BUILDING DIGEST

CENTRAL BUILDING RESEARCH INSTITUTE INDIA

PRECAST CELLULAR UNITS FOR FLOORS & ROOFS

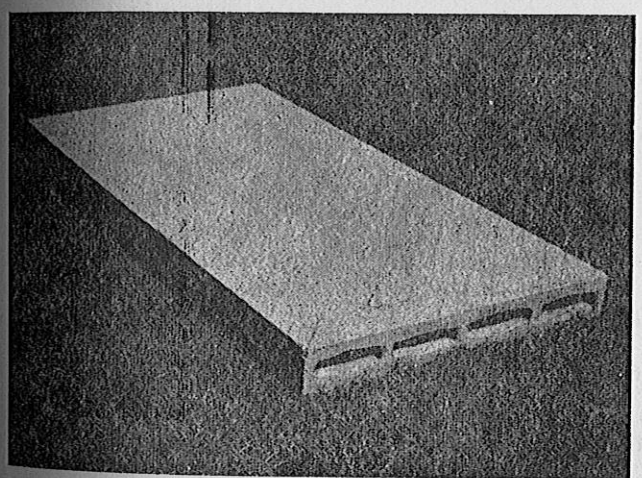
Introduction

Certain forms of low cost roofs were described in Building Digest No. 5 "Inexpensive Roofs for Small Houses" and in Building Digest No. 43 "Doubly Curved Tile Roof." The present digest deals with a new form of flat precast hollow rectangular concrete unit which can be used for floors and roofs. It saves in scarce materials like steel and cement and results in an overall economy in time of construction and cost as compared to conventional reinforced concrete roof slab.

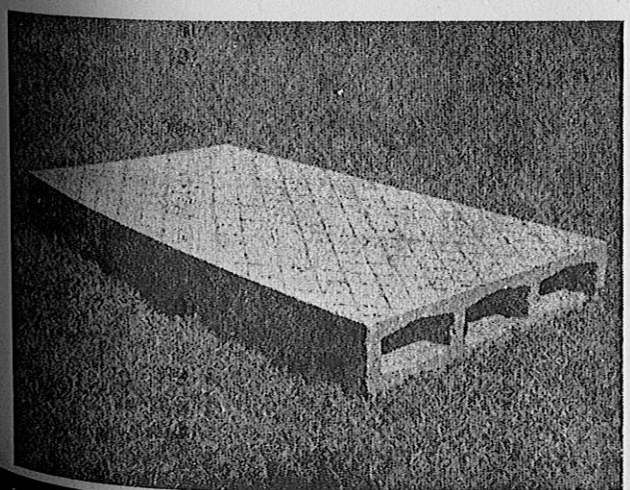
The floor/roof system consists of precast hollow concrete units which are placed on fully or partly precast beams. The units are covered with deck concrete when the supporting beams are partly precast. Desired floor finishes can be laid for floors while a water-proofing layer is provided for roofs.

The Unit

Figs. 1 (a) and 1 (b) show the cellular units with



Fg. 1 (a) Concrete Cellular Unit with four hollows



four and three hollows. The recommended size of the unit is 1 m x 0.5 m x 100 m m and it weighs 55 kg. These dimensions can also be varied depending upon the requirements. The minimum wall thickness of concrete at any place is 15 mm.

Casting

The units are cast with the help of a simple rectangular framework of timber (Fig. 2). Hexagonal

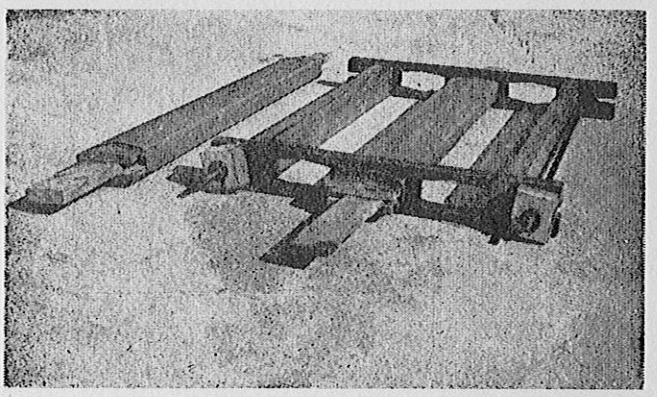


Fig. 2 Framework of unit and formwork for cells.

slots are provided at the two ends to permit insertion of the forms for creating the hollows. The latter consists of two wooden planks separated by wedges and covered with a rubber sleeve. The sleeve is formed by glueing an ordinary fabric reinforced rubber sheet commercially available. The overall size of the sleeve is kept such that it remains tight when the wedges are in position. One of the assembled forms for the hollows can be seen placed along side the main frame in Fig. 2. Other operations are as follows :—

(1) Assemble outer framework on a plain G. I. sheet or rubber sheath placed on a level platform. Fill Cement Concrete, 1 : 2 : 4 nominal mix, with coarse aggregate of 10 mm and down upto the bottom level of the cells and vibrate with a pan vibrator.

(2) Insert forms for the hollows with rubber sleeve wrapped round these.

(3) Fill concrete slightly higher than the top of the main frame work and vibrate with the pan vibrator.

(4) Remove surplus concrete and finish top surface rough to provide key to the concrete screed.

(5) After about half an hour, depending upon the weather conditions, remove wedges from the forms and pull out the forms themselves carefully and then rubber sleeves.

(7) Leave the unit undisturbed for 24 hours after which stack it vertically against some support on Sand for curing for 14 days.

Supporting Beams

Typical structural schemes incorporating the cellular units are illustrated in Figs. 3 (a) and 3 (b).

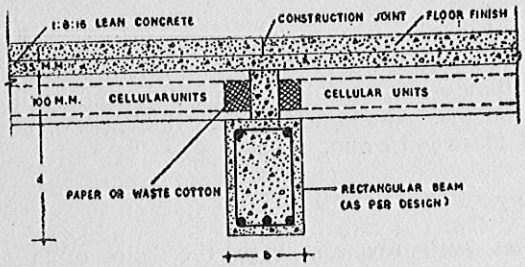


Fig. 3 (a) Cellular Units Roof/Floor with Rectangular Beam

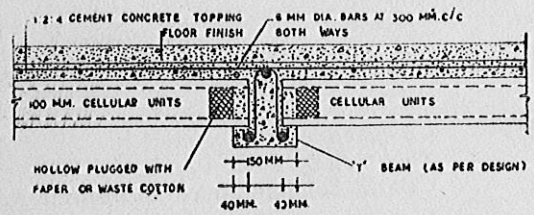


Fig. 3 (b) Cellular Units Roof/Floor with 'T' Beam

The supporting beams are designed according to the conventional design principles taking the dead and live loads into account. They may be designed as rectangular beams or composite tee beams. It is desirable to precast them unless a flush soffit is desired when the beams are cast-in-situ. Use of precast tee beams require temporary propping of about a week till the in-situ part of the deck concrete has gained sufficient strength. It also entails provision of distribution steel reinforcement and structural concrete of a thickness of 35 mm over the precast units. The use of rectangular beams dispenses with propping during erection as also with the distribution steel and top structural concrete but it results in deeper projections of beams inside. A layer of 35 mm thick cement concrete 1 : 8 : 16 is however necessary to improve the impact resistance of floors and roofs.

For spans longer than 4 meters, provision of main beams in addition to the supporting beams is necessary. Main beams being heavier, it is preferable to cast them in-situ. They may also be designed as rectangular or tee beams. When designed as tee beams, the precast roofing units are laid short of the distance equal to the flange width of the main tee beam on either side.

Tests

Tests carried out on 4'×2'×3" (1.2 m×0.6 m× taking a static load of 450 lbs./ ft² (2200 kg/m²) at failure and an impact load of 60 lbs (27 kg) dropped from a height of 5 ft (1.5 m).

Tests were also carried out on prototype floors of 8 ft. (2.4 m) span. The floors consisted of three supporting beams with the 1.2 meter units spanning between them. It was observed that the two assemblies, one with rectangular supporting beams and the other with tee beams failed at a load of about 400 lb/ft² (1950 kg/m²). The failure in both cases occured in the beams and not in the cellular units. This indicates that the cellular units have adequate reserve strength beyond that of beams. In the impact load test, no signs of distress were observed even when a load of 90 lbs. (40.8 kg) was dropped from a height of 12 ft. (3.65 m).

Economics

The consumption of cement and steel as well as the cost for the conventional R. C. floor and the proposed roof schemes are given in Table 1 for a typical span of 3.5 m.

Table—1

Item	R.C. slab	Cellular Units roof with Rect. beam.	Cellular units roof with 'T' beam
Cement (kg/m²)	33.40	23.35	26.66
Steel (kg/m²)	11.42	2.73	5.27
Cost (Rs·/m²)	29.17	15.61	18.73

It is seen from Table 1 that savings in cement, steel and cost are 32%, 76% and 42% respectively when rectangular beams are used for supporting the units. When tee beam type construction is adopted the corresponding savings are 22%, 54% and 35%.

Precautions

Construction of this type of roof has shown that the following precautions are necessary :—

(a) Adequate Supervision on the casting of Units to ensure proper compaction of concrete.

(b) Avoid imposing heavy loads, much beyond the design load on units during the stage of construction.

(c) The minimum bearing of the units over the supporting beams should be 40 mm.

(d) The web concrete should be properly compacted.

(e) Because of the thinness of concrete in the walls of the unit, it is undesirable to make any holes or provide any fixtures. Normally fan hooks should be provided in beams. If it is desired to have concealed wiring, the conduits may be run through the hollows. The draw-off-points should be predetermined and provided during

(f) When rectangular beams are adopted the construction joints in the floor finish are to be arranged to coincide with the centre line of the supporting beams.

Concluding remarks

The individual unit as well as the roof assembly are structurally strong for use in normal buildings. The form-work for casting of units is simple and the casting method is manual except that a pan vibrator is required for compaction of the concrete. The main advantages consist of savings in the consumption of scarce materials, cost and considerably reducing the time-consuming expensive form work on site. This type of roof has been adopted in some buildings around Roorkee and for a school building at Delhi. The performance of these buildings has been found to be satisfactory.

There is a demand for short notes summarising available information on selected building topics for the use of Engineers and Architects in India. To meet the need this Institute is bringing out a series of Building Digests from time to time and the present one is the 45th in the series. Readers are requested to send to the Institute their experience of adopting the sugges ion given in this Digest.

SfB	(23) Gf 4
UDC	691.327-478

Compiled by V. K. Jain
Published by P. L. De,
Central Building Research Institute Roorkee.

September 1966