Chapter 34
Symmetrical Pattern: Analysing *Songket* in Wallpaper Patterns

Norwani Md. Nawawi, Rafeah Legino, Norakmal Abdullah, Mohd Firdaus Md. Khalid, Ruzaika Omar Basaree, and Mohd Yusof Ahmad

Abstract Various patterns can be found in traditional Malay textile fabrics such as stripes, checkers and zigzag. These patterns often provide opportunities for identifying the unique mathematical patterns in the traditional Malay songket fabrics. Basically in songket, there are six types of patterns which have been identified by local weavers. However, this paper will explore more patterns in classifying mathematical pattern groups such as the frieze patterns and wallpaper patterns. By understanding regularities based on the data we gathered, we can actually predict what comes next, estimate if the same pattern will occur when variables are altered and begin to extend the pattern. The classification of wallpaper pattern can be found in the badan kain of a sarong and badan kain of a traditional shawl. This paper seeks to identify early Malay songket textiles within the context of the mathematical pattern groups in the twentieth century, which may have influenced, or been influenced by, technical development in the production of pattern-woven textiles from the Islamic world.

N.Md. Nawawi (✉) • M.F.Md. Khalid
Faculty of Art and Design, Universiti Teknologi MARA,
40450 Shah Alam, Selangor, Malaysia
e-mail: nmn572000@yahoo.com; firdauskhalid@salam.uitm.edu.my

R. Legino
Formgiving Design Research Group, Design and Creativity Communities of Research,
Universiti Teknologi MARA, Shah Alam, Selangor 40450, Malaysia
e-mail: leginorafeah@gmail.com

N. Abdullah
Faculty of Arts, Computing and Industry Creative, Universiti Pendidikan Sultan Idris,
35900 Tanjong Malim, Perak, Malaysia
e-mail: cahayasempurna79@gmail.com

R.O. Basaree
Cultural Centre, University of Malaya, 50603 Kuala Lumpur, Malaysia
e-mail: zeqah@yahoo.com

M.Y. Ahmad
Faculty of Administrative Science and Policy Studies, Universiti Teknologi MARA,
40450 Shah Alam, Selangor, Malaysia
e-mail: yusofahmad@salam.uitm.edu.my

O.H. Hassan et al. (eds.), *International Colloquium of Art and Design Education Research (i-CADER 2014)*, DOI 10.1007/978-981-287-332-3_34

Keywords Songket • Symmetry pattern • Wallpaper pattern

34.1 Introduction

The analysis of textiles in *songket* offers an exciting opportunity to classify the material culture of *songket* pattern within the mathematical approach. The *songket's* traditional pattern portrays the Malay weaver's talent motivated by devotion and act of submission to the Creator of the Universe (*Allah*) which the Muslim regard as the source and origin of all creations. Islam has taught the Muslim to see the natural world which portrays the greatness of Allah's creations. His greatness can be seen in nature, for example, the beauty of the petal arrangement in flowers, the repetitive shape in bee hives, the different arrangement of clouds, the stars in the universe and many more. In *Quran*, some of the verses are repeated so that they will be remembered and understood. It is the same with the Islamic design. The motif is repeated to form into a harmonious pattern. As mentioned in the hadith, *Allah is beautiful and He loves beauty*; as such, the motif must give the feeling of harmony, balance and pleasing to the eyes. The harmonious patterns of the Islamic art can be further observed in this study of *songket* patterns that include the symmetry principle, which is the transformation of design through translation, rotation, reflection and glide reflection. In this work, we would like to report on the symmetrical pattern through analysing *songket* motifs in wallpaper group.

34.2 Songket

Songket is a Malay heritage textile which is originally woven using either cotton or silk with extra weft weave of gold or silver threads. In the past, this cloth was specially designed and made for the royalties. *Songket* was usually found in the Malay communities with Islamic beliefs who live by the rivers or sea [1]. The Malay weavers usually get their materials from other countries such as silk from China, cotton from India and metallic threads from the Middle East countries. Therefore, the weavers lived near the sea for easy access to the port for weaving materials [2]. The *songket* design motifs were usually repeated within the areas by different sections in a *sarong* or a *selendang* (shawl). The *songket* motifs were mainly floral in nature. Sometimes fauna motifs are used by stylising them into geometrical shapes or by distortion. However, nowadays, the designs are totally floral and geometrical shapes which the designers developed. It is a challenge for the designers to come up with extraordinary and decorative designs in order to become the greatest pattern maker of their time. Therefore, this study aims to find out how the designs developed into which category in today's mathematical findings.

Geometric motifs are popular among the Islamic designs which can also be found in *songket*. The process of making *songket* itself involves the calculation of the amount of warp, weft yarns to be prepared and the numbers of *tekat* in *songket*

to be made. Therefore, in designing the *songket* pattern, graph or point paper is used for easier calculation for the weaver to follow. When the warps had undergone the process of threading or making of shafts, it is then ready for *menyongket bunga* and *angkat butang* where the weaver works by using the fine stick or *lidi* to make the songket design. Later, the weaver will start weaving using *torak* or shutter filled with weft yarns [3]. In looking at the shape of a sarong, we could find that there are sectional areas with different patterns. For example, the sarong has the *kepala kain* with *pengapit kepala kain*, *badan kain* and *kaki kain.* Basically, there are six main types of patterns in *songket* designs. They are the *songket corak penuh* (overall or full pattern, e.g., *corak teluk berantai*), *songket corak bertabur* (spotted or scattered pattern), *songket corak jalur* (striped pattern), *songket corak siku keluang* (zigzag), *songket corak petak catur* (checkers) and *songket corak pucuk rebung* (triangle). However, what we would like to find out is how the *songket* motif is repeated and how it can be classified in the mathematical pattern groups such as the symmetry groups of the wallpaper patterns.

34.3 Geometrical Concepts of Symmetry and Transformation

In *songket* design, the motifs can be taken from nature which are mainly in organic shapes; nevertheless, the structure of the motif in weaving will be in geometrical shape governed by symmetry principles. The definition of symmetry is the exact match in size and shape between the two halves of the design. Symmetry also refers to the quality of being made up of approximately similar parts facing each other or around an axis. Symmetry is found in four perspectives which involve translations, rotations, reflections and glide reflections [4]. It is important to study the symmetry in *songket* patterns so as to enable us to classify each motif and pattern into the mathematical pattern groups [5]. Symmetrical designs in textile produce a pleasing effect; but if the motifs are too close, it could be monotonous.

Translation

It is a repeating pattern or the motif slides up, down, right, left or diagonally while still maintaining the same orientation. The formal definition of a translation is every point of the pre-image moves at the same distance in the same direction to form the image (Figs. 34.1, 34.2 and 34.3).

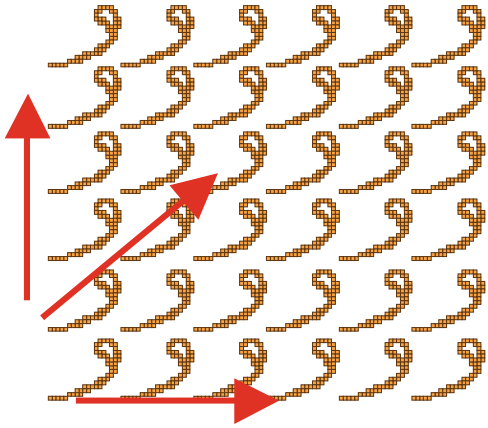


Fig. 34.1 The motifs move at the same distance in vertical, horizontal and diagonal direction

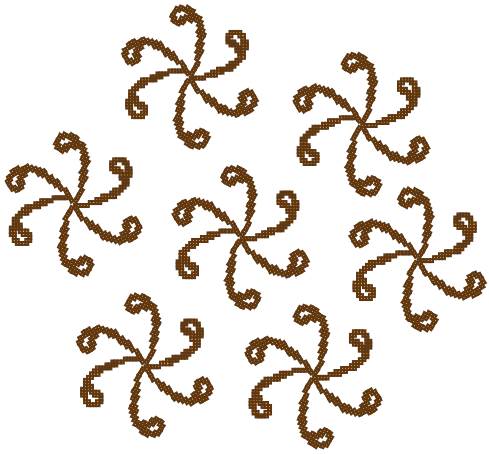


Fig. 34.2 60° rotation

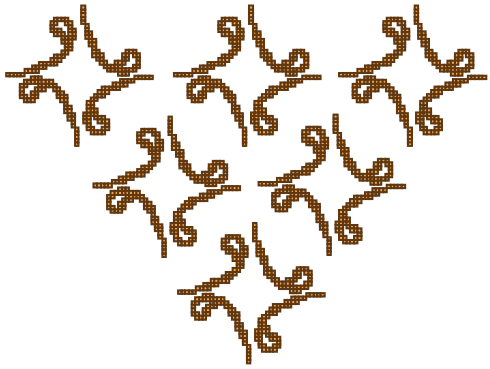


Fig. 34.3 90° rotation

Rotation

It is when a motif is repeated around a point. It is a transformation that is performed by 'spinning' the object around a fixed point known as the centre of rotation. The angle of rotation can be 60°, 90°, 120° or 180°, and it can rotate either in clockwise or counterclockwise (Figs. 34.4, 34.5 and 34.6).

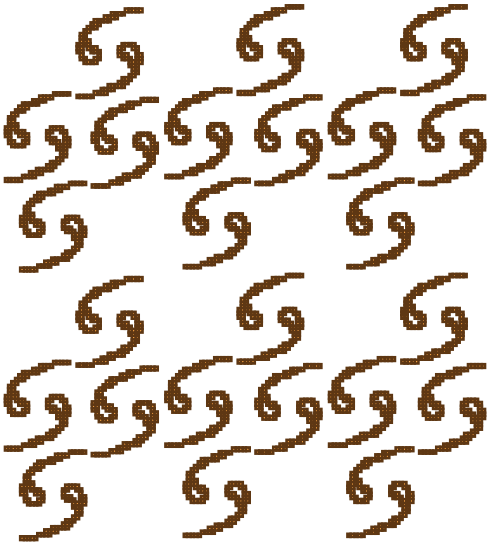


Fig. 34.4 180° rotation

Fig. 34.5 Eightfold rotation in Arabic design

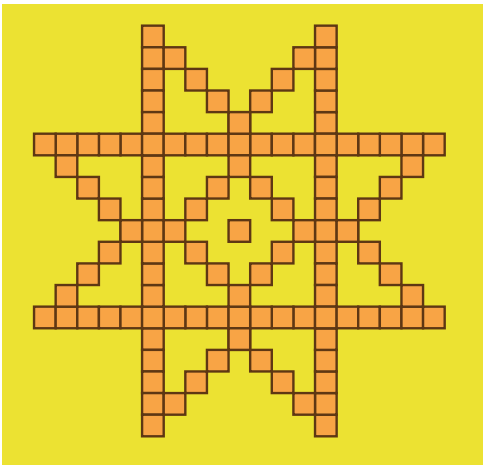


Fig. 34.6 *Tapak Sulaiman* motif or *Bunga Bintang Beralih* in *Songket* with eight pointed stars

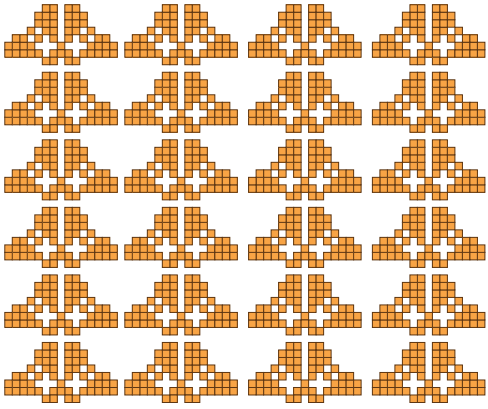


Fig. 34.7 Vertical reflection

Reflection

It is a 'flip' image of an object over a line, 'the axis of reflection', and it can also occur when a motif is reflected and the image is reversed as in a mirror (Figs. 34.7 and 34.8).

Glide Reflection

It happens when a motif translates along the axis while at the same time reflects across an axis (Figs. 34.9 and 34.10).

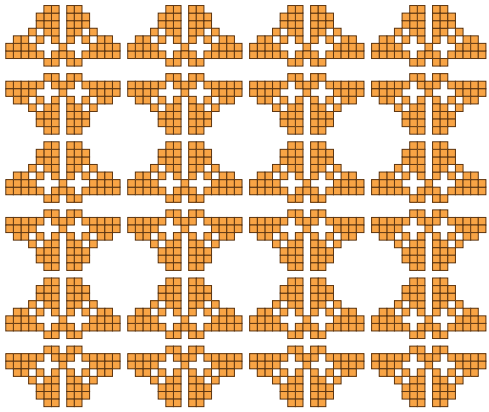


Fig. 34.8 Horizontal vertical reflection

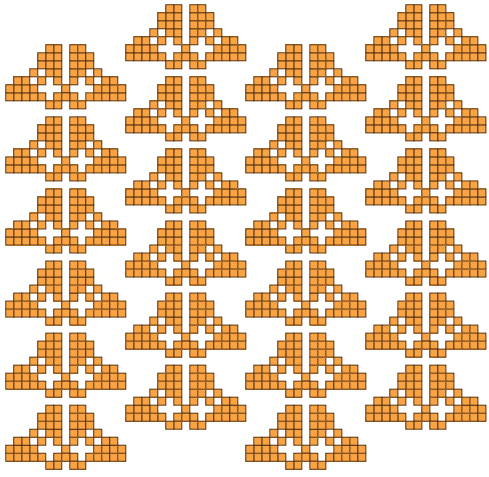


Fig. 34.9 Glide reflection

From the explanation on the four concepts of symmetry and transformation, we could visualise any pattern in *songket* cloth which could fall in any of these repetitions [6].

The songket motifs and patterns, as well as their compositions, show the *songket* weaver's artistic or creative mind at work. In the production of *songket*, the design is determined prior to the weaving process. Therefore, a weaver needs to calculate the amount of warp and weft for the weaving as well as to determine the pattern of a *sarong* or a *selendang*. This paper will study a few *songket* cloths in the section of the *badan kain* (main body of sarong), *kepala kain* (head panel) and *punca kain* (ends of the shawl).

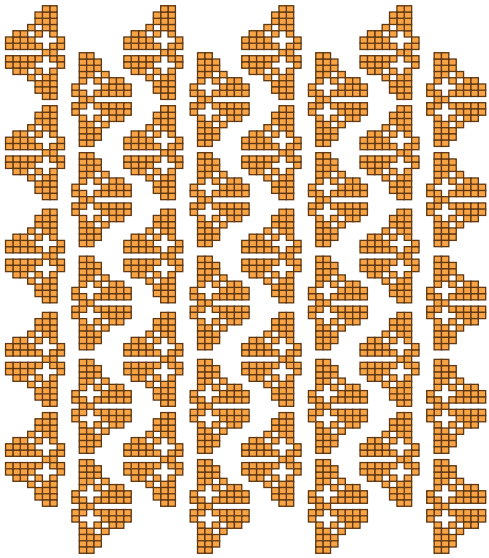


Fig. 34.10 Glide reflection

34.4 Wallpaper Pattern in *Songket*

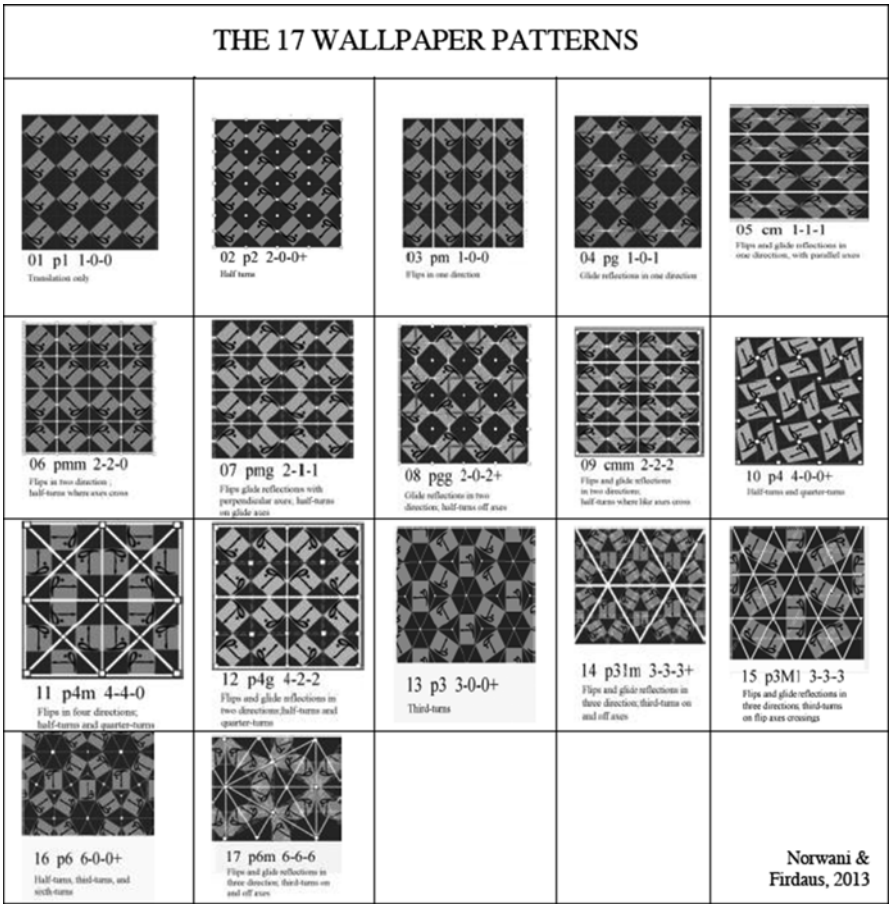
A wallpaper group or plane symmetry group is a mathematical classification of a two-dimensional repetitive pattern, based on the symmetries in the pattern. There are 17 possible distinct groups [7]. Wallpaper groups are two-dimensional symmetry groups, intermediate in complexity between the simpler frieze pattern groups and the three-dimensional group. The word 'group' as used in the English language just means 'a bunch of things considered together'. Mathematicians need a word for something more, and, for better or for worse, they decided on 'group'. A group of things, for a mathematician, means a collection of things with a certain structure.

In songket, we only study on its repetitive pattern that falls either in frieze or wallpaper pattern. From this study of songket patterns, it seems that we studied on the badan kain of the sarong and the end cloth of the shawl. In most of the sarong songket, the patterns are in full, isolated and stripes patterns; however, we would like to find out if these patterns fall on which symmetrical groups of wallpaper patterns [8] (Table 34.1).

34.5 Classification of Wallpaper Pattern That Can Be Found in Full-Pattern Songket

Designs in songket were mainly taken from the sarong and the traditional shawl. Here are some examples of wallpaper pattern in songket as shown in Figs. 34.11, 34.12, 34.13, 34.14, 34.15, 34.16, 34.17, 34.18, and 34.19.

Table 34.1 The 17 wallpaper patterns



Patterns in *songket* are well arranged by the weavers. Motifs and patterns were designed in such a way that it can be described in translations, rotations, reflections and glide reflections.

34.6 Conclusion

This study concludes that *songket* fabric consists of a well-organised design in its complex, elaborate motifs and patterns. Moreover, it is found that *songket* pattern can be classified along the principles of symmetry and transformation. This study's analytical emphasis on the mathematical approach can be found in the sections of a sarong or in the shawl such as in the *kepala kain*, *badan kain* and *punca kain* (end

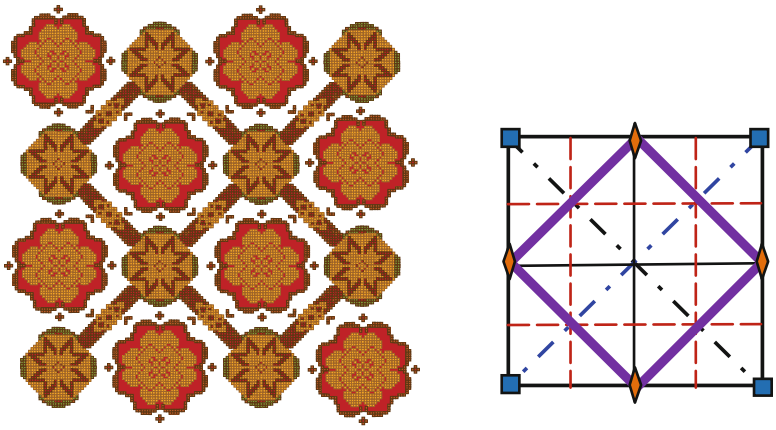


Fig. 34.11 The body of the *sarong songket* section consists of four motifs which are arranged in *teluk berantai* pattern or in groups of *type 11 p4m.* These repeats refer to one of the 17 wallpaper patterns which the pattern flips in four directions, half turns and quarter turns

Fig. 34.12 *Kain limar bersongket* with songket motifs woven onto the weft ikat background. The pattern is situated at the body of the sarong section. The motifs are *tampuk kesemak*, *bunga bintang* or *tapak sulaiman* and *buah tamar* (dates)

cloth). The designers of *songket* are mainly Muslims, and they design the patterns on the concept of infinity, where the motifs are beautifully stylised and executed in repeated patterns from the vegetal with no beginning nor ending. However, the patterns are repeated within the given space in different sections of a sarong or a *selendang*. As a matter of fact, God has given us alternative ways to design patterns away from human, animal or idol forms and figures. Therefore, in the Islamic design, the patterns are repeated in many ways and create interesting shapes of motifs with harmony and balance in the *songket* design.

Fig. 34.13 *Songket* sarong with motifs of *bunga mahkota raja* designed at the *kepala kain* section with *teluk berantai* pattern

Fig. 34.14 This *songket* pattern in type 11, p4m, which refers to flips in four directions, half turns and quarter turns

Fig. 34.15 *Selendang* or shawl with motifs of *pucuk rebung tepi gigi yu*, *bunga semangat* and *bunga pucuk* (flower bud) at the end cloth of the shawl

Fig. 34.16 *Songket* of *bunga pucuk* motifs arranged in type p2 wallpaper pattern

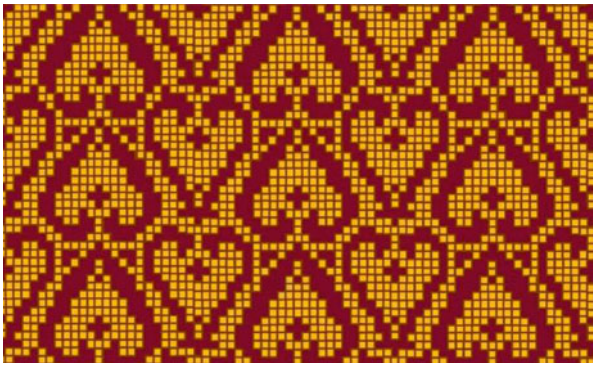


Fig. 34.17 Detail design of *bunga pucuk* with its motif facing up and down alternately at the end cloth of the shawl. The motifs are arranged in half-turn repeats

In this research, it has shown that the pattern in *songket* could be studied in transformational geometry that can be found in either the frieze and wallpaper pattern which is used by many researchers on other studies of analysing designs. There are many more *songket* patterns that are yet to be analysed; as such, the study on this matter must be continued.

It is hoped that the results of this study in classifying *songket* in mathematical approach will benefit the textile designers on how the *songket* pattern is designed

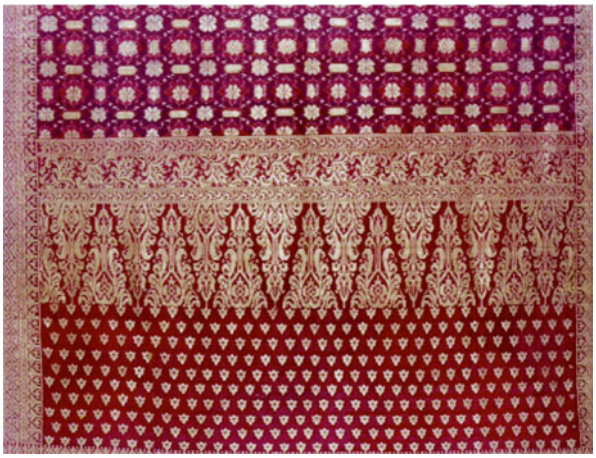


Fig. 34.18 A *limar bersongket* shawl with *corak bertabur* or isolated motifs at the *badan kain*, *bunga ati-ati* at the *pengapit kain* and followed by *pucuk rebung lawi ayam*, *bunga pucuk* motifs at the end cloth of the shawl

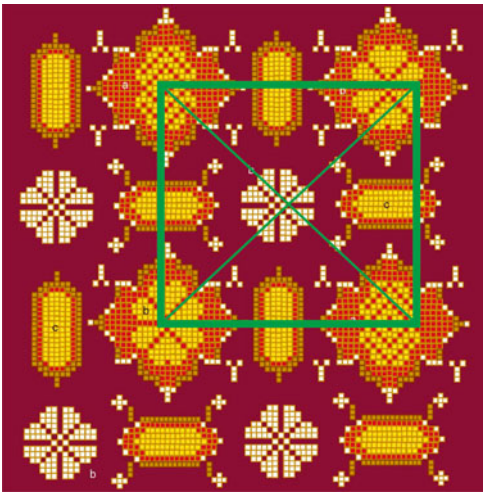


Fig. 34.19 Detail design at the *badan kain* of *limar bersongket* arranged in type 11 (p4m). The motifs are *bunga tampuk manggis* (mangosteen), *tampuk kesemak* (sharon fruit/ persimmon) and *buah tamar* (dates)

and calculated. This finding could also benefit the researchers, designers, museum curators and textile collectors on the knowledge of its design and pattern in symmetrical group classifications.

Acknowledgement The authors wish to thank the Research Management Institute (RMI); Universiti Teknologi MARA, Shah Alam, Malaysia; and the Ministry of Education under the funding of FRGS for the support of this research.

References

1. Maxwell, R. (1990). *Textile of Southeast Asia: Tradition, trade and transformation*. Melbourne: Australian National Gallery.
2. Mohd, N. N. (2002). *Songket Malaysia*. Kuala Lumpur: Dewan Bahasa dan Pustaka.
3. Mohd, N. N. (1989). *Malaysian songket*. Kuala Lumpur: Dewan Bahasa dan Pustaka, Kementerian Pendidikan Malaysia.
4. Martin, G. E. (1982). *Transformation geometry: An introduction to symmetry*. New York: Springer.
5. Embong, R., Aziz, N. M. A., Wahab, Z. A., & Maidinsah, H. (2010). An insight into the mathematical thinking of the Malay songket weavers. *Procedia-Social and Behavioral Sciences, 8*, 713–720.
6. Basaree, R. O., Nawawi, N. M., Khalid, M. F. M., Khalid, M., & Ahmad, M. Y. (2012). Glimpses of geometrical principles in Malay ornaments. *The 9Th Regional Symposium of the Malay Archipelago*, Universiti Teknologi MARA, Perak.
7. Weisstein, E.W. (2013). The seventeen wallpaper patterns [Online]. Available: http://mathworld.wolfram.com
8. Abas, S. J. (2001). *Islamic geometrical patterns for the teaching of mathematics of symmetry*. Budapest: International Symmetry Foundation. Special issue of symmetry: Culture and science. Symmetry in ethnomathematics, 12 (1–2), 53–65.