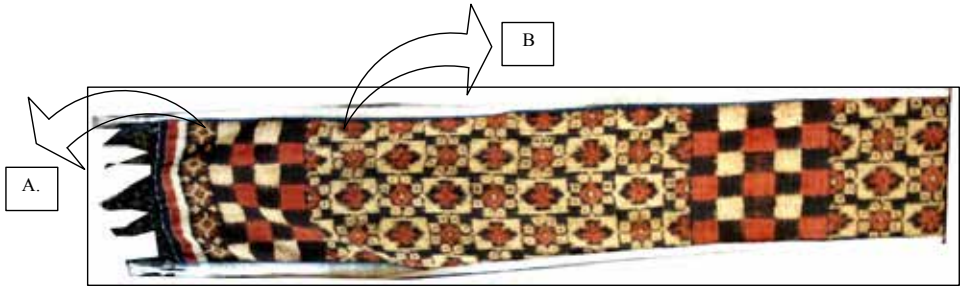
No	Design Unit	Point Symmetry
1		d1
2		d4
3		d4

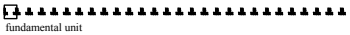
B. Body Patterns	Two-Dimensional Symmetry Group
	pmm2   Fundamental unit

No	Design Unit	Point Symmetry
4		d4
5		d4
6		d4
7		d4
8		d4
9		d1

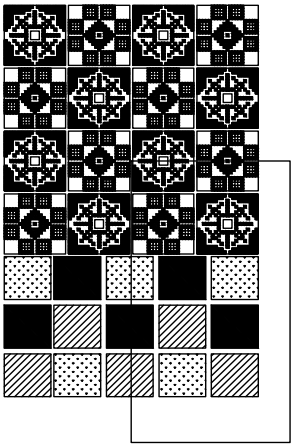
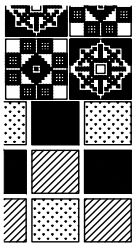
d1-22%; d4-78%

SAMPLE 7



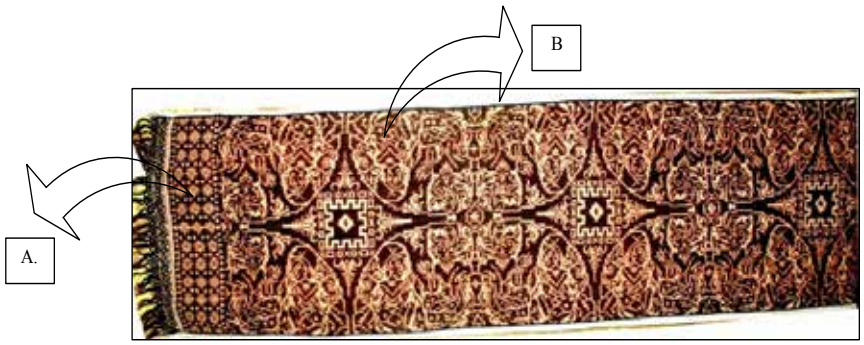
A. Border Patterns	One-Dimensional Symmetry Group
 fundamental unit	pm11
 fundamental unit	pm11
 fundamental unit	pm11

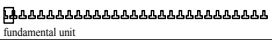
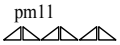
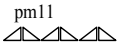
No	Design Unit	Point Symmetry
1		d1
2		d4
3		d4

B. Body Patterns	Two-Dimensional Symmetry Group
 Fundamental unit	pmm2   Fundamental unit

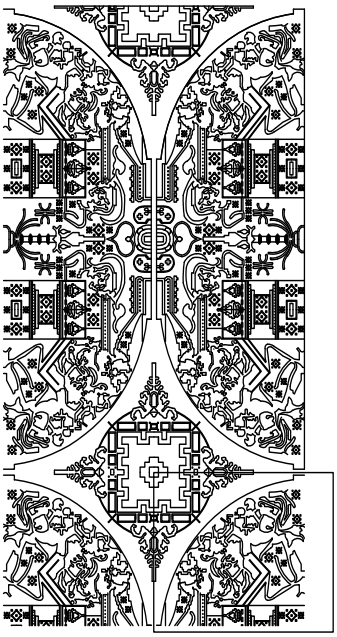
No	Design Unit	Point Symmetry
4		d4
5		d4
6		d4
7		d4
8		d4
d1-13% ; d4-87%		

SAMPLE 8



A. Border Patterns	One Dimensional Symmetry Group
 fundamental unit	pm11 
 fundamental unit	
 fundamental unit	pm11 
 fundamental unit	

No	Design Unit	Point Symmetry
1		d1
2		d4
3		d4
4		d4

B. Body Patterns	Two-Dimensional Symmetry Group
	pmm2 
 Fundamental unit	

No	Design Unit	Point Symmetry
5		d1
6		d4
7		d1
8		d1
9		c1

c1-12%; d1-44%; d4-44%

Result and Discussion

Table 1. Comparation symmetry analysis of the sample from Patan Patola and Geringsing

Patan Patola				Patterns' Structure	Geringsing			
Sample 1	Sample 2	Sample 3	Sample 4		Sample 5	Sample 6	Sample 7	Sample 8
				Border Patterns				
33%	33%		33%	p111				
67%	67%	100%	67%	pm11	100%	100%	100%	100%
				Body Patterns				
				pmm2	100%	100%	100%	100%
		100%		p111				
100%	100%			pm				
			100%	pmm				
				Point Symmetry				
33%	25%	54%	17%	c1				12%
17%	25%		17%	d1	9%	22%	13%	44%
50%	25%	46%	66%	d4	91%	78%	87%	44%
	25%			d5				

Border patterns in both textiles use only two of the seven classes-- *p111* and *pm11*-- under the one-dimensional symmetry group. Border patterns in *Patan Patola* use both classes while border patterns in the *Geringsing* samples consistently use only *pm11*. Body patterns in both textiles use two of the seven classes-- *pmm2* and *p111*--under the one-dimensional symmetry group and two of the seventeen classes--*pm* and *pmm*--under the two-dimensional symmetry group. Patan Patola body patterns use *p111*, *pm*, and *pmm* while *Geringsing* consistently admits only *pmm2*.

The border patterns between the two textiles have a positive connection since both admit *pm11* class, although the percentage of this class is not a full hundred percent for Patan Patola, but these percentages are higher than that of the other class for *p111*. However, for the body patterns, both *Patan Patola* and *Geringsing* textiles do not share any similarity in the classes they are included. The *Geringsing* textiles consistently use the *pmm2* class for the body patterns, which means the fundamental parts are repeated reflectively in one direction. *Patan Patola* uses classes of p111, pm, and pmm, which show that the fundamental parts in *Patan Patola* are repeated with translation. As *Patan Patola* and *Geringsing* textiles are rich in patterns, both their border and body patterns are composed of patterns that also admit finite or point symmetry. Analysis of point symmetry shows that Patan Patola and Geringsing admit cyclical (cn) and dihedral (dn) point symmetry: *c1*, *d1*, *d4*, and *d5*. Cyclical point symmetry patterns appear in almost all Patan Patola samples while it appears in only one Geringsing sample (sample 8). Consistently, *d4* appears in all samples, and, interestingly, its appearance tends to be higher in the *Geringsing* samples when compared to the *Patan Patola*. In terms of consistency, *d1* also appears in almost every sample, although there is one sample in which it does not (sample 3). The appearance of *d5* is rare, found in only one *Patan Patola* sample.

The results indicate again that *Patan Patola* admits more symmetry classes than *Geringsing*. In the categories of border patterns and point symmetry, all classes admitted by *Geringsing* are also admitted by *Patan Patola.* However, both textiles have different class symmetry for the

body patterns. The sizes of the both textiles are different as Patan Patola textiles tend to be longer and bigger compared to Geringsing textiles; therefore, the arrangement of the fundamental parts of the patterns is limited and only repeated in one direction in Geringsing textiles.

Conclusion

All symmetry classes that are admitted by the *Geringsing* patterns are also admitted by the *Patan Patola* patterns especially under categories of border pattern and point symmetry. The symmetry classes included by both textiles is highly similar; past research has shown that higher similarities in symmetry classes indicates an increased likelihood that the patterns possess a common connection. According to Englebrecht, this stylistic homogeneity is correlated with the intensity of an interaction with other cultures (Englebrecht, 1974, pp.52-65); that is, *Patan Patola* and *Geringsing* textile patterns exhibit widely-dispersed homogenous styles, indicating an intense interaction. Hence, this study provides additional evidence of a relationship between the two areas based on these analysis of textile patterns.

References

Bühler, A., Ramseyer, U., & Ramseyer-Gygi, N. (1975). *Patola und Gĕringsing: Zeremonialtücher aus Indien und Indonesien: Führer durch das Museum für Völkerkunde und Schweizerische Museum für Volkskunde Basel: Sonderaustellung 1975/1976*. Das Museum.

Buhler, A., & Fischer, E. (1979). The Patola of Gujarat: Double Ikat in India. Publication of the Rock Foundation, New York, and of the Museum of Ethnography, Basle.

Dhamija, J (2002). Woven Magic: The Affinity between Indian and Indonesian Textiles. Jakarta: Dian Rakyat.

Engelbrecht, William. (1974). The Iroquois: Archeological Patterning on the Tribal Level. World Archeology 6: 52-65.

Ramseyer, U., & Breger, U. (2009). *The theatre of the universe: ritual and art in Tenganan Pegeringsingan, Bali*. Museum der Kulturen Basel.

Ramseyer, U., Schaublin.,& Kartaschoff. (1991). Balinese Textile. British Museum Press:London.

Ramseyer, U. (1985). Clothing, Ritual, and Society in Tenganan Pengringsingan in Verhandlungen der Naturforschenden Gesellschaft Basel 95: 191-241.

Sarabhai, M., & Dhamija, J. (1988). Patolas and Resist-Dyed Fabrics of India. New Jersey: Grantha Corporation.

Schattschneider, D. (1990). Vision of Symmetry: Netbooks, Periodic Drawings, and Related works of M.C.Escher. New York: W.H.Freeman and Company

Shephard, Anna O. (1948). The Symmetry of Abstract Design with Special Reference to Ceramic Decoration. Carnegie Institution of Washington Publication no.574.

Shapiro, M. (1960). The Rotation of Drawings by Illeterate Africans. Journal of Social Psychology 52: 17-30.

Sudharsana, Ratna (2003). Identifikasi dan Inventarisasi Kain Geringsing di Desa Tenganan, Karangasem: 1-23.

Van Gelder, L. (1980). Ikat, Techniques for Designing and Weaving Warp, Weft, Double and Compound Ikat.

Washburn, D.K., & Crowe, D.W. (1988). Symmetries of Culture: Theory and Practice of Plane Pattern Analysis. Seattle: University of Washington Press.

Washburn, D.K., & Crowe, D.W. (2004). Symmetries Comes of Age: The Role of Pattern in Culture. Seattle: University of Washington Press.

Washburn, Dorothy K. (2004). Embedded Symmetries: Natural and Cultural. Albuquerque: University of New Mexico.

Washburn, Dorothy K. (1983). Symmetry analysis of ceramic design: two tests of the method on Neolithic material from Greece and the Aegean. In D.K Washburn editor, Structure and Cognition in Art. Cambridge: Cambridge University Press.

Woods, H. J. (1935). 19—THE GEOMETRICAL BASIS OF PATTERN DESIGN. Part I: Point and Line Symmetry in Simple Figures and Borders. *Journal of the Textile Institute Transactions*, *26*(6), T197-T210.

Lekesan is the name of Interdisciplinary Journal of Asia Pacific Arts, is dedicated to the best representation of Asia Pacific Arts from various perspectives.
As the link of exchange knowledge and experience, its provides opportunities to world scholars, artists, and the community, who are focused in the aesthetic theory and practice of Asia Pacific Arts

9 772598 219003