

CLAY FLOORING AND TERRACING TILES FROM ALLUVIAL RED AND BLACK SOILS

Introduction

Clay flooring and terracing tiles are one of the cheapest building materials commonly used in many States of India. Flooring tiles (Fig. 1) are used in rural and low income urban housing, light duty floors in factories, schools, health buildings etc.,. These tiles are also used for terracing and waterproofing reinforced brickwork or kuchcha roof, laid over mud phuska or lime concrete substrata (Fig. 2).

Tiles conventionally manufactured in northern India from alluvial soils suffer from common defects such as high water absorption, poor impact and abrasion resistance, while those manufactured from plastic black and red soils in southern states are porous and possess poor flexural strength. These defects arise out of improper selection of raw materials, silty nature of clays possessing poor workability, non-development of dense structure at the normal temperature of firing and adoption of improper moulding, drying and burning techniques.

The Central Building Research Institute has developed a process (Fig. 3) for the manufacture of tiles of standard quality from alluvial, red and black soils, which is briefly described in this note.

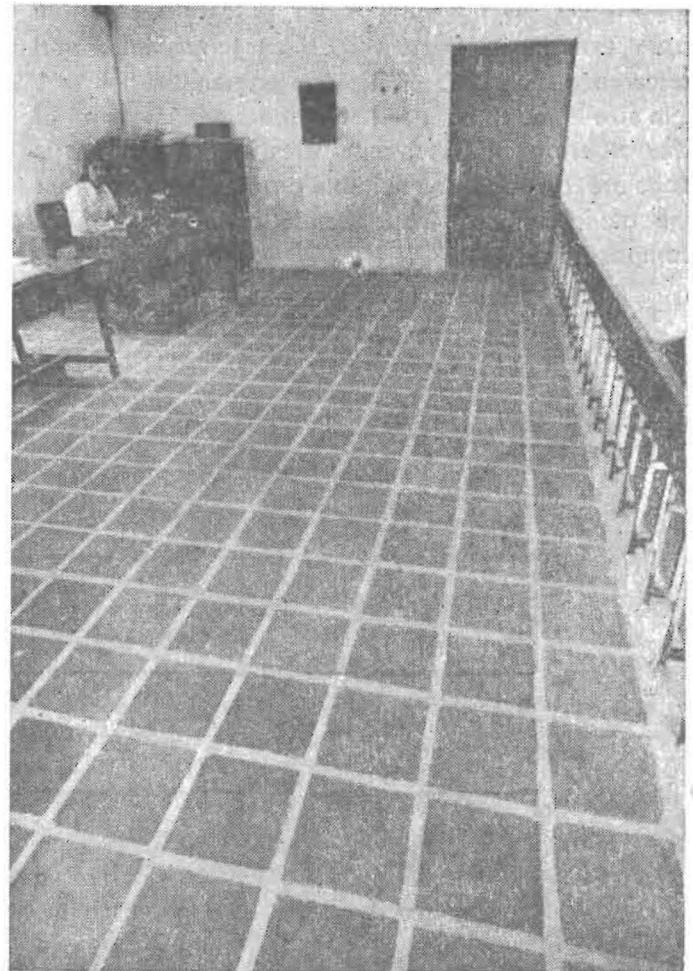


Fig. 1 Clay Tile Floor

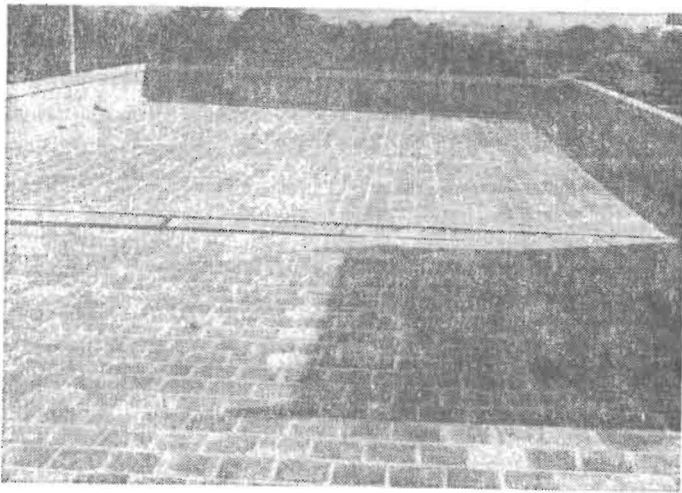


Fig. 2 Clay Tile Terrace

Soil characteristics

Moderately plastic soils, loamy in texture and free from extraneous matters such as ferruginous and calcareous nodules, or siliceous aggregates below 1 mm size should be used for the manufacture of clay flooring and terracing tiles. Lean and plastic soils are blended in suitable proportions so that the blended mass has the following mechanical composition :

A—Flooring Tiles

Clay	25 - 35 per cent
Total Fines	60 - 75 per cent
Plasticity Index	More than 20

B — Terracing Tiles

Clay	20 - 25 per cent
Total Fines	50 - 60 per cent
Plasticity Index	more than 18

Soil Preparation

The mixture of lean and plastic soils is left exposed for weathering by alternate wetting and drying for a period varying from one to two months. The weathered clay mass is kneaded manually or pugged mechanically either in a pug mill or thoroughly mixed in a double shaft mixer and passed through differential speed rolls. The pugged mass is left for ageing for a period of 6 to 8 days in a shed for homogenisation of moisture in the plastic clay mass. The pugged mass is tempered and repugged if necessary to ensure uniform distribution of moisture.

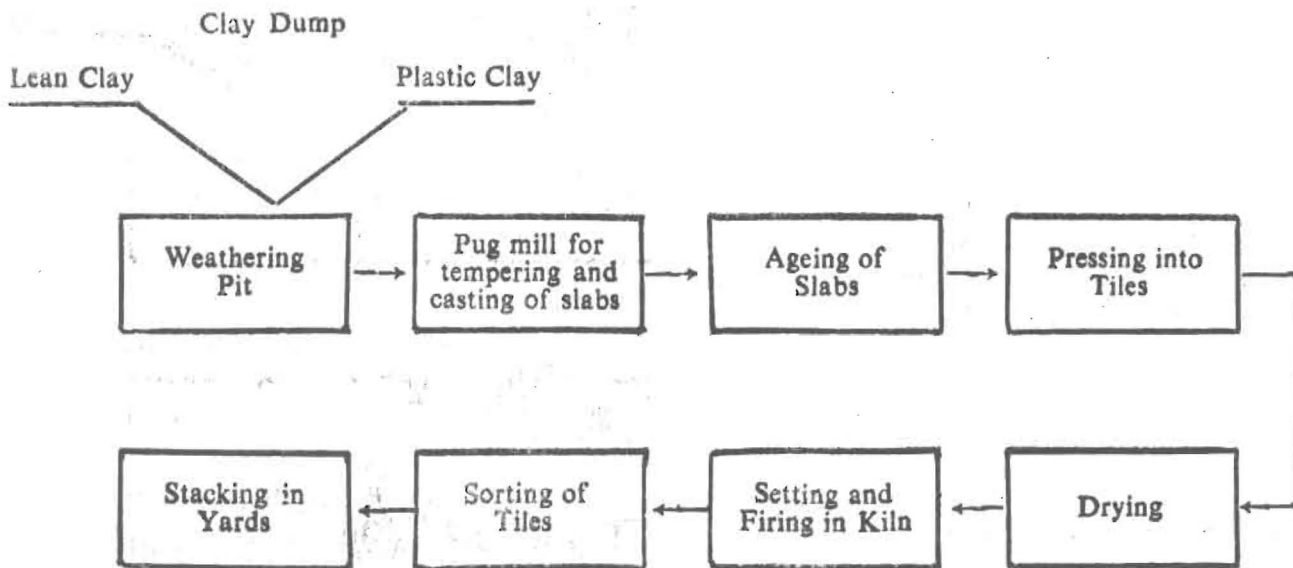


Fig. 3

Shaping of Tiles

Slabs of suitable size are either hand-moulded or mechanically extruded from the processed clay, containing moulding moisture at least 5 per cent above plastic limit of the soil. The slabs are properly lubricated with 5-10 per cent Neem Oil in Kerosene for easy demoulding and reducing the problem of sticking of the tile with the die. The slabs are pressed into flooring or terracing tiles either in hand-operated or power-operated tile press. The pressed tiles are released from the die and received on wooden pellets, trimmed to proper size and set on racks for drying.

Drying of Tiles

The pellets carrying the tiles are placed on wooden racks, and tiles are slowly dried. The racks may be placed in a shed with low pitched thatch roof or in a room in which ventilation may be controlled. The side walls of the drying shed should have suitable opening for controlling air flow. Direct blast of air on the freshly set tiles should be avoided particularly during summer months. During extreme weather conditions in summers, high humidity and lower temperatures in the drying chamber can be maintained by sprinkling water on the floors and covering the racks with wet gunny bags. The drying time of these tiles vary from 5 to 10 days depending on weather conditions.

Firing of Tiles

The tiles are fired in a downdraft kiln using coal or firewood as fuel. Tiles should be fired in the temperature range of 850° – 950°C maintaining a controlled firing and cooling rate not exceeding 30° – 50°C/hr. The tiles are set upto shoulder height of the kiln at a setting density of 360–390 tiles of size 250 × 250 × 25 mm per cubic metre. The setting pattern is shown in Fig. 4.

Flooring / terracing tiles are also fired in continuous type of Hoffman kiln using coal or firewood as fuel at comparatively much lower energy inputs. The rate of heating and cooling, firing temperature

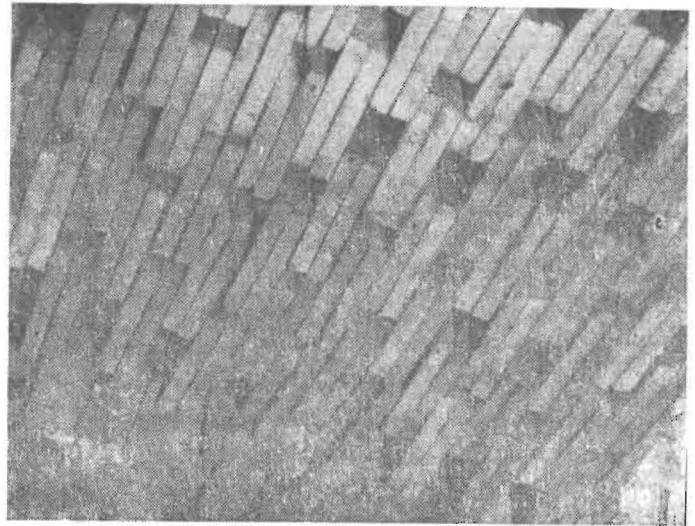


Fig. 4 Setting Pattern of Tiles in Downdraft Kiln

for firing these tiles in Hoffman kiln, however, remains the same as indicated above.

Attempts have also been made to fire these tiles with common building bricks in Bull's trench kiln. In this kiln the tiles are carefully loaded over brick columns at a height of 10 brick course. Loading of tiles in central portion of trench is however, avoided. No setting of tiles is done on columns just close to the side walls of the kiln. On each column, 10 tiles are set vertically in each course. The tile setting is finally covered with three brick layers and ash in a conventional way.

Field Manufacture

Full scale production trials have been undertaken in coal or wood fired down draft kiln at KVIC units in Meerut, Saharanpur and Shahjahanpur in U.P., Wardha and Bhadravati in Maharashtra and Raipur, Durg in Madhya Pradesh. The process for the manufacture of clay tiles have been largely adopted by a number of small and medium scale units in the country. The burnt tiles possess uniform texture, colour, metallic ring and good finish. Experimental and commercially produced tiles were tested as per B.I.S. Specification 1778 : 1976; B.I.S. 2690 : 1975 and the test results are given in tables 1 and 2.

Table 1 - Properties of Burnt Clay Flooring Tiles

Properties	Manufactured Tiles, Quality	B.I.S. Requirements for Flooring Tiles (B.I.S. 1478-1976)		
		1st Class	2nd Class	3rd Class
Flexural Strength kg/cm width,	7-20	6.0	3.5	2.5
Water Absorption (%)	8-16	10	19	24
Impact Test (ht. in cm at failure)	75-150	75	65	50
Abrasion Resistance Test (Loss in thickness mm)*	1.5-2.5	—	—	—

*Abrasion Resistance was determined as per B.I.S. 1237-1959 for Cement Concrete Flooring Tiles.

Table 2 — Properties of Burnt Clay Terracing Tiles

Properties	Manufactured Tile	B.I.S. Requirement B.I.S. 2690 : 1975
Flexural Strength Kg/cm ²	45-90	15
Water Absorption per cent	7-15	15

The first quality tiles are found to be abrasion resistant when tested as per specification laid down in BIS 1237 : 1959 for cement concrete flooring tiles.

In a properly designed down-draft kiln, the coal consumption for burning these tiles is expected to be 50 ± 5 tons per lakh of tiles of size $250 \times 250 \times 25$ mm.

Cost

The cost of production of clay flooring tiles from alluvial soils is estimated to be Rs. 800-1000 per thousand. The selling price is Rs. 1200-1500 per thousand numbers for 1st quality tiles in various regions of the country.

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