A Low Cost Device for Production of Country Roofing Tiles

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Country roofing tiles, are extensively used in the villages as roofing material. The conventional production technique used for producing tiles is through potter wheel or by manual moulding technique. These processes yield non-uniform, uncompacted, dimensionally unstable and poor quality products. The tiles generally depict considerable damage or breakage during transportation or fixing in a roof. In view of this, a low cost moulding device for production of compact country roofing tiles was designed and fabricated in Central Building Research Institute (CBRI), Roorkee. Extensive trials have proven its amenability to commercialization for production rate of 500-600 tiles/day by a semi-skilled worker. The details of the low cost device for production of country roofing tiles have been delineated. Use of this device will certainly generate employment in the rural areas of India and other developing countries.

Introduction

Production of country roofing tiles has long been considered an art within the domain of artisans' skill, primarily due to the intricate shapes and forms of products. Advances in industrialization and agricultural technologies have generated new avenues of employment on account of which artisans are being attracted towards higher wages and simultaneously small scale manufacturers of country roofing tiles are facing the problem of acute scarcity of skilled potters and moulders1. Large scale units use automatic and costly machines to produce about 1,000-2,000 clay tiles/h. Small manufacturers cannot afford such expensive machines. However the manual process involving semi-skilled moulders yield poor quality, dimensionally unstable and uncompacted products2. Further there is a necessity to produce low cost quality country roofing tiles. In view of this a project for development of a low cost moulding device was undertaken in the laboratory to cope up with the demand for the production of compact and uniform size country roofing tiles, comprising two units, i.e., “Nalia” and “Khapra”. The device developed is simple in nature and can be operated even by a semi-skilled worker to produce quality country roofing tiles of desired size and shape, simply by changing the mould assembly fitted on the rigid wooden base or table3.

Salient Design Features

The device (Figure 1) essentially consists of a wooden or steel table (4) to which metallic moulding box (2) having projection of 5 mm above the table top is fixed with nuts and bolts. The moulding box is endowed with a loosely fitted movable rectangular shaped plunger (9) at its bottom. The bottom plunger comprises four bolts 10 mm in diam, one at each corner, on which rests a flat bottomed mould (3), (Nalia or Khapra), as per requirement. The mould is made identical in shape and geometry to that of the required tile. The inner size of the mould is predetermined taking cognizance of allowances for drying and firing characteristics of the clay to be processed. The mould is fabricated to facilitate easy sliding of the plunger along the inner surface of the moulding box. The bottom plunger consists of a vertical ejector shaft (7) which can be actuated by the foot operated lever (10) with central pivot mechanism. An effort is applied at free-2 end of the lever to exert pressure. Second lever mechanism is deployed for pressing the product whose one end is hinged, whereas at the other end pressure is applied. Load acts at the middle (4) of the lever, having an identically opposite profile to that of the bottom mould. A thin metallic lining is provided in the lower and upper pressing plungers to avoid wearing and sticking of moist clay mass during shaping of country roofing tiles. The top plunger, while pressing, leaves a gap of desired thickness inbetween the moulding box and the pressing plunger for maintaining a uni-
form thickness of the product. The special features of this moulding table which distinguish it from some of the conventional presses are: (i) Top pressing, and (ii) foot operated ejection system.

Operational Technique

Initially, plastic clay is wetted with water and kept for about 24-48 h for homogenization and uniform distribution of moisture within the clay mass. It is then kneaded properly, either manually or through small capacity pug mill, before being charged into the mould in the form of clay bats. The bats are moulded manually into rectangular shape of requisite thickness and overall volume. These are slightly larger than that of the actual table mould size. Moulding of the clay bats is separately done well in advance on the level ground or table itself, over which fine sand is sprinkled so as to avoid sticking with each other.

The clay bat is rested on the mould and the top plunger is operated for pressing the clay by a handle provided at the end of pressing lever (4). For accurate pressing, one semi-circular shaped projected wooden piece is nailed to the top plunger and an identical shaped grooved wooden piece is fixed to the plunger just below the upper projection. After pressing the top plunger is

wire bow handle (11) for removal from the mould. For ejection the foot operated pedal is pressed downward which pushes the mould up to its top level. The operator picks up the mould along with the pressed tile (Nalia/Khapus) and turns on a wooden pallet for its removal. The pedal is then released which brings the bottom plunger down which rests on four corner supports of the moulding box. After releasing the prepared tile the wooden mould is withdrawn and returned to the mould box. This makes the mould ready for subsequent operations. The lining of the mould may require application of waste oil after the shaping of 4-5 tiles to avoid sticking of clay with the top plunger and the mould. Alternatively, fine sand or fine sandy clay, screened coal ash/flyash passing 100 mesh screen could also be used as dusting material to facilitate easy demoulding of tiles from the mould box assembly. The produced tiles are shifted to plain ground surface or on floor for drying in an enclosed shed.

Commercial Production

Extensive trials were conducted in the Institute for production of country roofing tiles by this low cost moulding device and it was observed that about 500-600 tiles could be produced per day when a semi-skilled worker is trained for 3-4 days. For commercial production of Nalia/khapsa, one skilled worker/moulder and two companion labourers are required. The quality of the product obtained is superior to the one made by the moulder, either in a mould or on potter’s wheel. The tiles prepared are not disturbed till sufficient handling strength has been obtained. The top compaction renders higher strength to the tile which is found to be more dimensionally stable than the conventional roofing tiles. Therefore, probability of damage during handling and warping in firing is substantially reduced.

Concluding Remarks

Produced tiles when fired at 900 ± 20°C, show performance load strength as 40-60 kg with water absorption of 15-20 per cent. The detailed design drawings of the pressing and ejection system of low cost production device are available in the Institute. The estimated cost of the table fitted with the mould, pressing arrangements, and accessories is projected at Rs 5,000/- approx. This low cost technology for production of country roofing tiles is ready for commercial exploitation on commercial scale, holding potential for employment generation.
References


