

건축공간에서 직조 조형의 미적 특성에 관한 진화 미학 연구

Research on Evolutionary Aesthetic and Characteristics of weave modeling in Architectural Spaces

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Abstract

Nowadays, the weave modeling has been actively applied in commercial buildings and residential spaces as a design trend. However, for the preference of weave modeling, there is no in-depth study, especially for the aesthetic value of weave modeling, there are few researches from the perspective of aesthetics, while most researches on weave modeling are carried out from the perspective of construction mode or construction thought. Therefore, based on evolutionary aesthetics, this study explores the aesthetic characteristics of weave modeling to find out the aesthetic elements favored by weave modeling. Finally, it is hoped that the results of case analysis can provide a scientific reference for the effective use of weave modeling in the future architecture. First of all, this paper tries to understand the concept of weave modeling and the origin of "weaving", exploring the application of weave modeling in architectural space. Secondly, based on evolutionary aesthetics, this paper summarizes the aesthetic characteristics of weave modeling into three aspects: modeling, structure and environment, analyzing their respective performance characteristics. Finally, this paper concludes the analysis results from some chosen cases according to the three aspects. This study examines the aesthetic characteristics of weave modeling from three aspects: modeling, structure and environment to sum up six performance characteristics like symmetry, rhythm, toughness, flexibility, openness and concealment. Through the case analysis, it shows that the rhythm of weave modeling is the most prominent characteristic, followed by symmetry and openness, and the flexibility shows the least. This study explores the general aesthetic characteristics of weave modeling from the perspective of evolutionary aesthetics. Through the case study, it is confirmed that the characteristics mentioned before are reflected in the actual architectural space design with weave modeling. Thus, it is necessary to consider the methods to stimulate aesthetic consciousness from the perspective of evolutionary aesthetics for the effective use of weave modeling in the future architectural space design.

Keyword

Evolutionary Aesthetic(진화미학), Aesthetic Characteristics(심미 특성), weave modeling(직조 조형), Architectural Space(건축 공간)

요약

최근 디자인 트렌드로 직조 조형이 상업 건축과 주거 공간에서는 적극적으로 활용되고 있다. 하지만 이와 같은 직조 조형의 선호에 대한 심층적인 연구는 이루어지지 않고 있다. 직조 조형에 대한 대부분의 연구는 구조적 구축 방식이나, 기계적 구조 관점에서 분석되며, 이러한 직조 조형에 대한 미학적 관점에서의 연구는 현저히 부족하다. 본 연구에서는 진화 미학을 바탕으로 직조 조형이 갖는 심미적 특성을 탐구하여 직조 조형을 선호하는 미의식 요소를 찾아낸다. 사례분석 결과를 통해 이후 건축물에 효율적인 직조 조형의 활용에 과학적인 참고가 될 것으로 기대됩니다. 첫째 직조 조형의 개념과 기원을 알아보고, 직조 조형이 건축공간에서 어떻게 활용되고 있는지 알아본다. 둘째, 진화 미학을 바탕으로 직조 조형의 미적 특성을 조형, 구조, 환경 세 가지층위로 요약하고 각각의 표현적 특징을 분석하여 정리한다. 마지막으로 이를 토대로 선정된 사례를 분석하고 분석 결과를 총 정리한다. 본 연구는 조형적, 구조, 환경적 세 가지 측면에서 직조 조형의 미적 특성을 고찰하였다. 이를 통해 대칭성, 운율, 안정성, 유연성, 개방성, 은폐성의 6가지 표현 특성이 도출되었다. 사례분석을 통해 보면 직조 조형의 운율은 가장 두드러진 특성을 나타내고, 뒤이어 대칭성과 개방성, 높은 점수로 나타났다. 가장 약한 것은 유연성이다. 본 연구는 진화미학의 관점에서 직조 조형의 보편적인 미적 특성을 고찰하였다. 사례연구를 통해 실제 직조 조형을 이용한 건축 공간 설계에 기존에 도출된 특성이 반영되고 있음을 확인할 수 있었다. 따라서 향후 건축 공간 설계분야에서 직조 조형을 효율적으로 활용

하기 위해서는 미의식을 고취시키는 방법을 진화 미학적으로 고려할 필요가 있다.

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1. Introduction

1-1. Research Background and Purpose

In recent years, a large number of architectural space designs with the "weaving" as the main design characteristics can be seen everywhere, and the design with weave modeling has been much more attractive. Weave modeling first appeared in nature or as an instinct of animals, such as leaf veins, spider webs, cocooning of spring silkworms, etc., and generally it began to appear as decorative elements in porcelain and pottery. Later, it was gradually widely used in architectures due to its large load-bearing capacity. Nowadays, the architectural space with weave modeling has been more and more impressive, not only as a supporting structure, but also as a decorative element. However, there is no in-depth analysis of the reasons for this popular phenomenon of weave modeling. Thus, it is necessary to

understand the aesthetic value of weave modeling for better analyzing the design trend of architectural space with weave modeling. For a long time, the research on its structure is mainly from the perspective of construction mode or construction thought. While, from the perspective of aesthetics, most of these studies stay in the overview of weaving texture or form, and there are few researches on the aesthetic value of this structure. For the inspiration of nature and animal instinct, this study tries to analyze the aesthetic characteristics of weave modeling to find out the aesthetic factors favored by weave modeling according to the evolutionary aesthetics. Hoping the results of case analysis can provide a scientific reference for the effective use of future architecture with weave modeling.

1-2. Research Scope and Methods

In this paper, "weaving" is "weaving" and "knitting" in a broad sense, such as knot, braiding, weaving, textile, modern fiber art and other construction methods of material forms that show the idea of weaving. In other words, any construction behavior such as arrangement and connection that can form a linear texture form can be included in the category of "weave modeling" in this paper.

This study analyzes the aesthetic characteristics of weave modeling in architectural space design from the perspective of evolutionary aesthetics. First of all, this paper discusses the concept of weave modeling and the origin of "weaving", exploring the application of weave modeling in architectural space. Secondly, according to evolutionary aesthetics, this paper summarizes the aesthetic characteristics of weave modeling into three aspects: modeling, structure and environment, analyzing their respective performance characteristics. Then the analysis framework of the current situation of architectural space design with weave modeling is summarized on the basis of these three aspects. Finally, this paper concludes the analysis results from some chosen cases.

2. Theoretical Background

2-1. Definition of "weave modeling"

"Weaving" is a well-known concept. Generally speaking, "weaving" refers to the interlacing and collusion of linear objects, which finally forms a surface with holes. Japan's journal, *New Architecture*, once defined "weaving" as all behaviors or ways that can organically organize different or conflicting things.¹⁾ The reference and imitation of "weaving" logic or representation can be collectively referred to as weave modeling, which seems to be a "weaving"

phenomenon - a kind of "weaving" in a broad sense.²⁾



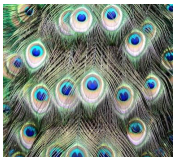

The essence of "weaving" in nature and tradition is a method of composition. The external form of "weaving" comes from various forms of "weaving", or the form of "weaving" obeys the logic of "weaving". All kinds of weaving phenomena in weave modeling are more diverse in forms than "weaving" in natural and traditional processes, which can present the connotation they are eager to express with the technical support and continuous innovation.

2-2. The origin and characteristics of "weaving"

2-2-1. Origin of "Weaving"

"Weaving" originated in primitive society, which was inspired by nature, such as the texture of feathers, the shape of spider webs, branches and petals, etc <Table 1>³⁾.

<Table 1> Natural image of weave modeling

Spider Web	Vein
	
Animal Feather	Plant Leaves Petals
	

Thus, rope rubbing and knot tying can be regarded as the earliest weaving. According to *The Book of Changes*, humans in the Paleolithic

1) Architectural Society of Japan, *New Architecture in Japan*, Liaoning: Liaoning Science and Technology Press, 2018.

2) Zuo Jianbing, "Weaving" Techniques in Architectural Design in the View of Construction, China Residential Facilities, 2019.

3) Picture source: www.baidu.com.

age woven the plant phloem into a "Gu" (something like mesh pocket), which could be thrown out with stone balls to hurt animals.⁴⁾

At that time, weaving created objects with capacity. Weaving marks of bamboo mat impressions were also found on Neolithic site. In addition, various decorative crafts like wreaths and hanging screens made by weaving also appeared with the improvement of weaving technique. Architect Gottfried Semper found that weaving, as one of the earliest human activities, had experienced a series of development and change processes: Primitive enclosure stage (early primitive civilization) - mat making stage (late primitive civilization) - fabric weaving stage (Assyrian civilization) - facing texture stage (Mesopotamian civilization) - colorful coating stage (Greek period).⁵⁾

2-2-2. Characteristics of "weave modeling"

The characteristics of the weave modeling are organized by previous research into the following table <Table 2>.

<Table 2> Previous Research

NO	Author	Research Content	Characteristic s
1	Chen Rong	From Representational Form to Constructive Thinking-Analysis of the Deductive Track of Weaving Art Form and Its Aesthetic Characteristics	A Stable System Built by Points and Lines
			Symmetry
			Dynamic beauty
2	C a i	Research on the construction method	Hollow and dense

4) Mao Yijing, From Bamboo Basket Weaving to Fiber Art, Craftsmanship, 2019, pp73-75.

5) Shi Yonggao, Hidden in Appearance-Research on the Dual Properties of Material Construction and Space, Doctoral Dissertation, Nanjing: Southeast University, PhD, 2007.

3	Ying	of weaving form building	Symmetry
			Lightness
	Zhang Nan	Weaving Building	Organic and clear force system
			rhythmic form
			woven light and shadow

2-3. "weave modeling" in Architectural Space

In general, the inherent impression of "weaving" is mainly the texture feeling formed by vertical and horizontal interleaving or winding. However, it is proved through countless human creative activities that the inspiration from the linear construction law of weaving technique has already made the expression form of weaving language break through the general morphological boundary, which is widely penetrated into all aspects of architectural space.

2-3-1. Architecture Structure

The staggered connection between linear materials creates the overall structure of the building, and the grid frame formed by "weaving" plays the role of structural support, which strengthens the anti-seismic capacity of the building. As the continuous development of science, technology and industry, steel structures are becoming more and more mature, which are widely applied in architectural space, making the traditional steel slenderer. Besides, these linear structural components will be used to re-form the supporting structure by means of "weaving", which can deepen the structure and architecture.

Like the Chinese National Stadium of the 2008 Beijing Olympic Games, it carries out rigorous stress calculation with the help of computer through customized steel components, showing up the architectural structure and appearance effect with weave modeling. The combined support between the components in

the structure forms the overall frame of the whole stadium. The "Cocoon" Tower in Shinjuku, Japan, forms a weave modeling through the steel frames crossing in three directions of the tower. The force between three linear materials in different directions improves the ductility and stability of the building <Table 3>. Both of them are examples of applying stability of weave modeling, which not only bears the mechanical load of the building, but also has the decorative effect on the building surface, increasing the supporting capacity and aesthetic at the same time.⁶⁾

<Table 3> Architecture Structure⁷⁾

N A ME	National Stadium	"Cocoon" Tower
Ima ge		

2-3-2. Building Skin

In some buildings, the weave modeling expressed on the building skin is only symbol, like a pure decoration, rather than structure. Semper's veneering theory holds that the weaving texture in the weave modeling leads to the emergence of the original decoration. He said, "The texture of houses constructed by means of 'knot' and 'binding' is naturally formed, which causes the emergence of the original 'decoration'." It is mentioned in 2.2 that the "weaving" has experienced a series of development processes, from the original enclosure stage with branches and fences to the

6) Chen Rong, From Representational Form to Constructive Thinking—Analysis of the Deductive Track of Weaving Art Form and Its Aesthetic Characteristics, Nanjing University of the Arts, Master's Thesis, 2014.

7) Picture source: www.baidu.com.

Greek period when the veneering reached the peak of art as the "colorful coating" of the wall. Like Prisma, the headquarters building of Pisa Communication Electronics Manufacturing Company in Italy and Selfridges department store in the UK, they both integrate elements related to the construction law and morphological characteristics of weaving into the decoration of the building skin <Table 4>. For this matter, the weave modeling is an aesthetic structure.

<Table 4> Building Skin⁸⁾

N A ME	Prisma	Selfridges department store
Ima ge		

2-3-3. Enclosure and Partition

Enclosure and partition can separate the space. As early as the Song Dynasty, palaces or temples began to use doors, windows and screens with weave modeling to realize the division of architectural space. Nowadays, the architectural form becomes more and more free, the application of weave modeling in enclosure and partition plays a certain function of aesthetic decoration more than the simple functional element like doors, windows and screens. For example, bamboo mat partition and straw mat partition in traditional Japanese houses directly use hanging fabrics to create a soft transition from indoor to outdoor; The Tang Palace Seafood Restaurant in The Mixc of Hangzhou, takes bamboo board as the main material to weave a huge hollow ceiling extending from the wall to the ceiling, which makes people feel as if they were in a bamboo basket <Table 5>.

8) Picture source: www.baidu.com.

They are both examples of applying hollowing and translucency in weave modeling. Now, the weave modeling is a structure with both functionality and aesthetics.

〈Table 5〉 Enclosure and Partition⁹⁾

N A M E	Partition	The Tang Palace Seafood Restaurant in The Mixc of Hangzhou
Image		

3. Evolutionary Aesthetic Observation on the Aesthetic Characteristics of weave modeling

Professor Michael Gazzaniga of the University of California points out that aesthetics does not depend on acquired learning and culture. The good impression obtained from visual objects is not random, but the result of evolution through millions of years combined with the development of human perception and cognition.¹⁰⁾ In order to adapt to the living environment, human beings have experienced a long period of evolution, during which the accumulated experience is genetically embedded into the human spirit based on the theory of natural selection. Therefore, human beings are able to automatically get the attention and good feeling to the favorable factors for survival. Thus, human beings have formed a transcendental and universal aesthetic consciousness of specific

images and environments (Yun, 2011). In fact, humans show a general preference for naturally occurring forms such as symmetry and spirals; a preference for structures that are conducive to survival and high in stability and safety; High preference, this is all an intelligent structure of resource value that human beings have evolved to benefit from survival and reproduction. By understanding this feeling and incorporating it into your design, you can provide people with an effective sense of satisfaction. "Aesthetics" comes from Greek, which means the sensory perception and understanding or sensory knowledge in the 18th century, and philosopher Baum defines it as sensory satisfaction or sensory joy (Goldman, 2001).¹¹⁾ In terms of the evolution theory, the essence of organisms is to adapt to the environment first, then adapt to the environment again to evolve different adaptive abilities. So, aesthetics can also be regarded as an adaptive ability in the process of evolution. From the perspective of evolutionary aesthetics, aesthetics meets the needs of both life and senses, because happy emotions can promote the healthy development of organisms. "Weaving" is an image originated from nature, which reflects human's aesthetic consciousness of natural image. Therefore, on the basis of 2.2.2 analysis of weave modeling characteristics, in terms of the evolutionary aesthetics, the author divides the internal aesthetic consciousness of weave modeling into three aspects: modeling, structure and environment, obtaining the corresponding aesthetic characteristics.

3-1. Modeling

Modeling is a concrete form that can be perceived, which is the most basic cognitive element in spatial experience. For modeling, symmetry and rhythm are typical representatives in the aesthetic characteristics of weave

9) Picture source: www.baidu.com.

10) Micchael S.Gazzaniga, & Park In yun Station, 왜 인간인가: 인류가 밝혀낸 인간에 대한 모든 착각과 진실, 추수밭, 2009, p297.

11) Hekkert, P., Design Aesthetics: Principles of Pleasure in Design, Psychology Science, 2006, 48(2), p158.

modeling. weave modeling creates a unique texture through the weaving of linear materials, and the structure and shape of texture determine the shape and pattern expression of the overall appearance. So, according to a certain order, these linear textures are circularly and repeatedly arranged together to form a symmetrical overall texture shape of the object surface.

Symmetry refers to the one-to-one correspondence between the parts on opposite sides of a figure or object based on the vertical axis in size, shape and arrangement. Symmetry is not only the basic law of the universe, but also the basic characteristic of natural phenomena, which is an ordered beautiful and perfect concept that people have been trying to understand and create for thousands of years. Symmetry means the proportion and balance between harmony and beauty (Zee, A. 2007, Christopher T. Hill & Leon M. Lederman. 2005). Human beings have a general aesthetic preference for symmetry.¹²⁾ Like what the physicist, Herman Wey, wrote in his classic book, "beauty is connected with symmetry" (Weyl, H, 1989). Symmetry is a common form in the natural environment, such as butterflies, leaves, snowflakes, beehives, etc., which is natural, stable, balanced, neat and perfect visually. Moreover, it has a sense of beauty, which is fit for people's visual habits. Therefore, the weave modeling is an image reflecting the natural order, which will automatically have a good impression on the perceptual in the spatial experience.

Corbusier once said that "rhythm is a state of balance, which arises not only in a series of simple or complex symmetries, but also in a series of elegant balances".¹³⁾ "Balance" is the

12) Yi Huang, Xiaodi Xue, Elizabeth Spelke, Lijie Huang, & Wenwen Zheng & Kaiping Peng, The Aesthetic Preference for Symmetry Dissociates from Early-emerging Attention to Symmetry, Scientific Reports, 2018, 8(6263), p1.

13) Yang Yinan, Research on Weaviness of

key to generate rhythm, which means any regular repetitive movement (Liddell & Scott, 1996). For visual art, rhythm is the soul that regularly repeats various scattered elements to form an organic whole. Therefore, rhythm regularly repeats the elements in the system to achieve balance that people can get the enjoyment of sensory and psychological beauty. The rhythm of weave modeling is reflected through the regular repetition or change of unit composition, which has more coherence and integrity due to the existence of linear materials and construction, compared with other composition methods.

<Table 6> Aesthetic characteristics at the modeling level

1	Charac teristic	Content
Mode ling	Symme try	The one-to-one correspondence between the parts on opposite sides of a figure or object based on the vertical axis in size, shape and
	Rhyth m	Rhythm regularly repeats the elements in the system to achieve balance

3-2. Structure

In Chinese characters, "Bian" (weaving) tends to connect materials with toughness and hardness into faceted objects with certain strength; While, "Zhi" (knitting) is more inclined to change soft and slender materials into flexible surfaces with tools. From this point of view, the woven surface can be divided into two different types: toughness and flexibility.¹⁴⁾

weave modeling generally appears in the natural environment and biological shapes. The

Construction, Dalian University of Technology, Master's Thesis, 2009, p47.

14) Zuo Jianbing, "Weaving" Techniques in Architectural Design in the View of Construction, China Residential Facilities, 2009, p2.

skills of "weaving net and nest" accumulated by animals relying on instinct and experience have become the basic principle of weave modeling. Like the spider web weaving, the spider web is generally hexagonal or octagonal structure, which is radial, and the support is radial radius structure. The structure of spider web has great tension, which can give full play to the tensile characteristics of "fiber material". The external impulse is evenly dispersed on the whole web by crisscross cobweb, so that it can bear such strong impact. Likewise, when birds are "weaving nest", they turn the thin grass-blades in a circle, interspersing up and down to create stack layers, and finally a sphere-shaped "house" with curved surface which is tight is built. Such "weaving means" makes its weaving surface become a flexible free-form surface, showing dynamic force, which has the dynamics of gravity-free structure. The bird's nest like this will be soft and well protected for bird egg, and the enclosed surface can also maintain the most suitable temperature for egg hatching.

According to the theory of evolution, the genetic features that help animals survive will be copied and passed on to future generations. For those objects considered valuable for survival, such as high-quality environment and organisms, our brain cognition will recognize them as "beauty", while on the other hand, it will be known as "ugliness".¹⁵⁾ Through the analysis of evolutionary theory and evolutionary psychology, the significance of weave modeling is gradually formed in human cognition in the long-term evolution of human beings. The weave modeling gradually symbolizes the stable structure that is conducive to human life as safety, stability, warmth and continuity. Weave modeling also has survival value and significance for human evolution. Therefore, in the process of continuous evolution, human aesthetic preference

for weave modeling is a kind of feeling that was input into our genes a long time ago, as well as a good impression of a specific shape.

<Table 7>Aesthetic characteristics at the structure level

2	Characteristic	Content
Structure	Toughness	Stable supporting force, which can bear strong impact
	Flexibility	It shows the dynamic force flow with the dynamics of gravity-free structure

3-3. Environment

Human beings show a strong emotional response to their own environment. Evolutionary aesthetics believes that this human emotional response and the consciousness of beauty origin from the preference of habitat conditions suitable for survival. Humans like "sightly but invisible" places where people can see prey, but will not be found by the enemy. Human beings prefer an environment with unobstructed vision and hiding conditions.¹⁶⁾ The "Prospect-refuge" theory proposed by British geographer Jay Appleton also explains the favorable impression on the open and hidden characteristics of space.¹⁷⁾ Vision protection literally means "being able to see others without being seen", like hunters need to be close to their prey without being seen and soldiers need to stay high to escape from the enemy. In the process of evolution, people prefer the sheltered landscape with low risk, good vision and few obstacles, because it can make people feel safe enough.

The aesthetics of modern people is closely

15) Volland, E., Grammer, K., *Evolutionary Aesthetics*, Springer, 2013, p1.

16) Kaplan, S., *An Informal Model for the Prediction of Preference, in Landscape Assessment, Values, Perception, and Resources*, pp92-102.

17) Jay Appleton, *The Experience of Landscape*, reversion, 1975.

related to the early human perception of security. All positive emotional reactions, such as love, intimacy and support, are the product of security sense, which is the root of our aesthetic pleasure today. Because of more information and stimulation, a relatively safe environment can encourage people to explore. While, the scene like the flat prairie with little content lacks the sense of security, where the end can be known, so, it is not so attractive. From the above point of view, the weave modeling has an effective binary structure in both opening and concealment. Due to the gaps, the weave modeling can produce a fuzzy and ambiguous translucent interface, which can form a visual pause, ensuring the overlooking conditions and the space with openness. While, the relatively closed space formed by weave modeling effectively realizes the concealment of space. Therefore, the weave modeling can form a space similar to "lookout shelter" in terms of environment.

〈Table 8〉 Aesthetic characteristics at the Environment level

3	Characteristic	Content
Environment	Openness	Ensure open viewing conditions
	Concealment	Form a space in a relatively independent and hidden space

4. Case Analysis

4-1. Analysis Object and Method

This chapter analyzes the reflection of the aesthetic characteristics of weave modeling in architectural space through architectural cases at home and abroad. The cases in this study are all excellent architectural cases introduced on the ArchDaily in the past five years. Six of them are buildings with weave modeling inside and outside the space. According to the application

of weave modeling in architectural space in 2.3, the cases of the application of weave modeling in building structure, building skin, enclosure and partition were selected respectively, two for each type. According to the aesthetic characteristics of modeling, structure, environment and other aspects obtained above as the standard, for the evaluation of actual architectural space design, the specific evaluation items related to each characteristic are extracted as follows 〈Table 9〉. Due to the inability to visit the site, the evaluation was completed mainly through website pictures and re-analysis of the data of the previous research.

〈Table 9〉 Evaluation Standard


Modeling	Symmetry	The weave modeling is completely symmetrical on the left and right sides
		Use a weave modeling at a uniform frequency throughout the space
		Evenly distribute the load
	Rhythm	Elements are used evenly and frequently in weave modeling
		Generates a rhythm by repeatedly arranging elements in a weave modeling
		Elements in the weave modeling change regularly
Structure	Toughness	Supporting building loads with weave modeling
		Evenly distribute the load
		Create a secure appearance
	Flexibility	Weave modeling are used as domed ceilings
		Utilize weave modeling surfaces
		Create an atypical appearance
Environment	Openness	With the function of viewing and lighting
		Higher proportion of holes in the weave modeling
		Use weave modeling as windows, partitions, etc.
	Concealment	Visual occlusion
		Use of weave modeling as awning or canopy
		Forming a woven wall space


The analysis of this study is based on the

three aspects of aesthetic characteristics summarized in Chapter 3. The overall content should be summarized through the cases respectively, focusing on the six characteristics to evaluate its application intensity according to the aesthetic characteristics of weave modeling in each case with five scales (5: very strong, 4: strong, 3: average, 2: weak, 1: insufficient).

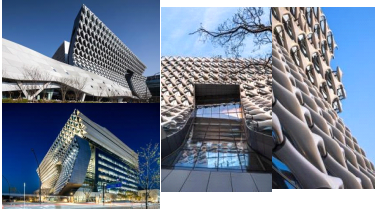
4-2. Case Analysis

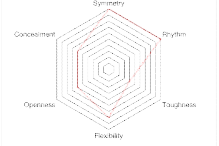
〈Table 10〉 case analysis

NO.1	"Bamboo Museum" Exhibition Hall		
location	Taiwan	Particular Year	2018
Overview	The building area of this bamboo exhibition hall is 1570 m ² with the whole bamboo material, including structure and woven surface. You can feel the various changes caused by light and shadow penetrating through the gap during the day, while at night, you can feel the romantic landscape interweaved with the lighting and adjacent water bank.		
Image			
Objectives	Content	Expression	Evaluation
Modeling	Symmetry	The left and right sides of the whole building are completely symmetrical	5
	Rhythm	Bamboo regularly repeats "weaving"	3
Structure	Toughness	The weave modeling is used to bear the load of building	5
	Flexibility	The characteristic of bamboo is used to form a streamlined architectural appearance	4


Environment	Openness	Exposed exterior of structural materials and the light and shadow that can penetrate the gap of bamboo weaving	4
	Concealment	A relatively safe and hidden space can be formed from the outside to the inside	3
Overall analysis			


〈Table 11〉 case analysis

NO.2	Kolon Group		
location	South Korea	Particular Year	2018
Overview	<p>This design encouraging more interaction and communication between various departments of the company, which demonstrates</p> <p>The facade design takes a series of interconnected sunshades as the characteristic, forming an integral outer skin, which is similar to woven fabric -- it uses Kolon's research on textiles for reference as a symbol of cooperation between various departments of the company.</p>		
Image			
Objectives	Content	Expression	Evaluation
Modeling	Symmetry	Complete left-right symmetrical "weaving" building skin	5
	Rhythm	The same element regularly repeats with an average frequency to achieve balance	5
Structure	Toughness	Evenly distributed power and stable appearance	2

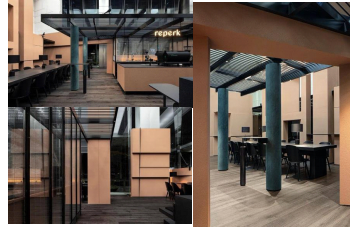
	Flexibility	An amorphous appearance and flowing dynamic	4
Environm ent	Openness	Hollowed building skin	3
	Concealment	Insufficient	1
Overall analysis			

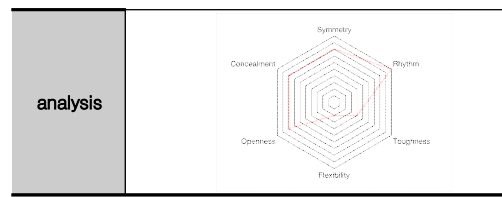
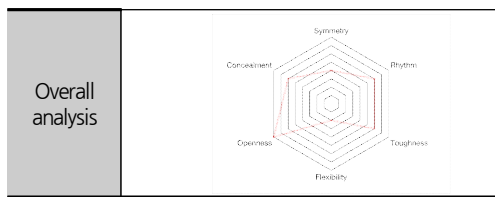
〈Table 12〉 case analysis

NO.3	Casa Tejida		
location	Colombia	Particular Year	2019
Overview	Casa Tejida is an experimental house with family coffee plantation. Casa Tejida weaves the landscape in the project with the residents, more than just the formation. Weaving technology is applied to structural elements throughout the building.		
Image			
Objective s	Content	Expression	Evaluation
Modeling	Symmetry	The weave modeling is relatively symmetrical	3
	Rhythm	The same element regularly repeats with an average frequency to achieve balance	4
Structure	Toughness	The weave modeling is used to bear the load of building	5
	Flexibility	Insufficient	1
Environm ent	Openness	Enough light transmittance	4
	Concealment	A relatively safe and hidden space can be formed from the outside	3

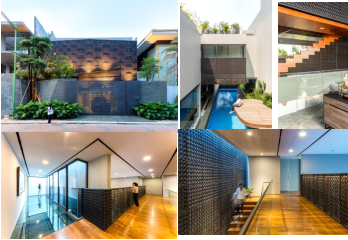
		to the inside	
Overall analysis			

〈Table 13〉 case analysis


NO.4	Reperk coffee shop		
location	South Korea	Particular Year	2020
Overview	Reperk coffee shop is located in downtown Seoul. Due to the factors of building their own conditions, structure is relatively hale and cool, the designer, by means of harmonic to relax the feeling of the space and comfort. Advantaged by make full use of natural light, through grille, a variety of forms such as humanly scaled let a space more fully, to reconcile the solemn and respectful feeling black.		
Image			
Objective s	Content	Expression	Evaluation
Modeling	Symmetry	The weave modeling like grille and window opening are relatively symmetrical	2
	Rhythm	The same element regularly repeats with an average frequency	3
Structure	Toughness	The weave modeling is used to bear the load of some building walls	3
	Flexibility	Insufficient	1
Environm ent	Openness	Taking weave modeling as a translucent partition	4
	Concealment	A relatively safe and hidden independent space	4

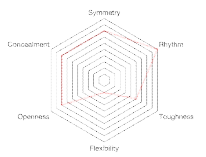


〈Table 14〉 case analysis

NO.5	Weaving House in Jakarta		
location	Indonesia	Particular Year	2020
Overview	This building is an independent residence with a unique facade designed by the architect, which is semi-transparent along the street for separating indoor and outdoor spaces with a full sense of privacy. The beauty and the security of residents' privacy are both considered. The weave modeling covers the second and third floors of the house, which is very dense from the outside and light from the eyelets.		
Image			
Objectives	Content	Expression	Evaluation
Modeling	Symmetry	The weave modeling is symmetrical left and right	4
	Rhythm	The same element regularly repeats with an average frequency to achieve balance	5
Structure	Toughness	Insufficient	2
	Flexibility	Insufficient	1
Environment	Openness	weave modeling are used in many places as translucent partitions	4
	Concealment	The semi-transparent facade provides enough privacy for separating indoor and outdoor space	4
Overall			

〈Table 15〉 case analysis

NO.6	Home of Palicourea		
location	Brazil	Particular Year	2021
Overview	There are two parts of the Home of Palicourea: home and studio. The structural system consists of two independent parts: the core structure composed of exposed concrete frame and solid brick wall, and the glued wood roof. There is a "cavity" between the room and the wood roof, which is an open space for natural ventilation.		
Image			
Objectives	Content	Expression	Evaluation
Modeling	Symmetry	The weave modeling is symmetrical left and right	4
	Rhythm	The same element regularly repeats with an average frequency to achieve balance	5
Structure	Toughness	The weave modeling is used to bear the load of some building walls	3
	Flexibility	Insufficient	1
Environment	Openness	weave modeling are used in many places as translucent partitions	4
	Concealment	The semi-transparent facade provides	4

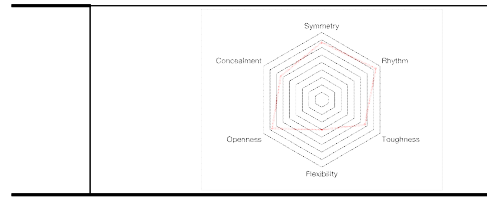
		enough privacy for separating indoor and outdoor space	
Overall analysis			

4-3. Summary

With the architectural space cases at home and abroad, the analysis results of the aesthetic characteristics of weave modeling are as follows <Table 16>. It can be found after analyzing the average value of these six cases that for the aesthetic characteristics of weave modeling reflected in space design in recent years, the rhythm expresses the most, followed by symmetry and openness, and then there comes toughness, concealment and flexibility. Therefore, the modeling characteristics of weave modeling in architectural application have been highly reflected. On the other hand, the flexibility of weave modeling rarely appears in the architectural space.

<Table 16> Analysis structure summary table

NO	Modeling		Structure		Environment	
	Symmetry	Rhythm	Toughness	Flexibility	Openness	Concealment
1	5	3	5	4	4	3
2	5	5	2	4	3	1
3	3	4	5	1	4	3
4	2	3	3	1	4	4
5	4	5	2	1	4	4
6	4	5	3	1	4	4
mean	3.83	4.17	3.33	2	3.83	3.17
Overall analysis						



5. Conclusion

This study analyzes the characteristics of weave modeling from the perspective of evolutionary aesthetics. Based on evolutionary aesthetics, this paper investigates the aesthetic characteristics of weave modeling from three aspects: modeling, structure and environment through the favorable structure of natural shape, resident preference and lookout shelter theory. Thus, there are six performance characteristics: symmetry, rhythm, toughness, flexibility, openness and concealment. Finally, based on these characteristics, this paper analyzes the case of architectural space with weave modeling. According to the analysis results, the intensity expressing in the aesthetic characteristics of weave modeling in the case design is successively the rhythm, symmetry, openness, concealment, toughness and flexibility.

In terms of the final analysis results, the rhythm of weave modeling in architectural space design is the most prominent characteristic. Compared with the disordered and non-rhythmic interface, the orderly and repeated weave modeling brings a visual balance, so as to realize a symmetry of the whole structure or building with interface balance. Whether it is in the building structure, building skin, or in the enclosure and partition, it has a more prominent performance.

From the perspective of structure, flexibility is relatively weak to express. According to the analysis, the flexibility of weave modeling is mainly reflected in the design of streamline. Compared with the dynamic spatial deduction, it is more used as the structural support of the

building. Through linear interleaving, the toughness characteristics of weave modeling are statically expressed to effectively generate a sense of authority in the space, so as to improve the user's psychological security.

In terms of the environment, the openness and concealment are relatively strong in expression. As a partition or enclosure, the weave modeling realizes the function of visual cover to ensure the domain of space, more than a wide vision.

Based on evolutionary aesthetics, this study concludes the general aesthetic characteristics of weave modeling. With the case analysis, it is notarized that the characteristics mentioned before are reflected in the actual architectural space design with weave modeling. Therefore, it is necessary to pay attention to the methods that can stimulate aesthetic consciousness from the perspective of evolutionary aesthetics in order to realize effective application of weave modeling in the future architectural space design.

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