BUILDING RESEARCH NOTE

B.R.N. 4

PRECAST R.C. PLANK FLOORING/ROOFING SCHEME

Introduction

The scheme consists of precast R.C.C. Planks supported over partially precast R.C.C. Joists (Fig. 1). This scheme has been successfully adopted in large number of residential buildings in different parts of the country by various organisations and also for industrial sheds and school buildings.

Elements of Floor/roof

The floor/roof consists of Precast R.C.C., Planks, (ii) Partially Precast R.C.C. Joists. and (iii) Primary and secondary beams for larger cover spaces.

Precast RC Plank

To provide Tee-beam effect of the joist with insitu concrete, the plank (Fig. 2) is made partly 3 cm and partly 6 cm thick. A 10 cm wide tapered concrete is also provided for strengthening the haunch portion of the unit during handling and erection. The plank is made of M-15 grade cement concrete reinforced with m s bars. Width is usually 30 cm. Length may vary upto maximum of 150 cm. One 30 × 150 cm plankweighs about 150 kg and can be handled manually.
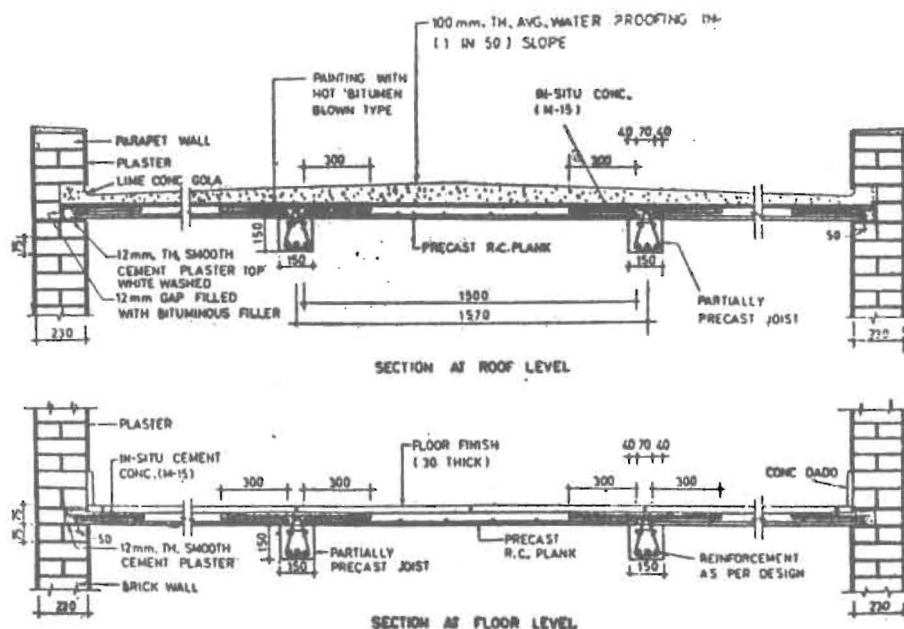

Fig. 1   PRECAST R.C. PLANK SCHEME

Partially Precast R.C.C. Joist

It is usually of square section 15 cm wide and 15 cm deep with stirrups projecting out (Fig. 3) so that the overall depth of the joist with insitu concrete is 21 cm. It is designed as composite Tee-beam with 6 cm thick flange comprising of 3 cm precast and 3 cm insitu concrete. This section can be adopted upto 4 m span.

Structural Design

The flooring/roofing scheme can be designed by limit state method in accordance with IS : 456-1978; Apart from self-weight and live load as specified in IS : 875-1964, (Indian Standard Code of Practice for Structural Safety of Building, Loading Standards)

(Revised), a load of 100 kg/m² for floor finish in the case of an intermediate floor and a load of 200 kg/m² for waterproofing and Insulation treatment for roof has been considered.

The planks are designed as simply supported for self-weight including insitu concrete in haunches and as continuous slab for live load and dead load of floor finish or waterproofing treatment. For floor as well as roof of residential buildings 3 Nos 6 mm dia m.s. Bars are provided as main reinforcement. Cross reinforcement comprises of 6 mm dia m.s. bars spaced 20 cm on centres. For continuity at the support, 2 Nos. 6 mm dia m.s. bars per plank along
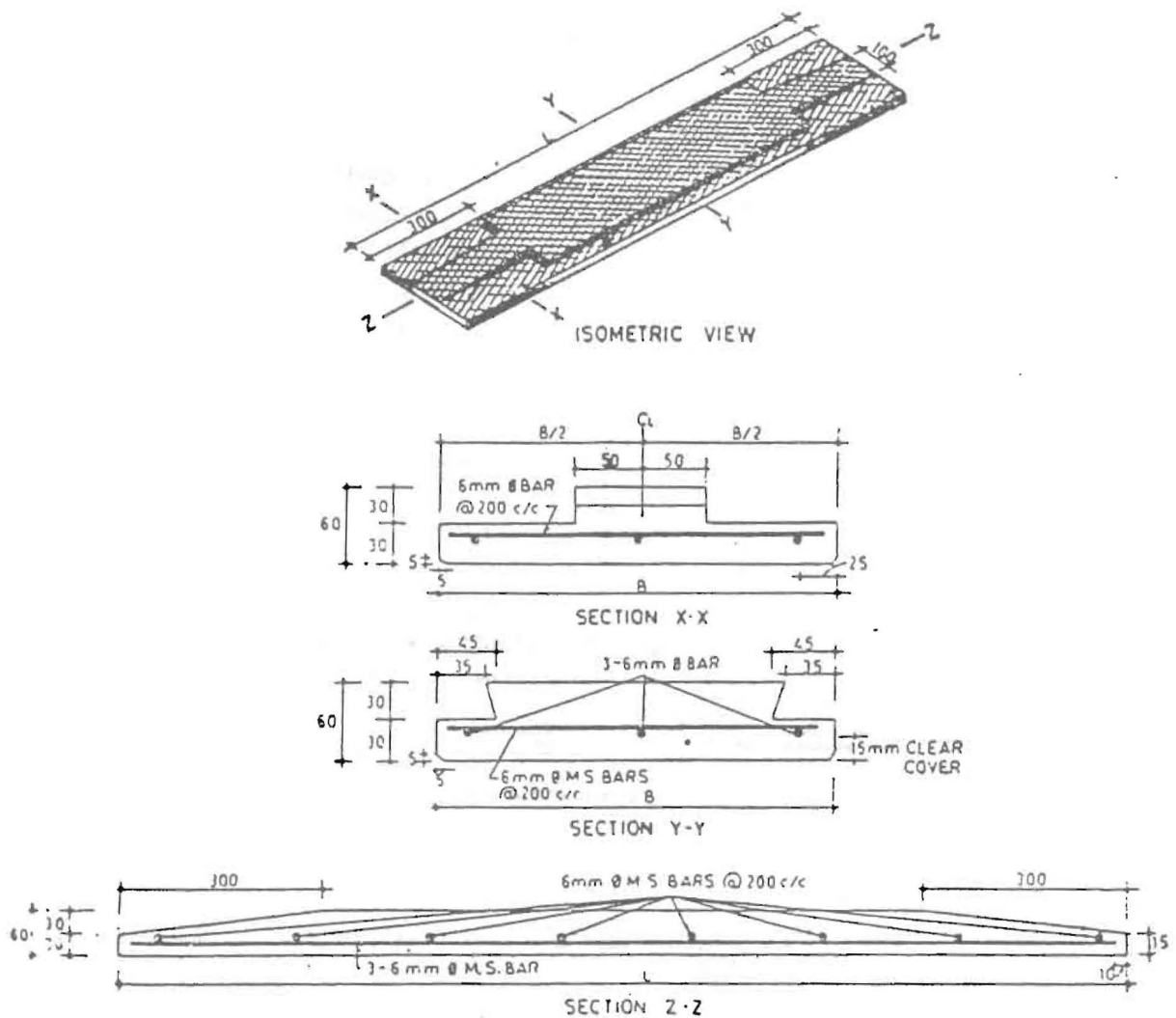

Fig. 2   PRECAST R.C.C. PLANK

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the length are provided in the haunch portion. Also 2 nos. 6 mm dia m.s. Bars are provided as transverse reinforcement in the haunch portion over each support. For other types of buildings, the reinforcement may be worked out depending upon the imposed loads.

The joist is designed as simply supported tee-beam with 6 cm flange thickness. Reinforcement is provided as per design requirements depending upon the spacing and span of the joist. Moments of resistance of tee-beam with different reinforcement based on limit state method are given in Table 1 for reference.

The joist can be designed as continuous beam also for intermediate floors only. For spans of more than 2.8 meter, the joist at the support is to be designed as doubly reinforced beam which necessitates welding of the bottom reinforcement of adjacent joists at the

Spacing Of Stirrups 130mm C/C

Minimum Distance Of Stirrups From Edge Of Joist on Either Side 50mm.

L = CLEAR SPAN + 200mm

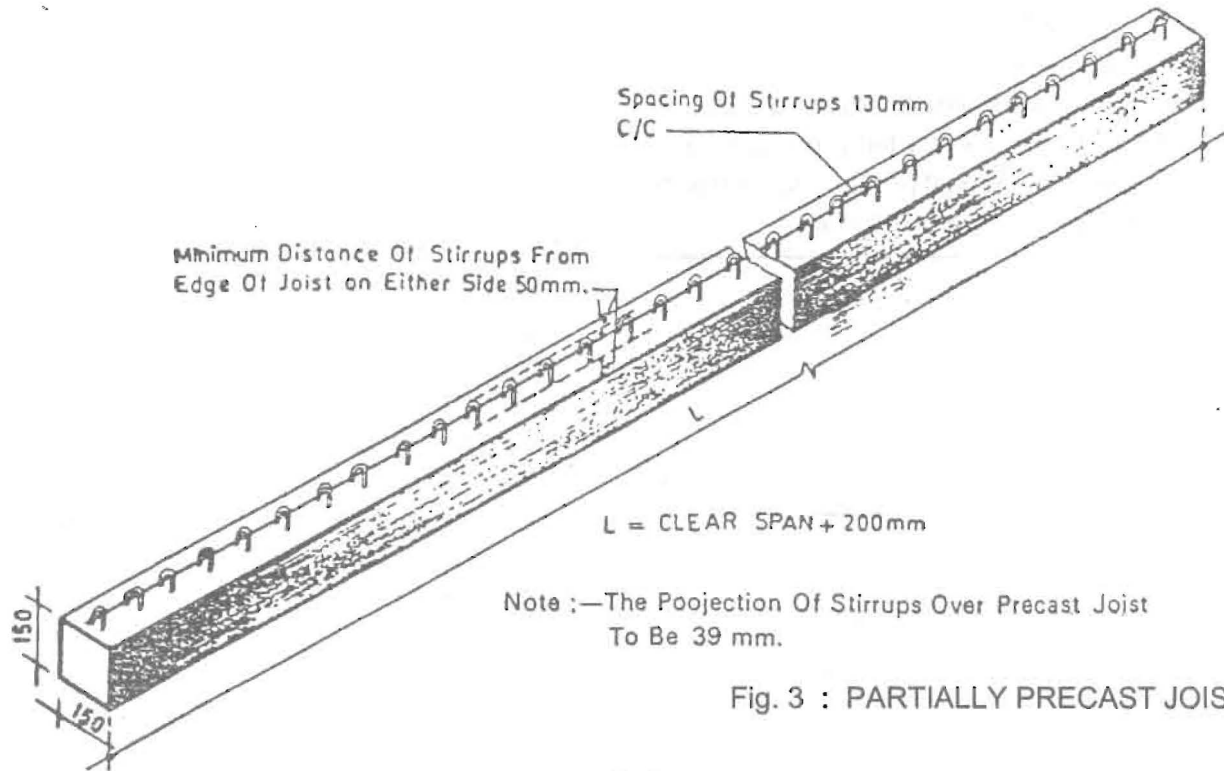Note :—The Poojection Of Stirrups Over Precast Joist To Be 39 mm.

Fig. 3 : PARTIALLY PRECAST JOIST

TABLE 1

+VE MOMENT OF RESISTANCE WITH DIFFERENT REINFORCEMENT FOR PARTIALLY PRECAST JOIST (WIDTH 150 mm. DEPTH OF PRECAST PORTION 150 mm AND OVERALL DEPTH WITH INSITU CONCRETE 210 mm)

A.	M.S. Bars,									
	Moment of resistance (Kgm)	891	1030	1157	1286	1355	1609	1774	1894	2206
	Area of reinforcement (cm²)	2.356	2.702	3.047	3.393	3.58	4.27	4.806	5.452	6.032
	Reinforcement	3-10mm	2-10mm +1.12mm	2-12mm +1-10mm	3-12mm	2-10mm +1-16mm	2-12mm +1-16mm	2-16mm +1-10mm	2-16mm +1-12mm	3-16mm
B.	Deformed Bars,									
	Moment of resistance (Kg m)	994	1304	1420	1477	1686	1895	2103	2433	2580
	Area of reinforcement (cm²)	1.57	2.073	2.263	2.356	2.702	3.047	3.393	4.02	4.273
	Reinforcement	2-10mm	2-10mm +1-8mm	2-12mm	3-10mm	2-10mm +1-12mm	2-12mm +1-10mm	3-12mm	2-16mm	2-12mm +1-16mm

Note : Mild Steel conforming to latest code provision and cold twisted bars conforming to latest code provision are to be used as reinforcement

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support. The reinforcement for negative moments at the support is to be provided in a limited space. This restricts to only two numbers reinforcing bars. The negative moment of resistance of the joist, based on limit state method is given in Table 2 with different top reinforcement having the bottom rods welded. For positive moments reference may be made to Table 1 and reinforcement in the joists provided accordingly.

TABLE — 2

-Ve moment of resistance with different reinforcement at top for the partially precast joist (width 150 mm, depth of precast portion 150 mm and overall depth with insitu concrete 210 mm)

A.	M.S. Bars			
	Moment of resis-tance (kg. m)	555	762	1192
	Area of reinforce-ment (cm^2)	1.57	2.26	4.02
	Reinforcement	2-10mm	2-12mm	2-16mm
B.	Deformed Bars			
	Moment of resis-tance (kg. m)	856	1177	2072
	Area of reinforce-ment (cm^2)	2-10mm	2-12mm*	2.16mm
	Reinforcement	2-10mm	2-12mm*	2.16mm

Note : * indicates that both the bottom reinforcement bars of the adjacent RC joists should be welded as shown in Fig. 8(c).

Since welding facilities may not be available at many places, while there may be a continuous span, the resisting moment of the joist may be increased by making its depth 20 cm.

Depending upon the loading, spacing and span of the joist, the bending moments corresponding to the design loads may be calculated and reinforcement provided for the same may be taken directly from Table 1 and Table 2 as the case may be.

Moulds

Moulds are made of well seasoned good quality timber but where more repetions are needed, it is better to make steel moulds. Timber moulds consists of two end piece and two tapering member (Fig. 4 A), while steel mould consists of two frames and two tapering members (Fig. 4 B).

Timber mould for partially precast joist consists of two longitudinal members, two end pieces, and clamps A & B (Fig. 5-A), while the steel mould consists of two longitudinal members, end cross plates and spacer plates (Fig. 5-B).

CASTING AND CURING

R. C. Plank

Inner sides of the mould that come in contact with concrete are oiled, the members assembled and placed on a casting platform having either mould oil applied or wrinkle free paper or G.I. Sheet spread, to cover the bottom surface of the plank including the mould. Reinforcement cage with mortar cover of 15mm is placed inside the mould and M-15 cement concrete with 10 mm and down, graded aggregate is poured to a depth such that after compaction with plate vibrator, it becomes 3 cm. The upper side of the longitudinal members of the mould are put in position and the two tapering members are also then placed over the mould M-15 concrete is then poured in the middle and the sides and compaction again carried out by plate vibrator. Concrete is finished level with the mould and the top surface, made rough by trowel markings half an hour after casting, the two tapering members are lifted off and cleaned for reuse for further casting. Two hours after casting, depending upon weather, the nuts are opened and the sides of the frame are removed by light tamping and sliding away. The unit thus cast is first slid. by push after 24 to 30 hours and then tilted through 90° on long edge. It is transported in vertical position and stacked against a support in the same position for curing by sprinkling water for 14 days. It is air cured for another 14 days before being laid in floor/roof.

Partially Precast Joist

The mould is assembled, oil applied on the inner side with old newspaper of the base. Reinforcement cage

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with mortar cover of 25 mm is kept in the mould and clamps A & B in case of timber mould or top spacer pieces in case of steel moulds, are fixed over the mould. Cement concrete M-15 with 12 - 20 mm graded aggregate is poured in the mould and well compacted with a plate vibrator by placing it on the mould. The mould is stripped three to four hours after casting. The joists are first slid by push, 48 to 72 hours after being cast depending on weather and then transported to the curing area by holding them near
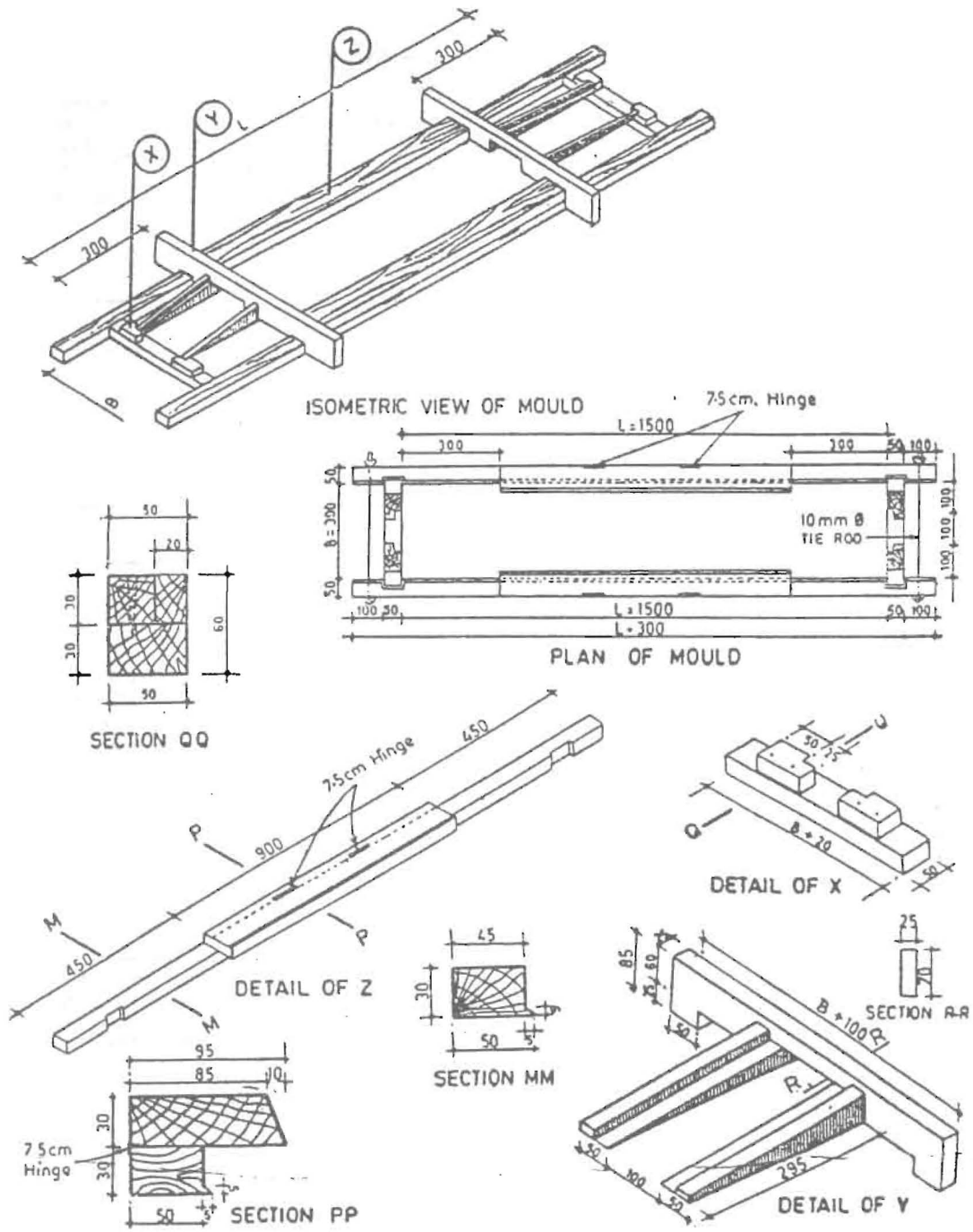

ISOMETRIC VIEW OF MOULD

PLAN OF MOULD

SECTION QQ

DETAIL OF Z

DETAIL OF X

SECTION MM

SECTION PP

SECTION R-R

DETAIL OF Y

Fig. 4-A : TIMBER MOULD FOR R.C. PLANK

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the ends, These are water cured for a minimum period of 14 days, followed by air curing for another 14 days before these are transported and laid in buildings.

ERECTION AND ASSEMBLY OF UNITS

Assemble the units in the following sequence :
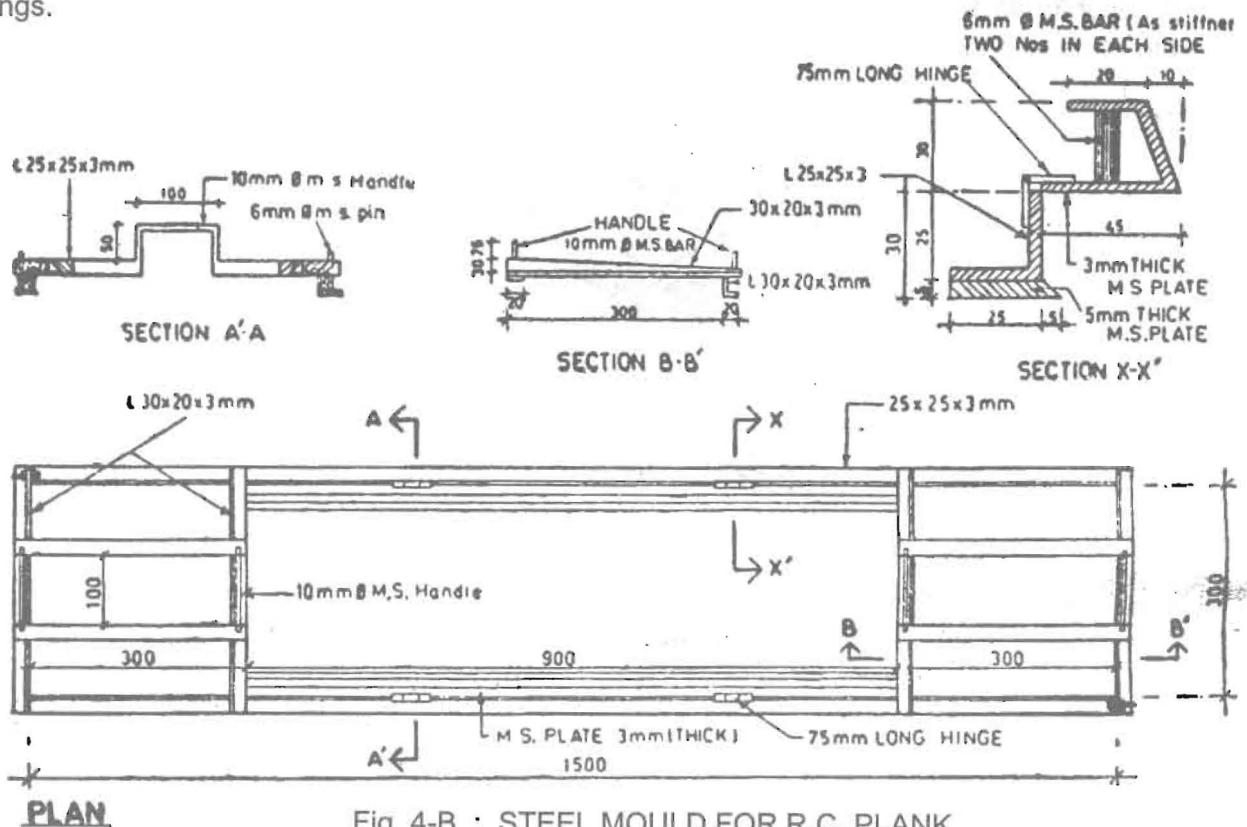
(1) Place the joists in position over cemen

SECTION A'-A

SECTION B-B'

SECTION X-X'

Fig. 4-B : STEEL MOULD FOR R.C. PLANK

PLAN

PLAN
SCALE 1:10

SECTION XX
SCALE 1:5

DETAIL OF CLAMP A
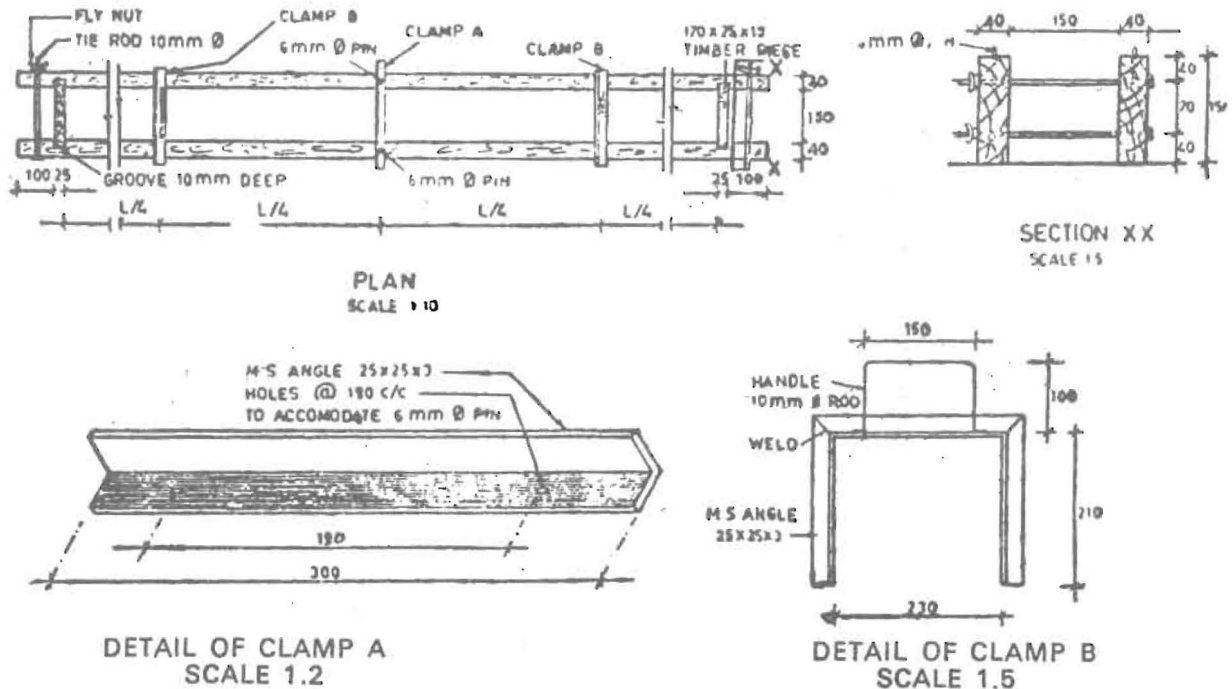SCALE 1.2

DETAIL OF CLAMP B
SCALE 1.5

Fig. 5-A : TIMBER MOULD FOR PARTIALLY PRECAST JOIST

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concrete 1:3:6 bed blocks of 30 cm × 23 cm × 7.5 cm having smooth finish on top. Align and level them immediately after erection, prop them at the middle with a prop having a timber plank of 35 cm length × 15 cm width × 3 cm thickness fixed at bearing level (Fig. 6).

(2) Level the top surface of the wall, with 1:6 cement sand mortar and also the top of the beam where the planks have to bear. In case of roof, the entire wall top be levelled, finished smooth and given a thick coat of white wash.

(3) Place the precast planks over the joists and walls side by side.

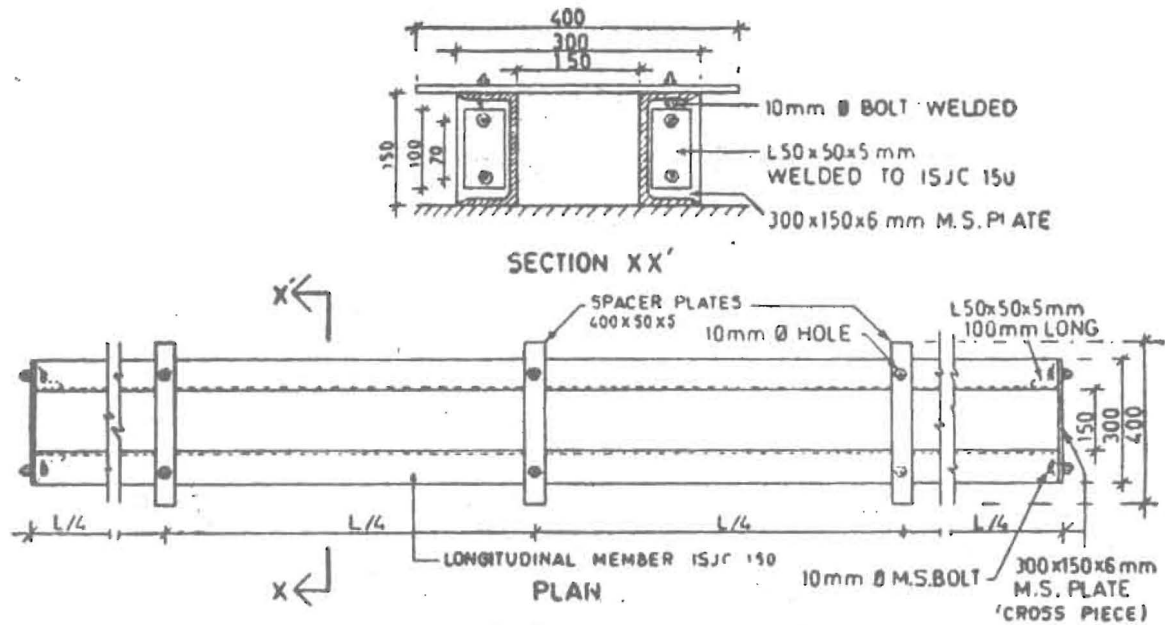(4) Provide fan hook while placing the planks over

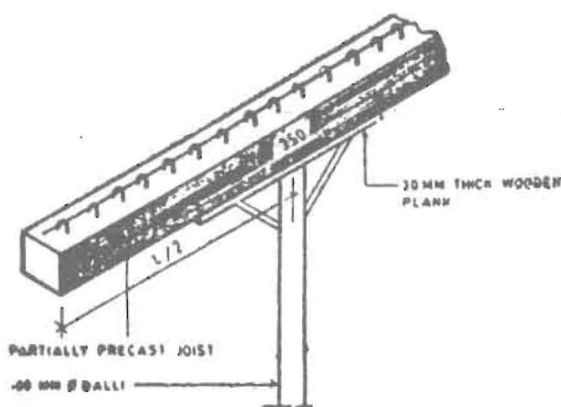Fig. 5-B : STEEL MOULD FOR PRECAST R. C. JOIST

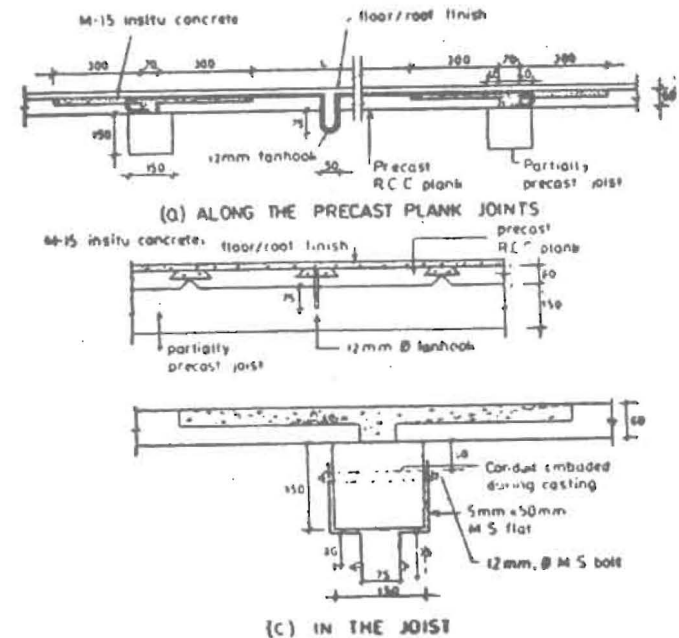Fig. 6 : PROPPING OF PARTIALLY PRECAST JOIST

Fig. 7 : FIXING OF FANHOOK

the joists in case the fan is to be hung in between the planks (Fig. 7 a & b) or alternatively when the fan is to be hung from the joist, a through and through hole of 15 mm dia. is to be left in the joist during its casting and fan is hung by a clamp (Fig. 7-c).

(5) Place distribution reinforcement, 2 nos. 6mm dia m.s. bars parallel to the joists and also two nos. 6 mm dia m.s. bars per plank across the

joist in the haunch portion and tie them with the projecting reinforcement of the joist.

(6) In case the spans are continuous but the joists have been designed as simply supported, a gap of 12 mm is kept between the joists and also between the planks which is filled by bitumen boards (Fig. 8 a & b). It is better to design the joist as simply supported for roof. In case the joists have been designed as
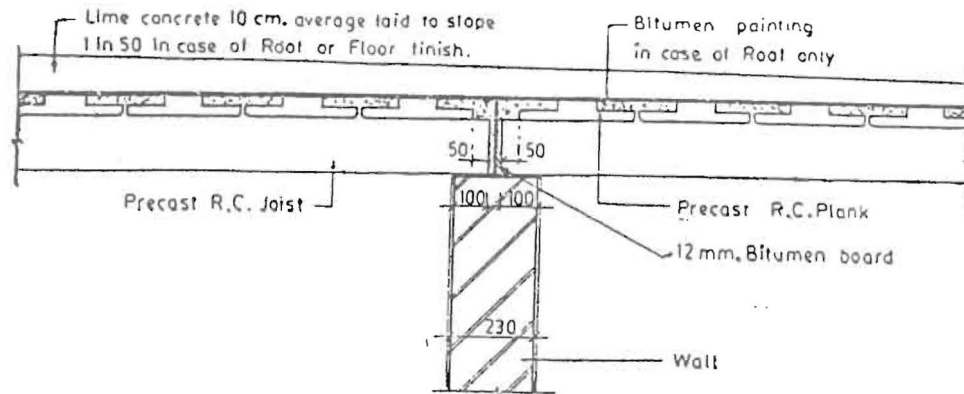

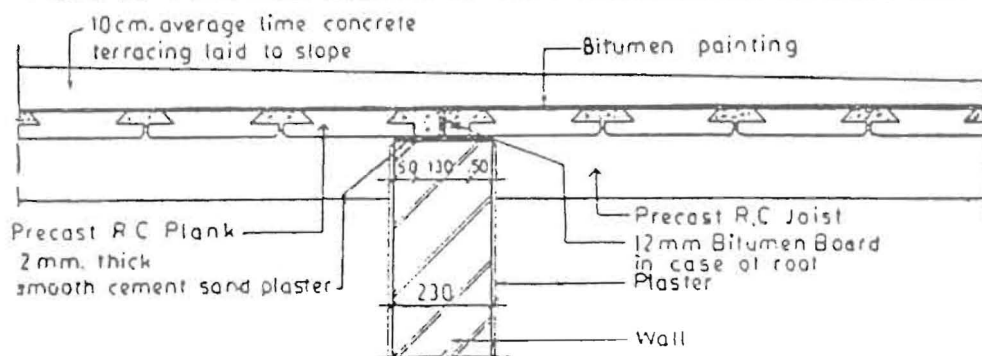Fig. 8 (a) : DETAIL FOR SIMPLY SUPPORTED JOIST AT SUPPORT

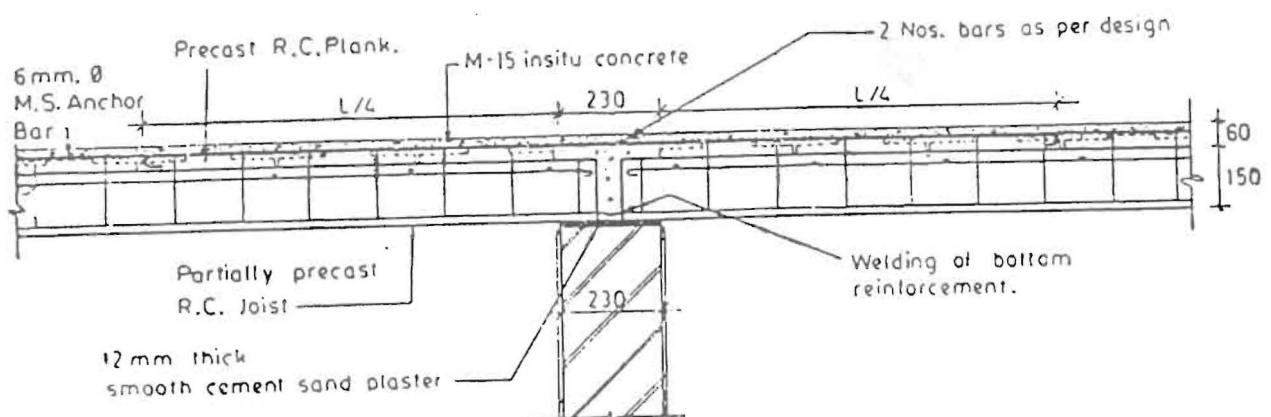Fig. 8 (b) : DETAIL FOR PLANKS BEARING AT ROOF TO AVOID LEAKAGE

Fig. 8 (c) : DETAIL FOR CONTINUITY OF JOIST AT SUPPORT IN INTERMEDIATE FLOORS

continuous for intermediate floors, the negative reinforcement as per design (only two bars of the same diameter) is provided over the support of the joists extending ¼ of span on both sides of the wall. In case the support moment exceeds 972.5 kgm, either the depth of 20 cm of the joist is designed as doubly reinforced beam and its

bottom reinforcement kept projecting out by 2 cm and welded (Fig. 8-c).

(7) Apply cement slurry wash at 4 kg. cement/10 m² over the precast joists and in haunch portions of the planks where insitu concrete is to be laid.

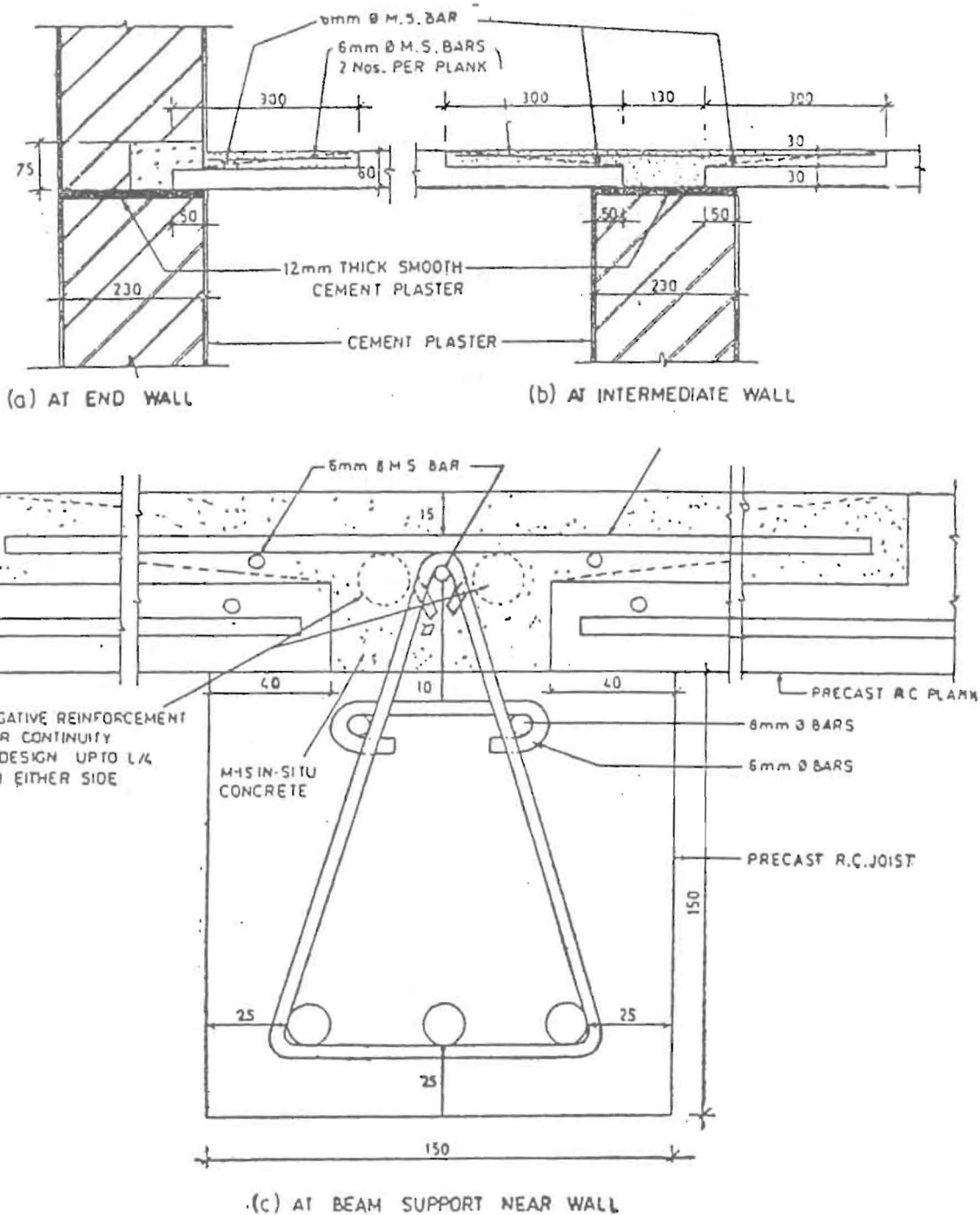(8) At the joints of adjacent planks along their length, lay a thick paste of cement sand mortar

(a) AT END WALL   (b) AT INTERMEDIATE WALL

(c) AT BEAM SUPPORT NEAR WALL

Fig. 9 : DETAIL SHOWING DIFFERENT BEARING POSITIONS

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1:4 by trowel to fill them upto the bottom and also to cover them, before laying insitu concrete in haunches.

(9) Lay cement concrete M-15 with 10mm and down, graded coarse aggregate, over the joists and in haunches between the planks and level the top flush with the middle portion of planks. The details of insitu concreting for various bearing positions are shown in Fig. 9, In case of roof without parapet, it is better to have planks projecting out to avoid leakage at the junction of wall and roof. A maximum projection of 10 cm can be given in either direction (Fig. 10 a & b). Further, by providing shuttering, laying reinforcement and concreting, a maximum projection of 50 cm can be provided across the joists (Fig. 10 c) and 100 cm along the joists by projecting the same and providing negative reinforcement in the joist at the top as in the case of balcony.

(10) Cure the insitu concrete for a minimum period of ten days.

(11) Do not remove the props of the joists before the curing is over and insitu concrete has attained strength.

(12) Provide floor finish directly over the planks. For roof, lay weathering couse after painting the top surface with a coat of blown bitumen @ 1.7 kg/m^2.

(13) Provide 'V' groove pointing in cement sand mortar 1:5 in the ceiling along the joints of the planks.

SERVICE AREA

In service area, the supporting slab is sunk to accommodate the pipes, floor trap, WC pan, etc. The details are shown in Fig. 11. To take care of the additional load of the filling and also to make the floor leak. proof, 2.5 cm thick M-15 concrete is laid over top of the planks in addition to haunch filling.

BALCONY/CHAJJA PROJECTIONS

Balcony projections are provided along the partially precast joists. The joist is designed with an overhang carrying superimposed loads for balcony in addition to the self load and the load due to railing. Main reinforcement is provided at the top in insitu concrete, the precast portion taking the compression. The free-end to the joist is propped adequately until insitu concrete attains sufficient strength (Fig. 12).

PRECAUTIONS

Following precautions are to be taken :

(1) Top of the walls/beams should be levelled with cement sand mortar 1 : 6 before placing the precast planks. In case of roof, it is preferable to give a thick coat of white wash over the smooth plastered wall bearing surface or bitumenised paper or polyethyiene film be placed over the surface.

(2) The planks should have minimum bearing of 5 cm and 4 cm on the load bearing wall and joist respectively. The joists should have minimum bearing of 10 cm over the wall.
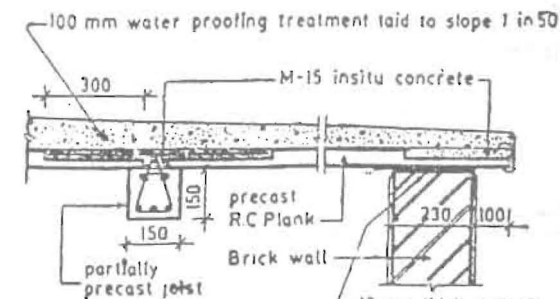
(a) ACROSS JOIST
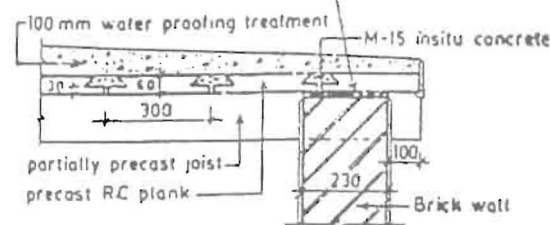
(b) ALONG JOIST
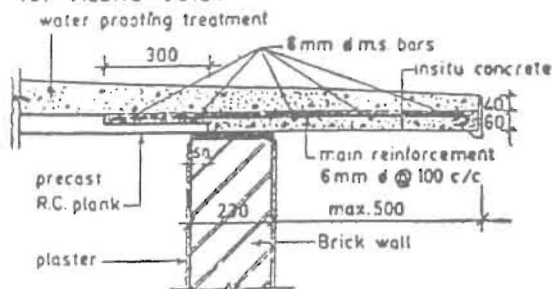
(c) CANTILEVER AT ROOF LEVEL WITH INSITU CONC.

Fig. 10 : DETAIL OF ROOF WITHOUT PARAPET

impregnated board or bitumenised sand, with blown bitumen to avoid leakage.

(14) 'V' groove pointing on the ceiling should be done after concrete in haunches has been laid and has attained strength.

(15) In case a fan is to be hung from the joist, either fan hook should be placed in the joist while casting by providing a groove in the casting floor at the position of hook or alternatively a conduit pipe of 15 mm dia be embedded to hang the fan by clamp.

STRUCTURAL TESTS

Deflection Recovery Test

Deflection recovery tests as per IS : 466-1978 Clause 16.5 were carried out on individual planks with insitu concrete over the haunch portion and also on the complete assembly with two beams. Loads were applied through concrete blocks and deflections were measured by fixing dial gauges. On removal of the imposed load, the recovery of deflection was satisfactory as per Indian Standard. No cracks were developed during the tests. The scheme has been found to have cross rigidity, monolithicity and composite action.

Deflection recovery test was also carried out on a cantilever of 500 mm cast-insitu slab along the plank by taking the reinforcement through the haunch portion of the plank. The deflection recovery was within limits as prescribed in the Indian Standard and there was no development of crack at the support.

Impact Load Test

The plank assembly, without any floor finish over it was tested under impact load by dropping a well tied gunny bag load of 40 kg. form a height of 1.2 m. No sign of distress in the roof assembly was observed.

FUNCTIONAL PERFORMANCE

Thermal Performance

The thermal transmittance (U) value of 6 cm thick RC plank with 7.5 cm average thick mud phuska and 5 cm tiles above is 2.189 K. Cal/Hr/m^2/^{0}C.

While with 9 cm average lime concrete terracing, the 'U' value is 2.7 K. Cal/Hr/m^2/^{0}C. It may be mentioned that 'U' value for 10 cm thick RCC slab with waterproofing and insulation treatments as mentioned above are 2.056 K. Cal/Hr/m^2/^{0}C and 2.4 K. Cal/Hr/m^2/^{0}C respectively.

The specified value as per I.S. 3792 -1978 Indian Standard Guide for heat insulation of non-industrial buildings is 2.00 K. Cal/Hr/m^2/^{0}C and Thermal Performance Index (T.P.I.) should be 100.

TPI for RC plank scheme with water proofing and insulting treatment as mentioned above are 130 and 140 respectively. While the TPI for 10 cm thick RCC slab with the treatments mentioned above are 122 and 134 respectively. It may be seen that none of the two satisfies I.S. requirements, though the RC plank scheme is only slightly inferior to 10 cm thick insitu RCC slab in thermal performance. This can be easily improved by making waterproofing and insulating layer thickness as follows :

(a) 10 cm (average thickness) mud phuskh and 5 cm tiles above.

(b) 13 cm (average thickness) lime -concrete terraching. With these, the 'U' values are 2.01 K. Cal/Hr/m^2/^{0}C and 2.092 K. Cal/Hr/m^2/^{0}C respectively and T.P.I. values are 110 and 115 respectively. However, to improve the thermal performance and making the T.P.I. value to the desired level, whitewash treatment on the roof of RC plank or insitu RCC slab can be given. Of course, this shall have to be done every year before the onset of summer in hot dry and hot arid regions.

Resistance to Impact Noise

The Impact Noise Rating (INR) indicates the degree of impact noise insulation provided by a floor. The INR for 6 cm thick RC plank slab is- 16.6 db while for a 10 cm thick RC slab it is 16 db. It can be seen that INR for conventional slab and RC plank scheme has insignificant difference. This is so, because the transmission of sound through a floor does not depend much on its thickness. The desired value of INR +5 db as recommended by Indian Standard Institution Code for Satisfactory Performance can be achieved only by putting a layer of resilient material between the slab and floor finish.

Fire Resistance

Fire resistance of RC plank slab with 3 cm concrete

floor finish in respect of thermal insulation criteria is 1 hour and 45 minutes while for 10 cm R.C. slab it is 2 hours.

Rain Penetration

Ponding tests over RC plank scheme were carried out and it was found that there was no seepage of water through the joints when all the suggested precautions, specially of filling of joints and laying a mortar layer over them before concreting in the haunches was followed.

FURTHER RESEARCH AND IMPROVEMENTS OF SCHEMES

The present form of RC plank was finalised about 20 years back after a series of developments in CBRI starting about 40 years back in the name of solid planks etc in different shapes and sizes. However most of these techniques were developed with manual methods almost in all operations. In recent periods, some of the organisations like BMTPC etc tried to introduce mechanised methods of production with upside down casting on a table associated with motorised operation in a factory or casting on templates over a vibrating table with hooks etc for lifting and shifting to curing yard. These methods were faster in production but were capital intensive and did not change much to the basic shapes and sizes of CBRI developed RC plank. As observed and reported by the originating scientists of this techniques, about four planks are produced in a day with a single set of mould. However it takes more than 30 minutes to cast a plank at special faster trials.

After visualising the above shortcomings of more capital investment in the mechanised systems in a factory or quite slow production in the conventional manual castings, a semi mechanised method of production has been developed with improvement of the basic shape of the unit with a new name 'Flat Panel' and 'Flat Pan' Roofing/Flooring as described below.

Flat Pan Roofing / Flooring

The flat-panel (Fig. 13) is a thin RCC unit rectangular in plan and having about 6 cm thickness at the central polygonal zone and only about 3 cm thickness at the peripheral area. After placing and assembly of the units in roof and filling the haunches with in-situ concrete and reinforcement, the flat slab will become quite leak proof. This technique has been developed for very economic and sound construction.

The components are cast by a semi-mechanised mould as shown in Fig. 14. The mould consisted of fixtures to adjust the width of panel to any size of 5 cm intervals from 40 cm to 65 cm. Thus enabling the choice of having numerous sizes with same mould. The mould has no loose but single assembly of components and can be operated by two persons with handles of easy moulding and demoulding almost instantly during casting under specially designed plate-vibrator. The mould can be removed immediately after casting for use for next unit. The lifting clamp can be used for lifting and shifting the units from the platform.
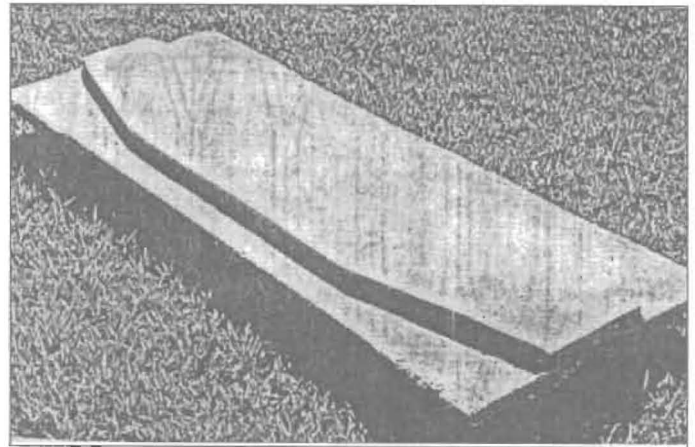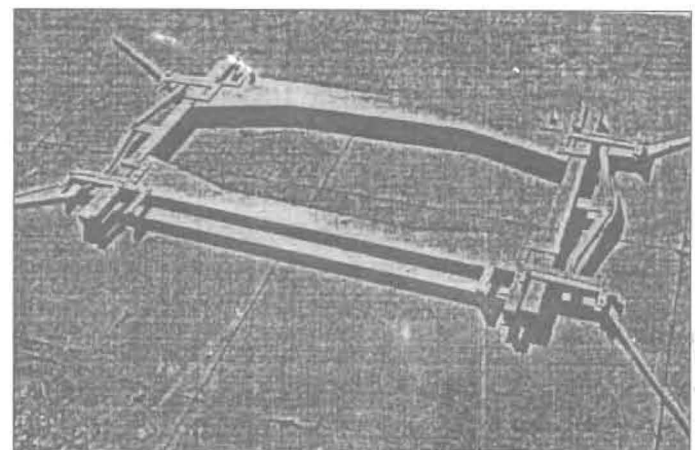

Fig. 13 RC FLAT PANEL

Fig. 14 Semi-mechanised Production set-up for Flat Panels of variable sizes

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The placement of the Flat Panels in roof is as shown in Fig. 15.

The salient features and improvements in the 'Flat Pan' scheme are as under :-

(i) Becaurse of introducing the central polygonal solid sections, the stiffness and strength of the unit are concordant to the external stresses, thus having less breakage during handling and scope of longer unit in the construction.

(ii) There is no slanting surface in the precast unit this having less troubles during casting and insitu concerting in haunch filling.

(iii) Production is faster with simple operation of casting on normal platforms in manual methods. Use of lifting clamp is quite easy with safety to the units.
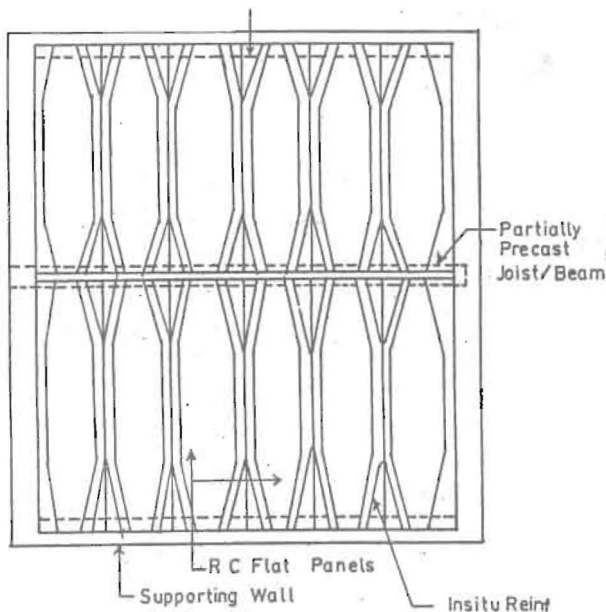

Fig. 15 Layout of Flat Panels in Roof.

However more research with tests and trials on the panels and Flat Pan roof may be necessary before arriving at any specific cost data in this scheme though it is asurred that if may yield a superior faster construction technique for low cost buildings in India. The economy and specific data sheet is prepared here only on RC solid plank scheme and presented as below :-

ECONOMY

The quantities of cement, steel, labour and overall cost for a room of 3.5 × 3.5 m have been calculated. Compared with conventional RCC slab, the approximate savings are as under. However the cost data and savings will vary from site to site.

Reinforcement	14 per cent
Cement	27 per cent
Coarse Aggregate	27 per cent
Fine Aggregate	25 per cent
Overall Cost	21 per cent

Since this scheme uses precast components, shuttering is eliminated and propping is required only for precast joists. Because of precast components quality can be controlled and the components being of moderate size and weight, no mechanical handling and erection is required. These can be easily carried out manually even in multistoreyed buildings. Because of prefabrication, the construction time of roof can be reduced by about 25 percent as compared to the conventional insitu RCC slab.

TOLERANCES

The planks and joists shall be cast accurately to the specified dimensions. Planks shall have a tolerance of ±3 mm in width ±5 mm in length and ±1 mm in thickness. The joists shall have a tolerance of ±10 mm in length, 3 mm in width and ±3 mm in depth.

MATERIAL AND LABOUR REQUIREMENT

Requirement of material and labour for preparation of the mould, casting and curing, transportation, hoisting and placing of units and completing the structural floor/roof is given below :

Quantity of reinforcement in joists will vary depending upon the span and loads, which may be obtained from Table 1 and 2 as the case may be or calculated. The quantity of steel in RC plank for residential building loading will remain the same as given. However for other loading, the same shall be increased as per design requirements in both RC planks and joists. By putting the prevailing rates of materials and labour the cost of floor/roof can be worked our from the data given below :

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DATA FOR CALCULATION OF COST

1. Moulds

(A) Precast R.C. Plank (1500 × 300 × 60 mm)
   (i) Wooden mould
   (a) Materials

Timber (Deodor/Teak)	=	0.016 cu. m.
M.S. tie rods 10 mm φ 50 cm long with washer and nut	=	2 Nos.
7.5 cm. hinges	=	4 Nos.
Sundries for nails & screws etc.	=	Rs. 10.00

   (b) Labour

Carpenter	=	1.0 man day
Mazdoor	=	1.0 man day

Note: One mould can be used for 60 castings.

   (ii) Steel mould
   (a) Materials

M.S. angles 25 × 25 × 3 mm	=	3.00 m (3.30 Kg)
* M.S. angles 30 × 20 × 3 mm	=	2.50 m (2.75 Kg)
M.S. plate 5 mm thick	=	0.09 sq.m. (3.53 Kg)
—do— 3 mm —do—	=	0.01 sq.m. (0.24 Kg)
—do— 1.5 mm —do—	=	0.20 sq.m.
	=	(2.35 Kg)
Hinges (75 mm)	=	4 Nos.
m.s. rod 6 mm φ	=	1.50 m (0.33 Kg)
10 mm φ 75 mm bolts with nuts	=	2 Nos

   (b) Labour

Fitter	=	1.5 man day
Welder	=	0.5 man day

One mould can be used for 1000 castings.
* If unequal angel is not available, 30 × 30 × 3 mm equal angle can be used in place of 30 × 20 × 3 mm.

(B) Partially precast R.C. Joist (Length 3.5 m)
   (i) Wooden mould
   (a) Materials

Timber (deodar/Teak)	=	0.05 cu.m.
M.S. tie rods 10 mm dia 30 cm long with washer & nut	=	2 Nos.
M.S. angle iron clamps made of 25 × 25 × 3 mm		
Type (A)	=	1 No.
Type (B)	=	2 Nos.

   (b) Labour

Carpenter	=	0.5 man day
Mazdoor	=	0.5 man day

Note: One mould can be used for 100 castings.

   (ii) Steel mould for the joist
   (a) Materials

I.S.J.C. 150	=	3.5 m long 2 Nos. (69.3 Kg)
M.S. angle iron 50 × 50 × 5 mm	=	0.40 M (1.52 Kg)
M.S. plate 6 mm thick	=	Two pieces of size 30 cm × 15 cm (1.76 Kg)
50 mm × 10 mm dia bolts with nuts	=	14 Nos
Clamps made of 25 × 25 × 3 mm M.S. angle iron	=	3 Nos

   (b) Labour

Fitter	=	1 man day
Welder	=	0.5 man day

One mould can be used for 1000 castings.

2. Casting of components

   (i) Precast RC Plank (1500 × 300 × 60 mm)
   (a) Materials
   (Volume of concrete M 15 = 0.0206 cu.m.)

Cement	=	6.95 Kg.
Coarse Sand	=	0.0093 cu.m.
Stone agg. (10 mm & down)	=	0.0186 cu.m.
Reinforcement (6 mm dia m.s. bars)	=	1.54 Kg.
(G.I. Binding wire-24 guage)	=	0.012 Kg.

   (b) Labour for casting Curing & Stacking

Mason	=	1/18 manday
Mazdoor	=	1/9 manday
Bhisti	=	1/200 "
Bar bender	=	1/30 manday
Helper with Barbender	=	1/60 manday

   (c) Miscellaneous Items

Casting platform	=	Rs. 1.00
Mould oil and old paper Vibrator and electric charges	=	Rs. 1.00
T & P and water charges	=	Rs. 1.00

Note: With one mould, four castings can be done in one day.

   (ii) Partially Precast R.C. Joist (Length 3.50 m)
   (a) Materials

Volume of cement Concrete	=	0.08 cu.m.
Cement	=	27.00 Kg.

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Coarse Sand	=	0.036 cu.m.
Stone agg. (12 - 20 mm)	=	0.072 cu.m.
Reinforcement		
(6 mm and upto 16 mm dia)	=	19.68 Kg.
G.I. Binding wire (24 gauge)	=	0.10 Kg.

(b) Labour

Mason	=	1/18 manday
Mazdoor	=	3/18 manday
Bhisti	=	1/100 manday
Bar-bender	=	1/4 manday
Helper with Barbender	=	1/8 manday

(c) Miscellaneous Items

Casting Platform	=	Rs. 2.00
Mould oil and old paper	=	Rs. 2.00
Vibrator & electric charges	=	Rs. 1.50
T&P and water	=	Rs. 1.00

Note : With one mould, two castings can be done in one day.

3. **Erection and Assembly**
     (Transportation within 60 m lead and erection upto 6 m lift)
     (i) Partially precast joists
     (a) Materials for Propping = Rs. 10.00
         (Balli, wedges etc.) L.S.
         Readymade adjustable
         steel props can also be used.
     (b) Labour

Mason	=	1/20 manday
Mazdoor	=	1/5 manday
Carpenter	=	1/20 manday

     (Only in the case of wooden prop)
     (ii) Precast RC Plank
     (a) Material
         (Cement mortar 1:6)

| Cement | = | 0.06 Kg |
| Sand | = | 0.003 cu. m. |

(b) Labour

| Mason | = | 1/40 manday |
| Mazdoor | = | 1/10 manday |

4. **Insitu concreting between planks and over beams (10.00 sq.m. floor/area)**
     (a) Materials

(Cement concrete M-15	=	0.1604 cu.m.
Cement	=	53.30 Kg.
Coarse Sand	=	0.072 cu.m.
Stone agg. (10 mm & down)	=	0.144 cu.m.
6 mm dia. m.s. bar	=	9.40 Kg.
G.I. binding wire (24 gauge)	=	0.1 Kg.

     (b) Labour (upto 6 m lift)

Mason	=	1/4 manday
Mazdoor	=	3/4 manday
Bhisti (water man)	=	1/4 manday
Bar-bender	=	1/8 manday
Helper with Bar-bendar	=	1/8 manday

     (c) Miscellaneous Items

| Providing cat walks etc. L.S. | = | Rs. 15.00 |
| T&P and water charges | = | Rs. 10.00 |

5. **Finishing (10.00 sq.m. floor/roof area) 'V' groove pointing in cement mortar 1:4 in ceiling**
     (a) Material

| Cement | = | 1.20 Kg. |
| Sand | = | 0.002 cu.m. |

     (b) Labour

Mason	=	1/2 man day
Mazdoor	=	1/2 man day
Providing scaffolding (L.S.)	=	Rs. 15.00

Note : 1. Contractor's profit and overheads are to be added.
        2. With a gang of one mason and 3 mazdoors having one mould for joist and four moulds for planks, 2 joists and 16 planks can be cast in one day.