

# Research on the Losing Process of the Traditional Gray Bricks and Tiles

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**Abstract.** Gray bricks and tiles are important materials of traditional buildings in China. However, the production process of bricks and tiles uses a large amount of clay resources from cultivated land, consumes a large amount of energy such as coal, and at the same time causes a great load to the environment. Therefore, the production process of traditional gray bricks and tiles is facing the risk of loss. This study investigates the traditional brick and tile manufacturers in Jiangsu and Zhejiang provinces and records the manufacturing techniques of traditional brick and tile blanks in detail, providing detailed records for the protection and repair of the architectural heritage.

## 1. Introduction

Bricks and tiles, as traditional building materials, have been used in architecture for a long time [1, 2]. With the development of industrialization and the shortage of clay resources, the research of traditional brick and tile making and processing technology is gradually reduced. As people raise their understanding of the protection of ancient buildings, more and more ancient buildings get people's attention and protection and repair. However, brick and tile materials are gradually buried in the tide of sustainable development and environmental protection [3, 4]. Adhering to the principle of keeping the original appearance for cultural heritage protection, we should pass down the traditional process of bricks and tiles [5]. Therefore, it is necessary to study the manufacture and application of bricks and tiles in Chinese traditional building construction technology, systematically sort out them with a record, and compare them with modern production technology to form the relevant standard standards for the quality inspection of traditional gray bricks and tiles. At the same time, it is of great significance to rescue traditional processes and protect cultural relics and historic sites.

## 2. Traditional and Modern Processes of Making Gray Brick and Tile Blanks

The process of making and firing gray bricks and tiles changes due to regional, cultural, folk-custom and other reasons, and it may be elaborated through visiting traditional artists in Suzhou and Jiashan, Zhejiang.

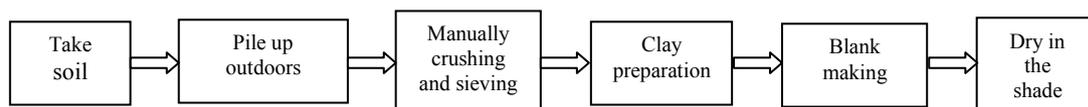


First of all, it's essential to select soil and mud, and good soil quality is the foundation to ensure the solid degree of various brick and tile components. To make bricks and tiles, you must choose loess, which has a greater viscosity and is not easy to break after being fired. There are also several types of loess, such as bean-like soil, clay, and white sand, among which only white sand is suitable for brick and tile production. Generally, the soil layer of 30cm on the surface of the ground shall be removed, because the first layer of the soil on the ground is exposed to the sun for a long period of time and is not sticky enough. The next layer of soil contains more rotten plants or roots and other debris, rich in organic materials and suitable for farming. The third layer contains a lot of minerals, so it's suitable for making bricks and tiles. Due to the quality of the soil, the ground can be excavated to 30 cm to 2 meters from the ground surface. The mud shall then be processed, letting the buffalo tread on the clay mud, which now is gradually changed to use mud mill, and use water pump instead of manual carrying water. The process of processing the mud is shown in Figure 1.



**Figure 1.** Pug process

The production of traditional brick blank is simple, i.e., filling the mold with mud, smashing, put it on the site, and open the mold, and then the brick blank is finished. Place it for 2 ~ 3 days, after the surface color of the brick blank becomes white, the brick blank can be raised up for drying, and after drying to 70-80%, it can be stored on the rack, to be burned. The manufacturing process of the traditional brick blank is shown in Figure 2.



**Figure 2.** Traditional Production Process of Unburned Brick

The manufacturing process of the tiles is complicated. Firstly, cover the tile on the turntable, and cut the mud evenly with the cutting bow, so that the length of the cut mud blank is the same as the length of the turntable. Place the clay blank on the tile barrel, press and beat with hands, and after the tile barrel and the clay blank are stuck together, the clay barrel and the wood block with the same height and width as the tile will adhere to the clay surface, rotate the turntable, and smooth the surface of the clay blank. Remove the tile from the turntable, place it on the levelled ground, withdraw the tile, and divide the formed clay blank into four pieces with a knife. In the division, only two-thirds of the mud blank needs to be cut, and after the mud blank is 90% dried, the mud blank can be pat open by hands and burned on the rack. The manufacturing process of the tile is shown in Figure 3.



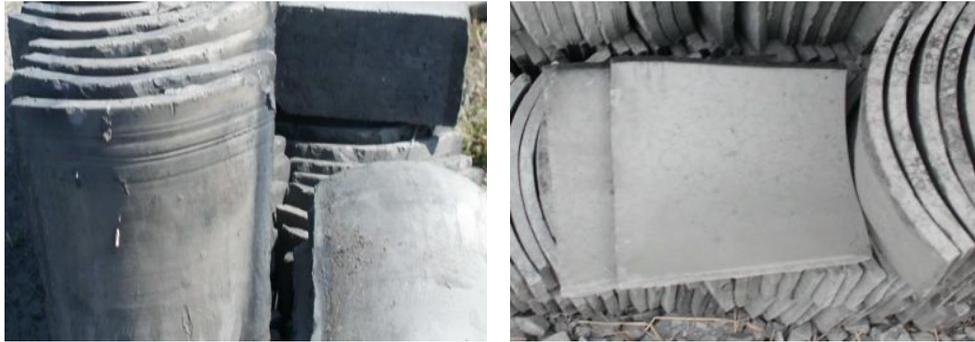
**Figure 3.** Traditional Production Process of Unburned Tile

Due to the long cycle and low efficiency of the traditional manual process, and the extremely difficult working environment of the workers, the manual process has been gradually replaced by high-efficiency mechanical suppression. In the manufacturing process of modern tile blank, clay is put into a mold and directly pressed into tile blank. In the manufacturing process of modern brick blank, clay is put into the machine for simple mixing then sent by conveyor to the right end and directly cut into brick blank, mainly used for the production of small-volume brick. Or, the prepared brick powder is pressed to the brick blank by 1,000 tons of hydraulic pressure, mainly used for making square brick blank. The manufacturing process of modern gray tile and brick blank is shown in Figure 4.



**Figure 4.** Modern Production Process of Unburned Tile and Brick

In improving efficiency, the mechanization of manufacturing process of modern gray tile and brick blank has simplified many manufacturing techniques, such as clay preparation, so that the durability, strength and other properties of gray tiles produced now are lower than those of gray tiles produced by traditional process. Compared with the gray tiles made by hands, the surface of the tiles made by machine is more smooth and level. Gray bricks made by machine after firing will often appear the larger thread in the large surface, which is due to the spiral stirring of raw materials. The products produced by the modern manufacturing process are shown in Figure 5.



**Figure 5.** Grey Tile Using Modern Technology

### 3. Conclusions

This study investigates the brick and tile processing plants in Jiangsu and Zhejiang provinces, and records and collates the manufacturing process of modern antique gray bricks and tiles. The production of brick blank and tile blank goes through such processes as making borrow soil, piling up in the open air, crushing and sifting, preparing clay, making blank and drying in the shade. Modern manufacturing processes have changed with the change of productivity, mainly in the use of machinery to replace the original manual process. Although the mechanical construction has improved the production efficiency, but has changed the traditional manufacturing process, and because of the simplification of the process, the strength and durability of the antique gray bricks and tiles made by modern process have been reduced.

### 4. Acknowledgements

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