

# The Application of Brick Building Art in Vernacular Architecture\*

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**Abstract**—At present, there have already been some researches on the understanding and application of bricks. But with the continuous progress of the times, the use of bricks gradually transformed from load-bearing and building maintenance to decorative art, which is the embodiment of brick building art. By studying the application of brick in local architecture, the researchers found that there were still many cases of applying brick structure in local architecture, old-fashioned and dry, though. Based on the research from the attributes of brick, the way of expression, cultural embodiment and the application of ancient buildings, this paper manifests that the brick building art has great potential in vernacular architecture, thus it is necessary to combine culture with architecture, and explore more possibilities of brick building art in modern society.

**Keywords**—brick building art; vernacular architecture; tile carving; culture

## I. INTRODUCTION

Nowadays, with the rapid development of China's economy, people's demands for quality of life and lifestyle are becoming higher and higher, so many designers have developed more and more new architectural forms. But for people, the earliest buildings were made of bricks, which are well known as building materials. The application of brick construction is most commonly seen in vernacular architecture, but the form of architecture is simple, and the artistic function of brick construction has not been brought into play, which causes the loss of artistic elements in vernacular architecture. In this paper, the application of brick building art in vernacular architecture is taken as the research content. By making use of the characteristics and attributes of brick itself, more design and application means are

proposed by changing the shape, arrangement and structural transformation. The significance of the study lies in that the brick material can be developed and utilized again, providing more choices for designers, and providing some references for the artistic development of vernacular architecture. This will have a certain influence on the development of traditional culture and causes the resonance of ancient architecture and vernacular architecture.

## II. BRICK BUILDING ART

As an architectural material with a long history of use in China, no matter in terms of its unique material expression, visual impact or unique cultural beauty, brick has an irreplaceable position. Nowadays, with the rapid development of the times, building materials have become more diversified. Brick materials have gradually disappeared from people's sight as the dominant materials of architecture. Therefore, the protection, innovation and inheritance of brick building art are particularly important.

### A. Attribute of the Brick Material

1) *Color*: Color is the most simple and direct element reflecting material characteristics and transmits material information, and can also bring the most immediate visual experience to people. The length of contact time with oxygen, the temperature in the kiln and the firing method can make a difference in the color of the brick when bricks are fired. In the process of firing bricks, constantly pouring water into the kiln for water cooling contributes to black brick with the color of gray green and under the condition of sufficient oxygen in the kiln, continuous high temperature firing will make red bricks. Black bricks and red bricks form the main color types of the brick material. In addition, the soil used for firing bricks also has a direct impact on the

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final shape of bricks, and the color of bricks produced by firing with different mineral content is also different.

2) *Texture*: Bricks are mostly made of natural materials such as clay, shale and sand, and the mixing ratio of materials leads to the difference in brick features. No matter what kind of brick, they all have common features — the surface of the material will appear different sizes of depression, and there are many pores inside the material, which is due to the expulsion of gas from the mold during the firing process. Of course, this is also the unique characteristics of brick material, and the different size of grain aperture reveal the natural beauty and primitive beauty of this kind of material.

3) *Features*: Brick has a long history as a building material in China. The archetype of brick was unearthed in the site of Daxi culture more than 6,000 years ago. Bricks were fired and made into square rectangles more than 5,000 years ago, used to build tombs in the Warring States Period, sublimated into exquisite works of art by Qin and Han dynasties. In the "Construction Method" by Li Jie in the Song Dynasty, there is also a special section called "brick operation". People are fond of bricks not only because of the plasticity and aesthetics of brick material, more because of the practicability of heat preservation, heat resistance and anti-weathering, etc.

**B. Definition of Brick Building Art**

Brick building art is to apply brick materials into the building, and make the brick become more artistic and aesthetic through changing the shape, arrangement, color different, not just for the sake of a structure itself, but also for decoration. In addition, under the condition of continuous exploration, the infinite possibilities of brick construction have been stimulated it can completely meet the aesthetic standards of people today.

**C. Expression of Brick Building Art**

With small volume and strong individuality, the brick materials are not only easy to carry, but can also produce different effects in different permutation and combination, with amazing variety and expressiveness. Through different masonry methods, color arrangements, brick materials can give the building with different vitality.

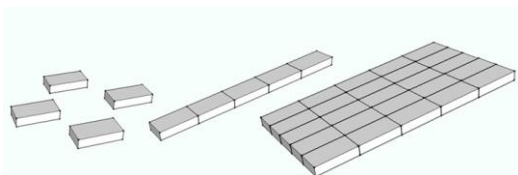


Fig. 1. Representation of point, line and plane.

<sup>a</sup> Source: drew by the author.

With independence and obvious unithood, each brick has its own unique pore size, bump and texture. Through different ways of construction or arrangement, the building can be more aesthetic. Through the dense arrangement, the

change of direction brings a strong sense of direction and delicate beauty, making the building closer to nature. Lines are arranged to form a surface. Bricks with different characteristics are arranged on the same surface, which seems rigid at the first glance but surprising in details (see "Fig. 1").

1) *Various construction methods*: Due to the unithood and geometric property of bricks, the difference in material selection, construction mode and arrangement can bring different visual experience to the building, and give the bricks a secondary texture. Early brick masonry technology was not mature. With the widespread brick making technology and more mature masonry methods, different forms of masonry technology also appeared.

a) *Single-brick one-way construction*: Single-brick one-way construction (see "Fig. 2") is the early construction method, which was mostly used before the Han dynasty. Usually used together with dry building, the building made had poor integrity of stability and aesthetics.

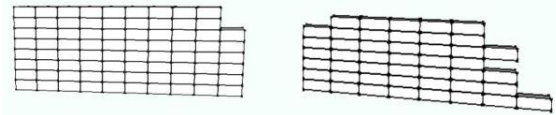


Fig. 2. Single-brick one-way construction.

<sup>a</sup> Source: drew by the author.

b) *Herringbone masonry*: As the most common masonry method, herringbone masonry (see "Fig. 3", "Fig. 4") achieves the overlap between the brick layer and brick layer through the horizontal displacement of the upper and lower brick layers, so as to improve the integrity and stability of the structure. The addition of header masonry method in the herringbone masonry can add the rhythmic beauty of the building.

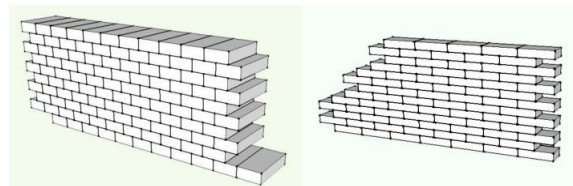


Fig. 3. Herringbone header masonry method and herringbone stretcher masonry method.

<sup>a</sup> Source: drew by the author.

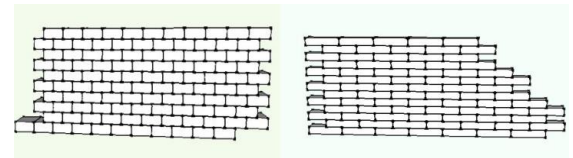


Fig. 4. Herringbone header masonry method and herringbone stretcher masonry method.

<sup>a</sup> Source: drew by the author.

c) *Rowlock wall masonry*: Since the Han dynasty, with the development of brick-making technology and maturity of bricklaying technology, rowlock wall masonry (see “Fig. 5”) has been widely used. The void in the interior of rowlock wall is mostly filled with construction waste, which not only realizes the recycling of construction waste, but also saves the use of brick materials.

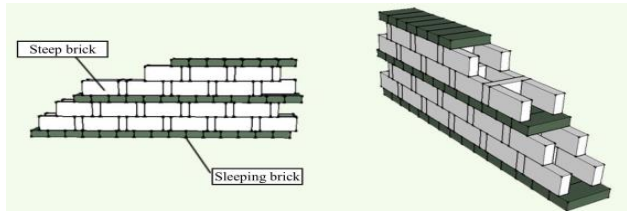
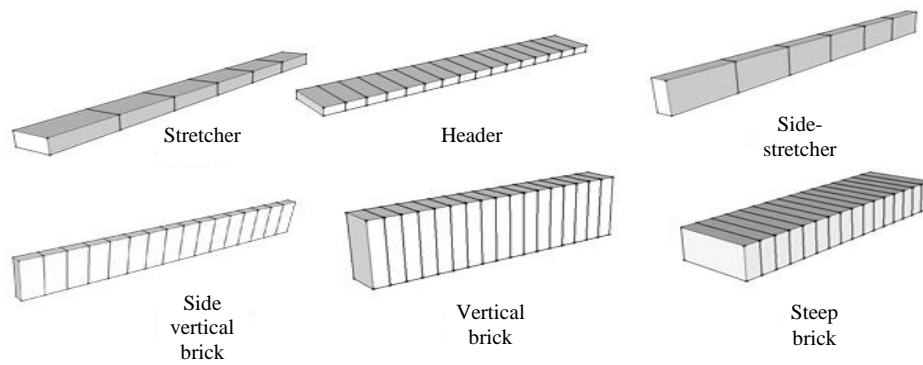


Fig. 5. Steep-sleeping brick masonry (the dark brick layers are sleeping bricks and white layers are steep bricks).

a. Source: drew by the author.



Six arrangements of bricks.

Fig. 6. The arrangement of bricks.

a. Source: drew by the author.

b) *Brick mat formation*: When the bricks and stones are used as building maintenance materials, this form of construction — brick mat formation emerges, which can be divided into indoor and outdoor mat formation. Indoor mat formation is used for moisture proofing and dedusting, and outdoor mat formation more for dewatering and skid resistance. Brick as a maintenance material paving the ground also has a long history, and the application of the ground paving is very widely used until now, such as in parks and square sidewalks. It gives people different visual experience and aesthetic feeling for the landscape through different forms of arrangements.

### III. BRICK BUILDING ART IN VERNACULAR ARCHITECTURE

#### A. The Homogeneity of Vernacular Architecture and Brick Building Art

1) *Public awareness*: Vernacular architecture is an architectural form of China's housing architecture, which

#### 2) Rich construction language

a) *Brick wall*: This form of construction came into being when bricks are used as a backing material for the building — brick walls. Brick walls are also constructed in a variety of arrangements, such as stretcher, header, side-stretcher, vertical brick, side vertical brick, steep brick and so on (see “Fig. 6”). Through different arrangements and combinations, brick walls of different forms are constructed. In landscape architecture, solid brick walls are the most common.

can show the cultural deposits of the region where the architecture is located. It bears the humanistic and historical feelings, and is the embodiment of the diversity of China's long-standing traditional culture. With a long-time presence of development in the history of human construction, bricks are widely used and can resonate with historical moments. Bricks are mainly used in vast rural areas. Different from modern materials, brick has a more full and natural texture. Brick gives off a warm and simple breath atmosphere and the transmission of rural flavor is closely linked with the use of bricks to a large extent. The subtle relationship between vernacular architecture and brick construction makes brick construction form the spiritual framework of vernacular architecture.

2) *Emotional attribute*: People's enthusiasm for a piece of land comes from the deep memory of a certain element of the land, a carrier that can express the sense of belonging. The characteristics of bricks and the inheritance of thousands of years and the wide application in local

architecture is relatively popular makes bricks a good memory carrier which can resonate with people's memory. This kind of ideological connection makes bricks form the breath of primitive simplicity and nature, and become a symbol and a carrier, making a piece of land and a group of people closely connected. Brick building brings people a close sense of belonging and also inherits the cultural spirit formed in a region for thousands of years. In other words, in this case, the bricks are not only the building materials of vernacular architecture, but the expression of the unique cultural connotation of a region.

3) *Physical attribute*: Bricks used in Vernacular architecture can mainly be divided into two types: one is the brick-red with warm color, the other brick-color cool color. Due to the different oxygen content and natural composition of clay in the firing process, the colors can be different. Brick has a rich texture, which comes from the uneven grain and holes on the surface. The color and texture of bricks are naturally formed. Compared with smooth and flawless modern materials, bricks are easier to express the natural and cordial feelings and create a comfortable and harmonious environment.

Red bricks are sintered building blocks, which are made through comminuting sandy clay, mixing and pressing it, and burning it in a flame at 900-1100 degrees Celsius. Red bricks are easy to absorb water, so the brick wall and cement mortar can be well combined. Cement brick is aerated concrete block with high density, high strength, durability, uniform color. With thick material and a lot of holes, red bricks have the effect of heat preservation, thermal insulation and sound insulation. Red bricks are of high plasticity, thus suitable for sculpture and other art decoration. Using this material in vernacular architecture can not only meet the practical needs, but also play a role of beautification and decoration.

Black bricks are also made of clay. After the clay is mixed with water, they are made into raw bricks and calcined in the brick kiln. Similarly, iron is contained in clay at 900-1100 degrees Celsius, which produces a chemical substance that is red when the iron is completely oxidized in the firing process. Water is added to cool it in the firing process and when the iron in the clay is not fully oxidized, it becomes blue, thus producing black bricks. The performance of black brick is better than that of red brick in resisting oxidation, atmospheric erosion and hydration. In addition, it has the characteristics of high density, good thermal insulation performance, and strong plasticity and is not easy to deformation. What's more, black brick gives a sense of calmness and simplicity, and is one of the good choices of applied materials for vernacular architecture. However, due to the complexity of the production process of black brick, the utilization rate in the vast rural areas is low.

Bricks have various texture changes, and different arrangement modes and layouts can bring the effect with apparent change of virtuality and reality relationship. The texture of brick is divided into uniform texture and non-uniform texture. Through the application of different brick

processing methods, a clear and colorful space layout can be formed.

### *B. The Inevitability of Applying Brick Building Art in Vernacular Architecture*

The improvement of living environment in rural areas is an important issue of people's livelihood and an important task of rural revitalization strategy. There are mainly two points demonstrating the inevitability of applying brick building art in vernacular architecture. First, brick has incomparable advantages over other materials. From the perspective of production cost, the raw materials of brick are common mud, sand, stone powder and auxiliary materials, which are all over the vast rural areas. The availability of materials is convenient for transportation and later production, in line with the principle of drawing on local resources, and the production cost is more cost-effective than that of modern building materials. The local characteristics need to be taken into consideration in the processing process, though. Since the brick can meet the needs of function and aesthetics and requires low production cost, it is widely accepted by the masses. From the practical point of view, brick has the characteristics of high density, high strength, good insulation performance and sound insulation effect, strong oxidation resistance, and thus is suitable for application in local architecture. From the point of view of aesthetics, the blue and red brick colors have their own characteristics, and the decorative effect is similar to that of ancient buildings. Second, with strong plasticity, brick can be used for artistic creation by means of carving and hollowing out, and has a great potential to explore. The application of brick in vernacular architecture can improve the overall appearance of rural areas and provide a broad prospect for the development of tourism. With a thousand years of development history, brick is easier to convey the flavor of simplicity and thick history. It is necessary to pursue development in line with local conditions. That is to say, to form the characteristics of the area and the advantages of the brick according to the local actual situation and humanity spirit and cultural characteristics, so as to adapt bricks to different cultures and local conditions. The brick building art is the embodiment of spirit, and different values given to it convey different cultural connotations. Second, the inheritance of local cultural feelings needs a high-quality carrier. No matter from its own value or its long development history, brick is a high-quality choice as the carrier of inheriting regional humanistic spirit. Brick is not only the filling material of the frame structure of the building, but also the warm images it conveys, making people more easily touched. Different regional cultures create different ways of brick art expression. At present, many traditional villages in China have good cultural deposits and profound humanistic spirit, but lack a high-quality carrier. It is an opportunity for the brick building art to display these histories in a better way. Of course, while paying attention to exploring the cultural deposits of rural areas, it is necessary to respect regional customs and habits, and show the diversity of traditional culture in vernacular architecture in the form of brick building art.

IV. THE APPLICATION OF BRICK BUILDING ART IN VERNACULAR ARCHITECTURE

A. Brick Building Art in Architectural Structure

1) *Bearing structure*: In vernacular architecture, brick is mostly used as the bearing structure. With good anti-pressure ability, the brick is often used in combination with reinforced concrete to build load-bearing walls. It plays an important role especially in vernacular architecture. Because people's living standard is relatively low, so brick this cost-effective material is widely used. And bearing wall can be divided into cross wall bearing, longitudinal wall bearing, and cross-longitudinal wall bearing, etc.

2) *Nonbearing structure*

a) *Facade art*: The brick is also used by some people for facade decoration. By use of the plasticity of brick, a variety of different textures and shapes are built as the facades, with embossments, flat carvings and stamp printings, etc. Based on the durability of bricks and the

characteristics of their colors, whatever red brick, gray brick or black brick and so on have the decorous feeling of history, which are suitable for solemn buildings. Besides, it can also be full of industrial style, while direct exposure can produce another art style.

b) *Space partition*: With a certain thickness, the brick material has some effect on heat insulation. Houses built with bricks usually have the effect of being warm in winter and cool in summer. Different constructing methods contribute to different display forms. In a lot of buildings where different walls are created with voids through special stacking methods. For example, in the "A House For All Seasons" by Prof. Lin Junhan, concrete columns are integrated with the roof structure and mud-brick walls (see "Fig. 7"). Different from the traditional building structure, the new hollowed-out tiled wall not only meets the needs of light and ventilation, but also protects the earth wall. In addition, the bricks are applied on the ground, which both maintains the unity of style and presents the air permeability of the brick.



Fig. 7. "A House For All Seasons" by Prof. Lin Junhan.

This is the concrete model of hollowed-out tiles in the building, with ordinary bricks forming the pattern according to the rule. The seemingly simple pattern not only introduces natural light and fresh air, but also acts as an ornament (see "Fig. 8"). The shadow produced when the wall is penetrated by light is also decorative.

a. Source: from the network.



Fig. 8. Specific arrangement of the wall.

a. Source: drew by the author.

**B. Brick Building Art in the Architectural Ornament**

**1) The adornment of the door**

a) *Chi Tou*: The durability of bricks is extremely good, and the use of bricks on doors is more obvious in many historic buildings, such as the quadrangle dwellings in Beijing and buildings in the North China. In the past, in order to give prominence to the status in society, people used to devote particular care to the changes on their doors. Chi Tou (墀头) is composed by lower shoulder, upper body and head (see “Fig. 9”). Chi Tou is one of China's ancient

architectural structures. It refers to the part of the gable projecting beyond the column of the eaves, projecting from the sides of the gables which can supports the front and rear eaves. It was originally used for drainage on the roof and water retaining on side walls. But since it was exposed outside, the householder tried his best to decorate it, making it full of implied meanings. Since the doors of ancient buildings were mostly made of stone material that was of high plasticity, patterns like flowers, grass, birds and animals, etc. were engraved on them.



Fig. 9. Chi Tou of the buildings in Hongcun Village.

<sup>a</sup> Source: drew by the author.

b) *Lintel*: The lintel is a beam above the door frame, made of solid wood and brick stone. In the ancient feudal system, only the imperial palaces and official mansions were qualified to mark the lintel on the front door, even the rich people cannot. The lintel is composed by hanging fascia, ice plate eaves and breast board and balusters. The hanging fascias are made from hollowed-out planks or brick material with engraved patterns. In most cases, the wood materials are used for interior space separation, while bricks are on the front door. The engraved patterns on them are the symbol of identity and meaning, mainly for decoration. The ice plate eaves can be divided into corbelling tile eaves and wood-like brick groove according to the brick materials. It can also be distinguished by the layers. The more the layers are, the more complex the ice plate eave is. In vernacular architecture, four layers, five layers and seven layers are most common.

**2) Wall space**

a) *Screen wall*: Screen wall (影壁, "ying bi" in Chinese) is very common in vernacular architecture. It is also called "照壁" ("zhao bi" in Chinese) and "萧墙" ("xiao xiang" in Chinese), indicating a screen wall facing the gate of a house. It is built mainly of black brick or colored glaze, with occasional use of tile cladding or decoration. Screen wall mostly plays a role in decoration and blocking the line of sight, mostly with colorful brick carving patterns above showing auspicious meanings. The most famous screen wall is the Nine Dragon Wall in the Imperial Palace.

b) *Viewing wall*: The viewing wall was a wall used for dividing the inner chambers and outer house, and the constructing method is similar to that of the veranda. Since the viewing walls are mainly placed at the conspicuous position as both sides of the festoon gate and there are tile carving and some diagonal square bricks laid above the wall, as well as brick pillars and big square-columns, all of which are structural art out of brick materials.

c) *Core-corridor wall*: The corridor wall is also called the "core-corridor wall", which is the wall between the eaves and the golden pillars of the building. It is a wall that can be seen in the eave corridor, so it is a little special. Around the bottom circumference is mostly narrow brick, at the center is the core of the corridor, in the middle of the frame is brick masonry or tile carving for decoration. The surface bricks are mostly good quality black bricks. The bricks used in this wall are different and the surface shows sags and crests, so this wall basically serves adornment effect. The core-corridor wall of the Huajue Alley Mosque of Xi'an is an example.

**3) Outline**

a) *Ridge*: Roof ridge refers to the slope opposite the roof or the top between the opposite sides. Brick carvings on the roof ridge are concentrated. Since there are many kinds of roof ridge, the bricks used are different. For example, hollowed-out ridge is made of hollowed-out bricks. However, brick carving is a common decorative technique in both the North and the South. The overall style of the North may be a little heavier, while that of the south is lighter. On the two sides of the roof are mostly animal

models, showing the historical background and cultural characteristics of the time.

*b) Cornice:* The cornice is the junction between the outer wall and the roof. Since the roof is the ridge above the cornice, its brick carving may be not only for decoration, but also for load-bearing. The brick building art on eaves is not too conspicuous, usually simple and regular modelling. For example, the tile carving of the Anzhuang Ancient Pagoda in the north of Wu'an city is decorated with lotus cornice brick, which is highly distinctive.

*c) Breast board:* The column board in the ancient building mainly plays the role of enclosure, as a guardrail. The baluster is the column between the breast board, composed of two parts, the scape and the chapter. Its materials can be either wood or stone. Styling can be done on the chapter, and the common patterns are dragon design, flower pattern, wind pattern and gourd pattern, etc. Mostly these structures appear in the gardens of parks and the armrests of bridges of the past. In fact, its application in the vernacular architecture now is not necessarily limited to structure in the past at all, and it can just serve as decoration and space division.

## V. CONCLUSION

Brick building art aims to inherit and carry forward the unique charm of local cultural deposits. However, the trend of modern transformation of the contemporary construction system makes brick building art and even traditional vernacular architecture fade out of public view. Therefore, only by attracting more people to participation in local construction can the vernacular architecture be injected into new vitality. The Brick Award was established in 2004 to explore the sustainability of bricks. The establishment of this award attracts a large number of professionals to participate in every year, so that the application of bricks broke through the traditional recognition and let people constantly re-understand the value of bricks. Similarly, it is necessary to actively develop the exploration and application of brick building art in local areas, so that brick building art will not be buried and more attention will be paid to vernacular architecture so as to better carry forward the Chinese traditional culture.

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