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The Fundamentals of Brick Manufacturing

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PREFACE

The fundamentals of brick manufacturing have not changed over time. However, technological advancements have made contemporary brick plants substantially more efficient and have improved the overall quality of the products. A more complete knowledge of raw materials and their properties, better control of firing, improved kiln designs and more advanced mechanization have all contributed to advancing the brick industry. Other Technical Notes in this series address the classification and selection of brick considering the use, exposure and required durability of the finished brickwork.

Brick is made of clay or shale formed, dried and fired into a durable ceramic product. There are three ways to form the shape and size of a brick: extruded (stiff mud), molded (soft mud) and dry-pressed. The majority of brick are made by the extrusion method. Brick achieves its color through the minerals in the fired clay or through coatings that are applied before or after the firing process. This provides a durable color that never fades or diminishes.

Brick shrink during the manufacturing process as vitrification occurs. Brick will vary in size due to the manufacturing process. The method used to form a brick has a major impact on its texture. Sand-finished surfaces are typical with molded brick. A variety of textures can be achieved with extruded brick. Brick manufacturers address sustainability by locating manufacturing facilities near clay sources to reduce transportation, by recycling of process waste, by reclaiming land where mining has occurred, and by taking measures to reduce plant emissions.

Clay is one of the most abundant natural mineral materials on earth. For brick manufacturing, clay must possess some specific properties and characteristics. Such clays must have plasticity, which permits them to be shaped or molded when mixed with water; they must have sufficient wet and air-dried strength to maintain their shape after forming. Also, when subjected to appropriate temperatures, the clay particles must fuse together. Types of Clays occur in three principal forms, all of which have similar chemical compositions but different physical characteristics. **Surface Clays:** may be the up thrusts of older deposits or of more recent sedimentary formations. As the name implies, they are found near the surface of the earth. **Shales Clay:** shale's clay is clays that have been subjected to high pressures until they have nearly hardened into slate. **Fire Clays:** are usually mined at deeper levels than other clays and have refractory qualities. Surface and fire clays have a different physical structure from shale's but are similar in chemical composition. All three types of clay are composed of silica and alumina with varying amounts of metallic oxides. Metallic oxides act as fluxes promoting fusion of the particles at lower temperatures.

Metallic oxides (particularly those of iron, magnesium and calcium) influence the color of the fired brick. The manufacturer minimizes variations in chemical composition and physical properties by mixing clays from different sources and different locations in the pit. Chemical composition varies within the pit, and the differences are compensated for by varying manufacturing processes. As a result, brick from the same manufacturer will have slightly different properties in subsequent production runs. Further, brick from different manufacturers that have the same appearance may differ in other properties.

There are four different operations are involved in the process of manufacturing of bricks such as, Preparation of clay, Molding, Drying, and Burning. **Preparation of clay** for bricks manufacturing is done in six steps: Unsoiling of clay we need pure clay for the preparation of bricks. The top layer of soil may contain impurities, so the clay in top layer of soil about 200mm depth is thrown away. This is called unsoiling. Digging after the removal of top layer, the clay is dug out from the ground and spread on the plain ground. Cleaning in this stage, the clay is cleaned of stones; vegetable matter etc. if large quantity of particulate matter is present, and then the clay is washed and screened. The lumps of clay are converted into powder with earth crushing rollers. Weathering the cleaned clay is exposed to atmosphere for softening. The period of weathering may be 3 to 4 weeks or a full rainy season. Generally, the clay is dug out just before the rainy season for larger projects. Blending if we want to add any ingredient to the clay, it is to be added in this stage by making the clay loose and spread the ingredient over it. Then take small portion of clay into the hands and tuning it up and down in vertical direction. This process is called blending of clay. Tempering in this stage, water is added to clay and pressed or mixed. The pressing will be done by cattle or with feet of men for small scale projects; pug mill is used as grinder for large scale projects. So, the clay obtains the plastic nature and now it is suitable for molding**.** In the **molding** process, prepared clay is mold into brick shape (generally rectangular). This process can be done in two ways according to scale of project. Such as, Hand molding (for small scale) and Machine molding (for large scale). If manufacturing of bricks is on a small scale and manpower is also cheap then we can go for hand molding. The molds are in rectangular shape made of wood or steel which are opened at the top and bottom. The longer sides of molds are projected out of the box to serve it as handles. If we take durability in consideration steel molds are better than wooden molds. In hand molding again there are two types and they are Ground molded bricks, Table-molded bricks and Machine molding of bricks. The bricks required are in large quantity, and then machine molding is economical and also saves more time. Here also we are having two types of machines such as, Plastic clay machines, and Dry clay machines. Plastic clay machines: contains an opening in rectangular shape and when we place the tempered clay in to this machine it will come out through this opening. Now, the rectangular strips coming out the opening are cut by wires to get required thickness of brick. So, these are also called wire cut bricks. Now these raw bricks are ready for the drying process. Dry clay machines: Dry clay machines are more time saving machines. We can put the blended clay into these machines directly without tempering. Means tempering is also done in this machine by adding some water. When the required stiffness is obtained the clay is placed in mold and pressed hard and well-shaped bricks are delivered. These are called pressed bricks and these do not require drying they may directly send to burning process. After molding process the bricks contain some amount of moisture in it. So, drying is to be done otherwise they may cracked while burning. **The drying** of raw bricks is done by natural process. The bricks are laid in stacks. A stack consists 8 to 10 stairs. The bricks in these stacks should be arranged in such a way that circulation of air in between the bricks is free. The period of drying may be 3 to 10 days. It also depends upon the weather conditions. The drying yards are also prepared on higher level than the normal ground for the prevention of bricks from rain water. In Some situations artificial drying is adopted under special dryers or hot gases. In the process of **burning**, the dried bricks are burned either in clamps (small scale) or kilns (large scale) up to certain degree temperature. In this stage, the bricks will gain hardness

and strength so it is important stage in manufacturing of bricks. The temperature required for burning is about 1100oC. If they burnt beyond this limit they will be brittle and easy to break. If they burnt under this limit, they will not gain full strength and there is a chance to absorb moisture from the atmosphere. Hence burning should be done properly to meet the requirements of good brick.

However, the editor thanks all chapter authors for their patients and dedicated work on this edition. Finally, the editor gratefully acknowledges the tireless efforts of this edition's technical editors and reviewer's, whose oversight and coordination expedited the development process and improved every chapters.

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Book Description

The fundamental of brick manufacturing remains a complementary book to brick manufacturing designers and brick field owners, environmental scientists and practioners, and students. The book covers its traditional area within the vast subject of brick manufacturing theories, types, practices and technologies with updating and expansion in all areas. All chapters have been written especially in this edition by recognized experts in the subject areas. The book continues its tradition of providing authoritative, up-to-date information for evaluating and ensuring quality bricks production.