

# Research on the design of Xilankapu patterns based on morphological analysis

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**Abstract.** As China's intangible cultural heritage, Xilankapu needs to be inherited and innovated under the continuous development of society. The article will deconstruct the components of Xilankapu patterns using the morphological analysis method, create a morphological analysis matrix, offer a fresh design concept for Xilankapu pattern design, and combine the brainstorming method to optimize the design scheme. This will serve as a workable reference for researchers and designers of Xilankapu pattern design.

**Keywords:** Xilankapu; morphological analysis; pattern design; brainstorming method.

## 1. Preface

Xilankapu, translated in Chinese as Tuhua pavement, is a family hand-woven brocade of the Tujia folk. It is woven on a wooden slant-waist loom with through the warp and weft broken and woven on the reverse side[10].It is also a treasure of ancient folk art in China. With the rapid development of society and the economy, the consumer market is changing day by day, and there is a proliferation of traditional handicrafts, mass production and a low market audience. As an important part of Tujia brocade, the design of patterns and motifs is a key issue that needs to be addressed in order to meet the needs of today's consumer market and to be better passed on. In this paper, the design of patterns and motifs for brocade weaving will be expanded by combining morphological analysis with the characteristics of brocade patterns. provides a new approach to the design of Tujia brocade patterns.

## 2. Morphological analysis method

Morphological analysis is an innovative design method established by Professor Zwicky of the California Institute of Technology. It is a method of combinatorial invention based on the principle of permutation in mathematics, in which the problem to be solved is broken down into a number of independent elements and then arranged in a network diagram to produce a systematic solution to the problem or to create an inventive idea.[6] The method is based on the principle of permutation.

The first point is to divide the design object into a number of independent basic elements to obtain sub-morphological elements; the second point is to list the possible forms of each independent basic element in turn, that is, morphological analysis; the third point is to build a mathematical multi-dimensional morphological matrix with the basic elements and the possible forms of each element, and then arrange and combine them to obtain a number of morphological scenarios, that is, morphological combinations; the fourth point is to evaluate and prioritise the many morphological combinations, usually with the criteria of novelty, value and feasibility go through multiple rounds of screening and evaluation, and the selection of the best solution.

### **3. Extraction of elements for the design of Xilankapu patterns based on morphological analysis**

#### **3.1 Elemental analysis**

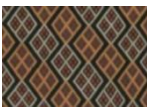


















According to the results gathered from many documents and research visits, there are more than 400 kinds of patterns in the traditional brocade of the Tujia family, and at least 120 kinds of patterns are still in existence. The design of this brocade pattern is based on the artistic decorative, functional, cultural connotation and fashion influencing factors of brocade, which can be split to obtain three basic elements of pattern composition form of organisation method, colour and content subject matter. Since each pattern of Tujia brocade has rich color matching, strong contrast and showy appearance, this will lead to the contradiction between the infinity of element analysis and the finiteness of result screening in morphological analysis. In order to make the splitting more detailed, the overall pattern of the brocade was then split into three basic elements according to the distribution of the content and structure: the upper part of the head, the main flower in the middle and the lower part of the head. The four separate elements are numbered A-D.

#### **3.2 Morphological analysis**

##### **3.2.1 The content themes of the Xilankapu pattern**

The content and themes of the Xilankapu patterns are colourful and involve almost every aspect of the Tujia people's lives. After collecting and consolidating the Tujia brocade patterns, the author found that the content and themes are mainly in the categories of astronomy and geography, daily life, plants and flowers, animals, folk stories, geometric figures and auspicious characters. In the category of celestial geography, there are cloud hooks and flowers, a thousand mound fields, sun flowers and full of stars; in the category of daily life, there are boat boat flowers, chair flowers, saw flowers, back basket flowers and Ciba rack flowers; in the category of plants and flowers, there are seedling flowers, rattan flowers, four plum blossoms, nine plum blossoms, rock rose flowers and leek flowers; in the category of animals, there are snake flowers, tiger foot traces, cricket flowers, cuckoo flowers, twelve zodiac signs and lion embroidery balls; in the category of folk tales, there are Ganchang (rush to the market), mice marry their daughter, wave dance, Maogusi dance; geometric figures include eight-hook flowers, twelve-hook flowers, twenty-four-hook flowers, forty-eight-hook flowers, rhombuses and so on; auspicious characters include ten-thousand-character grids, fortune, longevity and happiness, first rank in the imperial court, Wang-character flowers, etc., as shown in Table 1.

Table 1. Analysis of the content themes and illustrations of Xilankapu

Content Topics	Pattern name	Illustrations	Content Topics	Pattern name	Illustrations
Sky Geography	A thousand mound fields		Folklore Stories	GanChang	
	Full of stars			Mouse marries daughter	
	Boat Boat Flower			wave dance	
Daily life	Chair Flower		Geometric figures	Single eight hooks	
	Rattan Flower			Twelve hooks	
	Four plums			Forty-eight hooks	
	Nine plums			ten-thousand-character grids	
	Rockrose			Auspicious text	The First Class of the Imperial Court
Cuckoo Flower		Wang-character Flower			
Animals	Tiger's Foot Tracks Flower				
	Cricket Flower				

### 3.2.2 Structural allocation of the Xilankapu pattern

The overall composition of a Tujia brocade is simple and simple, with each brocade usually consisting of a cloth head, a Dangtou (both ends of Tujia brocade pattern) and a main flower. In this case, the author has divided the overall pattern design into three areas: the upper and lower parts of the Dangtou, the main flower in the middle, and then categorised the three areas in terms of their content and subject matter.

### 3.2.3 Composition forms of the Xilankapu pattern

The composition of the Xilankapu is mostly concerned with the artistic feature of balance and symmetry, and such a pattern feature brings out the symmetrical aesthetics pursued by the Chinese to the fullest."Chu Dialect" said: "The so-called beautiful things, no matter up and down, inside and outside or near and far, do no harm, so called beauty.[3] "Inside and outside are balanced and proper, only to be beautiful, symmetry is such beauty.As the overall composition of Tujia brocade is limited by the traditional weaving process, the patterns are generally abstract and geometric.The basic elements and skeleton of the top and bottom of the Dangtou of brocade are the same in both horizontal and vertical directions, and most of them are organised in a two-sided continuous way.Therefore, this paper will default to take the two-side continuous organization method as the top and bottom two parts of the organization method, which will not be included in the basic elements of the Xilankapu pattern design matrix.The middle part of the design is more varied, with the main flower being the centrepiece of the design and the secondary patterns surrounding it, as well as the repetition of thematic elements in the form of a folding diagonal, a continuous

quadrilateral, or a scattered pattern. Although the Xilankapu motifs tend to be repetitive and abstractly geometric, they are simple and profound, with a strong sense of integrity and a highly rhythmic and decorative effect.

### 3.3 Constructing the morphological matrix

Based on the analysis of the basic elements and the corresponding forms in the previous section, a morphological matrix was developed by combining the principles of the morphological analysis method for the design of the Xilankapu pattern. The four basic elements are the organisation method, the upper part of the Dangtou, the middle main flower and the lower part of the Dangtou. The possible forms for the organisation method are the independent body type, Bipartite continuity and four-sided continuous type and the scattered type. The possible forms of the upper part of the Dangtou and the lower part of the Dangtou are geometric figures, plants and flowers, animals, celestial geography, which are representative of the specific pattern names; the middle part of the main flower is rich in pattern content, and its possible forms can choose the specific pattern names that are representative of the 7 major categories of content materials listed above through integration. The four basic elements are represented by the letters A, B, C and D, and the possible forms corresponding to each basic element are represented by T. The formula  $N = T A^N \times T B^N \times T C^N \times T D^N$  is shown in Table 2.

Table 2

Basic elements	Possible form T					
A Organizational Approach	T A <sup>1</sup>	T A <sup>2</sup>	T A <sup>3</sup>	T A <sup>4</sup>	...	T A <sup>N</sup>
B when the upper part of the Dangtou	T B <sup>1</sup>	T B <sup>2</sup>	T B <sup>3</sup>	T B <sup>4</sup>	...	T B <sup>N</sup>
C middle main flower	T C <sup>1</sup>	T C <sup>2</sup>	T C <sup>3</sup>	T C <sup>4</sup>	...	T C <sup>N</sup>
D when the lower part of the Dangtou	T D <sup>1</sup>	T D <sup>2</sup>	T D <sup>3</sup>	T D <sup>4</sup>	...	T D <sup>N</sup>

In order to make the morphological matrix of the design more specific and detailed, and limited by the paradox between the infinite nature of elemental analysis and the limited nature of result selection in the morphological analysis method, for the selection of the possible forms of the middle main flower, The author will select the common and representative pattern elements from the integrated content themes, and take the six pattern elements, namely forty-eight hooks, cuckoo flowers, rock rose, mouse marrying a daughter, single eight hooks, and Ciba frame flower, as the possible forms of the C basic elements of this scheme design. This is shown in Table 3. From Table 3, we can see that the selected pattern elements of the representative content themes combined with the morphological analysis method to obtain a total of  $N = 4 \times 4 \times 6 \times 4 = 384$  design options for the Xilankapu.

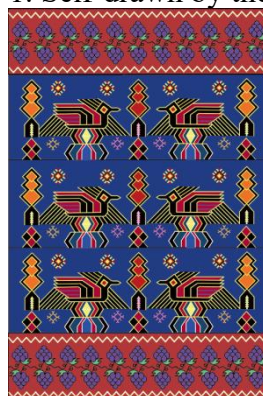
Table 3. Morphological matrix for the design of Xilankapu patterns

Basic elements		Possible form T					Morphological quantity statistics
A Organizational Approach	Independent subject style	Two-sided continuous	Quadratic continuous	Scattered			4
B when the upper part of the head	Geometric figures	Plants and flowers	Animals	Sky Geography			4
C middle main flower	Forty-eight hooks	Cuckoo	Rockrose	Mouse marries daughter	Single eight hooks	Cibrack flower	6
D when the lower part of the head	Geometric figures	Plants and flowers	Animals	Sky Geography			4

### 3.4 Optimisation analysis of design solutions

From the 384 design options calculated, we can select one of the Xilankapu design options and combine them, for example, in the A organisation method we choose the possible forms of the Two-sided continuous; B when the upper part of the head chooses the possible forms of plants and flowers; C when the main flower in the middle chooses the possible forms of Cuckoo pattern; D when the lower part of the head chooses the possible forms of geometric figures, and reconfigure the combination according to this option, the design is shown in Fig. 1, which not only has the traditional elements of Tujia brocade representation degree, but also incorporates some innovative elements of Xilankapu pattern.

Figure 1. Self-drawn by the author



If you want to optimise or innovate the design, you can then organise a brainstorming session with members who have the relevant scientific skills and knowledge, using a combination of the silent brainstorming method and the CBS method. Each participant has the first 5 minutes to come up with or draw 3 ideas on a card and then pass the cards to the next member on the right. In the second 5 minutes, each person gets a new idea from the 3 ideas of the others and passes the card again to the member on the right. And so on, 6 passes can be made in half an hour, and a total of 108 scenarios can be derive, each member then questions and evaluates the 108 ideas presented, use the form of a "positive" vote, with the more "positive" ideas being the more beneficial to the The more "positive" the idea, the better it will be for the optimisation of the design, and the more the ideas can be reinvented by these votes. The combination of morphological analysis of the basic elements and brainstorming of ideas provides a richer idea for the design of the Xilankapu pattern.

## 4. Summary

Xilankapu is the wisdom and art of the Tujia people, and is part of our traditional cultural heritage, whose transmission and development cannot be ignored. This paper has limitations due to the limited extraction of relevant basic elements and the contradiction between the infinite nature of element analysis and the limited nature of result selection in the morphological analysis method. However, the morphological analysis method provides a scientific and reasonable design method and possible development direction for the design of the Xilankapu pattern, and the brainstorming method is added to make the design thinking more diffuse and optimise the design solution. The use of morphological analysis combined with brainstorming to optimise this new design method can be used not only for the design of the Tujia family's Xilankapu pattern, but also for the design of other ethnic patterns, providing a realistic approach to the design of ethnic patterns.

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