CENTRAL BUILDING RESEARCH INSTITUTE, ROORKEE-247667 (INDIA)

BUILDING RESEARCH NOTE

B.R.N. 66

MANGALORE PATTERN CLAY ROOFING TILES FROM ALLUVIAL, RED & BLACK SOILS

Introduction

Mangalore pattern clay roofing tiles were first developed in Mangalore (Karnataka) in 1865 by German Missionaries. These tiles are interlocking type and are most popular in the coastal States. Nibs and lugs are provided to rest the tiles on battens. (Fig. 1).

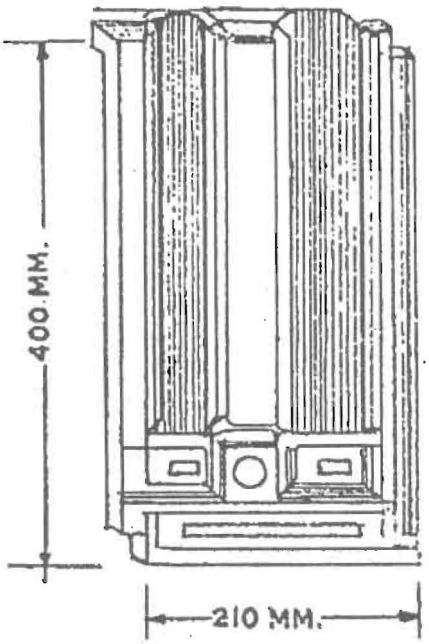

Fig. 1 Mangalore tile

Difficulties in producing Mangalore pattern tiles from alluvial soils arise during moulding and firing. These are, poor workability of alluvial soils due to their silty nature, and non-development of adequate strength and dense structure at normal temperature of firing. The tiles manufactured in southern states from red and black soils show heavy drying losses, warped surface, high porosity, low flexural strength and crooked alignment when laid on roof. This Institute has developed a process for the manufacture of these tiles from alluvial, red and black soils, which is briefly described in this note.

Soil Characteristics

Plastic, alluvial, red and black soils containing illitic or kaolinitic and low proportions of expanding group of clay minerals; free from nodular lime or aggregates above 1 mm should be used for the manufacture of Mangalore pattern roofing tiles. The lean and plastic alluvial soils are mixed in suitable proportions so that the admixture contains the following mechanical composition:

	Alluvial soils	Black/Red soils
Clay, % :	28 to 35	20-25
Total fines, % :	65 to 75	75-80
Plasticity Index :	> 20	> 20

Soil Preparation

The soil admixture is left exposed for weathering by alternate wetting and drying for periods varying from two to four months. The weathered soil is pugged mechanically in a pug mill and left for ageing for a further period of one week under shade. The pugged mass is tempered and

repugged to ensure that the moisture in the mass is four to five per cent above the plastic limit. In case of red and black soils addition of non-plastic soils or opening material as flyash, grog, basalt dust, rice husk ash, etc. upto 20 percent (w/w), may be considered to control the drying losses.

Moulding

Processed soil is used to cast clay slabs of size 35 × 18 × 2.7 cm either manually or through an extrusion machine. The slabs are properly lubricated manually with 10 to 15 per cent rice barn oil or neem oil diluted in kerosene oil, to help in easy demoulding and reducing the problem of sticking. The slabs are pressed into tiles by either power operated or hand operated screw press. Fig. 2. Demoulded tiles are trimmed to proper size and removed on wooden pallets for drying.

Fig. 2 Pressing of tiles

Drying of Tiles

The tiles resting on pallets are slowly dried over wooden racks under shade in a closed room or under low-pitch thatched roof Fig. 3. Direct blast of air should be avoided particularly during summer. The tiles take about seven days to dry, during summer and about fifteen days during winter.

Drying losses can be reduced by covering the racks with wet gunny bags particularly during summer when such losses are high. High humidity inside the shed may be maintained by filling the floor with sand and occassional sprinkling of water over it.

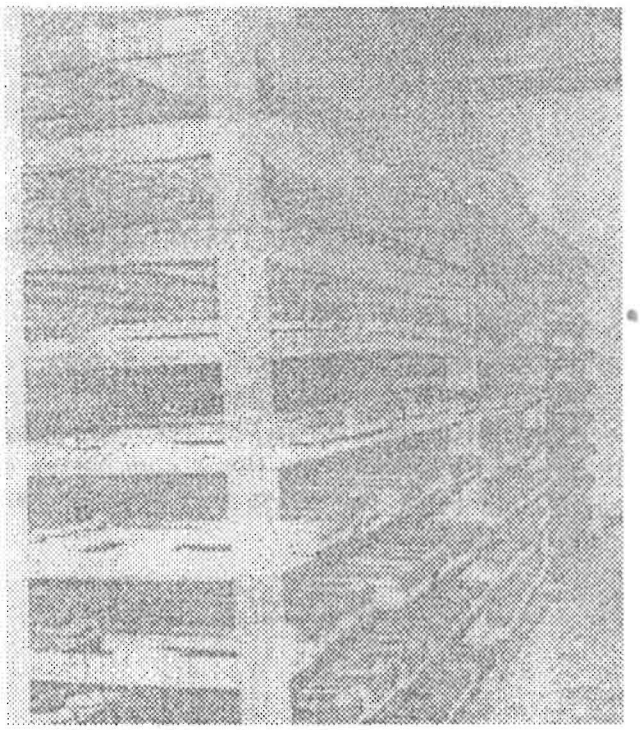

Fig. 3 Drying of tiles

Firing of Tiles

The tiles are fired in a down-draft kiln using fire wood or coal as fuel. They should be fired at controlled firing and cooling rate of 20° to 50°C/hr and at a temperature ranging between 820°C and 920°C depending on the nature of clay used. They are then set upto shoulder height of the kiln at a setting density of 178 tiles (of size 320 × 210 mm) per cubic meter. The setting pattern is shown in Fig. 4 (A & B). It is advantageous to maintain the maturing temperature for a period of three of fivehours before the firing is completely stopped.

Field Manufacture

Several lakhs of Mangalore pattern clay roofing tiles have been manufactured by the CBRI

process in fire wood or coal fired commercial downdraft kilns in various regions of the country. The burnt tiles possess uniform texture and colour, metallic, sound and good finish. They have been tested according to I.S. 654 : 1992 for Mangalore pattern clay roofing tiles. The results are given in table 1.

The tiles do not show any perceptible efflorescence and pass permeability test when tested according to I.S. 654 : 1992.

In a properly designed downdraft kiln, coal consumption for burning these tiles is expected to be 35-40 tons per lakh of tiles.

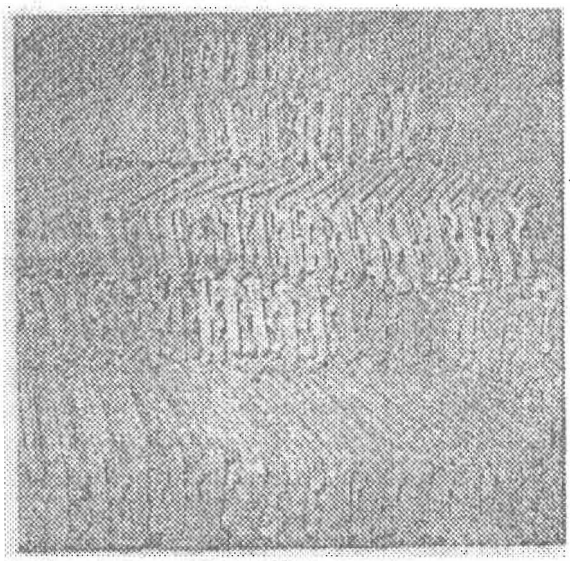

Fig. 4 (A) View of the setting in downdraft kiln

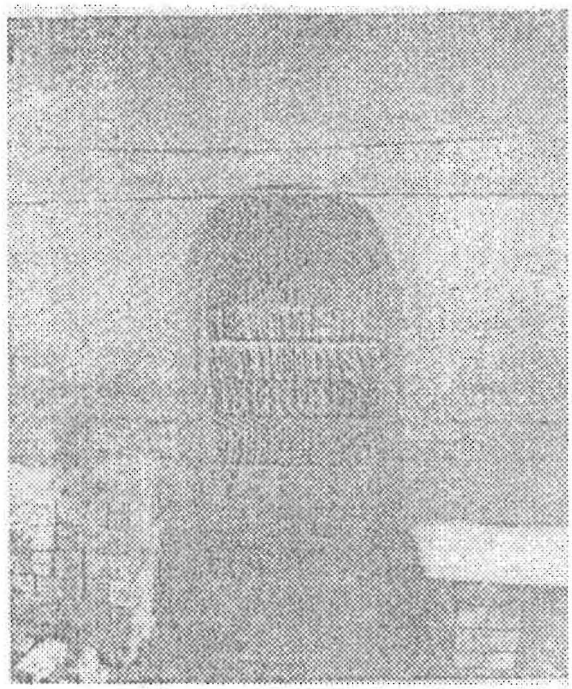

Fig. 4 (B) Setting of tiles in downdraft kiln

TABLE 1

Quality	Manufactured Tiles		I.S. Specifications : 654 : 1992		
	Breaking load Kg.	Water Absorption %	Min. Breaking Load Kg.		Max. Water Absorption %
			Agerage	Individual	
AA Class	110-190	12-16	102	91	19
A Class	90-110	14-18	82	82	24

Prepared by : J.M. Bhatnagar & R.K. Goel
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