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मानक

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IS 13990 (1994): precast reinforced concrete planks and joist for roofing and flooring [CED 51: Planning, Housing and pre-fabricated construction]



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भारतीय मानक

पूर्वठली प्रबलित प्लैंक एवं जॉईस्ट — विशिष्ट

Indian Standard

**PRECAST REINFORCED CONCRETE PLANKS
AND JOISTS FOR ROOFING AND FLOORING —
SPECIFICATION**

UDC 691.328—413 : 692.4/.5

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**BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002**

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Price Group 5

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Housing Sectional Committee had been approved by the Civil Engineering Division Council.

Considerable shortage of houses in the country, which is also increasing continuously, has led to increasing stress being laid in the development programmes of central and state governments, on facilitating speedy and economical construction of houses. Problem of housing being greatest amongst the lower income groups, both rural and urban, the enormous stress is being laid on housing for these target groups.

This calls for development and standardization of new building materials and construction techniques which are simple and economical, commensurate with structural and hygienic safety and durability, in order to ensure speedy and economical construction.

This standard is one of the series of standards on new materials and techniques of roof/floor construction which when implemented will result in substantial savings in materials and cost of construction, in addition to achieving speedy construction. The other standards being published in the series are:

- a) Specification for prefabricated brick panel and partially precast concrete joist for flooring and roofing,
- b) Code of practice for design and construction of roofs and floors with prefabricated brick panel,
- c) Specification for precast reinforced concrete channel unit for roofing and flooring,
- d) Code of practice for design and construction of floor and roof with reinforced concrete channel units,
- e) Code of practice for design and construction of floor and roof with reinforced concrete planks and joists,
- f) Specification for precast L-panel units for roofing,
- g) Code of practice for design and construction of roof with L-panel units, and
- h) Code of practice for construction of walls using precast concrete stone masonry blocks.

Precast reinforced concrete planks are partially precast rectangular slab elements which are supported over partially precast RCC joists side by side. These are joined together and also to the joist by pouring *in-situ* concrete over the haunches provided in the planks and the gaps between the planks over the joists. Monolithic action of the slab elements is ensured by leaving stirrups projecting out of joists and providing reinforcement across the joists over haunched portion of planks, tying them together and pouring *in-situ* concrete over it.

Roofs and floor made with precast RC planks are found economical as compared to conventional RC slabs mainly due to the following reasons:

- a) Components used for construction being precast, shuttering is eliminated.
- b) Quality can be controlled better in precast elements.
- c) Moderate size components are used thereby eliminating need for mechanical handling and erection equipment.
- d) Prefabrication leads to substantial reduction in time required for construction.

Considerable assistance has been rendered in the preparation of this standard by the Central Building Research Institute, Roorkee, who has developed this technique.

The Committee responsible for the formulation of this standard is given in Annex B.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (revised)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

PRECAST REINFORCED CONCRETE PLANKS AND JOISTS FOR ROOFING AND FLOORING — SPECIFICATION

1 SCOPE

This standard lays down requirements for precast reinforced concrete planks and joist used for construction of roofs and floors. The planks length up to 1.5 m long only are covered.

2 REFERENCES

The following Indian Standards are necessary adjuncts to this standard:

<i>IS No.</i>	<i>Title</i>
432 (Part 1) : 1982	Mild steel and medium tensile steel bars and hard-drawn steel wire for concrete reinforcement: Part 1 Mild steel and medium tensile steel bars (<i>third revision</i>)
456 : 1978	Code of practice for plain and reinforced concrete (<i>third revision</i>)
4905 : 1968	Methods for random sampling
13994 : 1994	Code of practice for design and construction of floor and roof with precast reinforced concrete planks and joist

3 MATERIALS

3.1 Concrete

Concrete used for making the planks, partially precast joists as also *in-situ* concrete shall conform to grade M15 of IS 456 : 1978. Coarse aggregate used for making concrete shall be well graded with maximum size of 10 mm, while for joist the maximum shall be 20 mm.

3.2 Reinforcement

Steel for reinforcement shall be as recommended in IS 456 : 1978.

4 SHAPES, DIMENSIONS AND TOLERANCES

4.1 Precast Reinforced Concrete Planks

4.1.1 Shape

Shape of the planks shall be rectangular with haunches as shown in Fig. 1. Top surface shall be chequered finish.

4.1.2 Dimensions

4.1.2.1 Width

The width of the planks shall be 300 mm. The dimension of 300 mm has been selected keeping

in view the requirements of modular co-ordination as also to keep the weight of the planks low so as to facilitate manual handling. However to suit to the room size, the width may be suitably changed to up to ± 50 mm.

4.1.2.2 Length

The length of the planks shall be limited to a maximum of 11.5 m. Smaller lengths required for varying room dimensions shall be permitted. However, it is preferable to use lengths in multiple of 300 mm only, keeping in view the requirements of modular co-ordination.

4.1.2.3 Thickness

To achieve monolithicity of roof/floor and to achieve T-beam effect with the joists in composite roof/floor made with these planks, the plank shall be made partly 30 mm and partly 60 mm thick as shown in Fig. 1. A 100 mm wide tapered concrete filling shall be provided for strengthening the haunch portion for shear during handling and erection.

Length of the tapered concrete filling at both ends shall be kept 300 mm for all lengths of planks and the length of central 60 mm thick portion shall be decreased for lengths of planks smaller than 1.5 m.

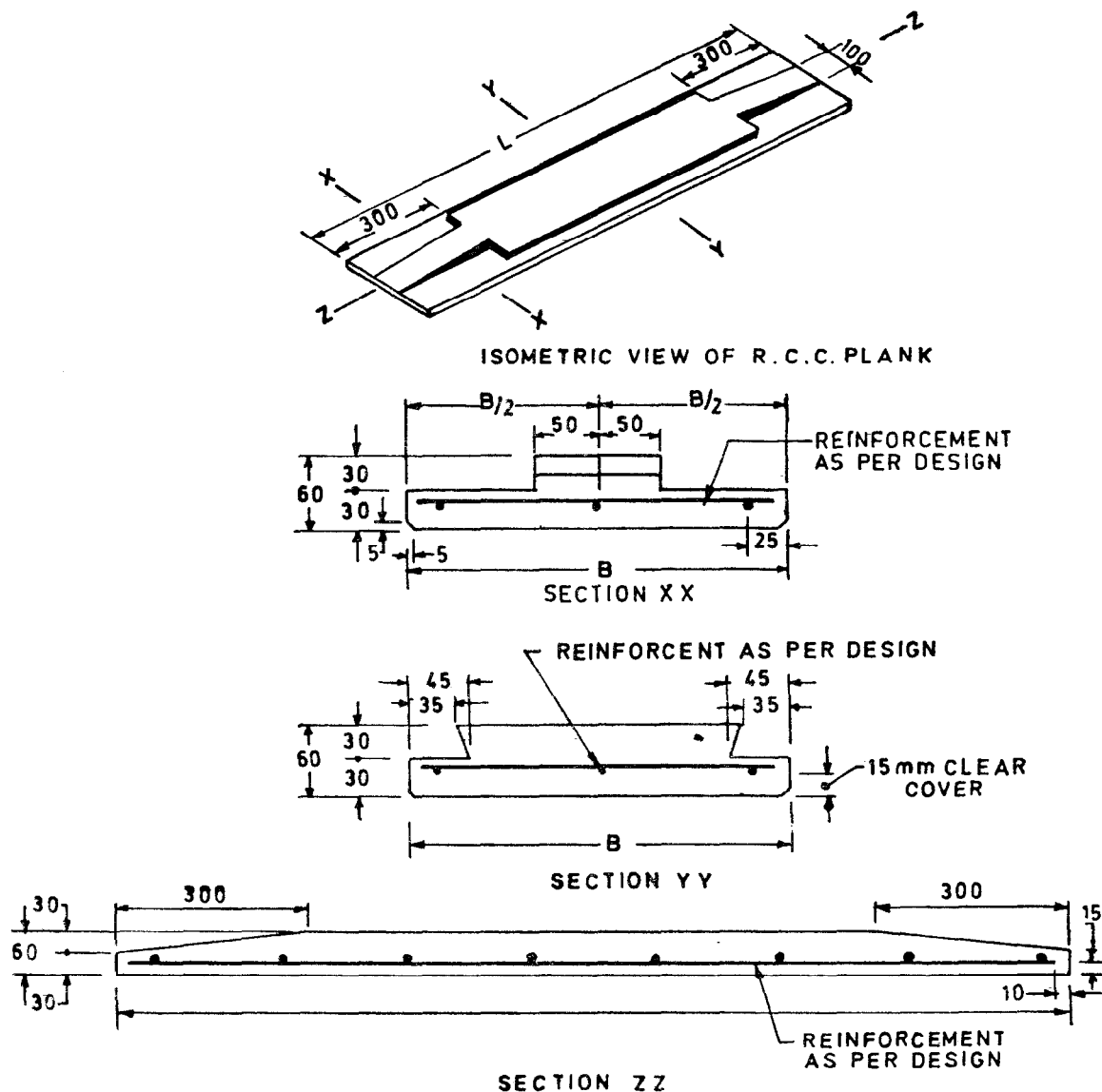
4.2 Partially Precast Joists

The width of precast joists shall be kept equal to required width of web of T-beam (*see* IS 13994 : 1994) and the depth shall be kept equal to the required overall depth of T-beam less the thickness of flange, that is, the maximum thickness of RC planks (60 mm).

4.3 Tolerances

Casting tolerances on various dimensions of plank shall be as given below:

<i>Dimension</i>	<i>Tolerance</i>
Length	± 5 mm
Width	± 3 mm
Thickness	± 2 mm
Bow (deviation from intended line or plane)	± 2 mm
Twist (distance of any corner from the plane containing other three corners)	1 mm



All dimensions in millimetres.

FIG. 1 PRECAST R.C.C. PLANK

4.3.1 Squareness

The long edge of planks shall be taken as the base line. The shorter side shall not vary in its length from perpendicular distance between long edges by more than 3 mm.

4.3.2 Flatness

The maximum deviation from a 1.5 m straight edge placed in any position on a nominal plane surface shall not exceed 2 mm.

5 DESIGN

5.1 The planks shall be designed as simply supported for self weight including *in-situ* concrete over haunches, and as a continuous slab for a load comprising live load, self weight and dead

load of floor finish and/or water proofing treatment. The design shall be in accordance with the limit state method of IS 456 : 1978.

5.2 Reinforcement

5.2.1 Reinforcement for the planks shall comprise three equally spaced bars of required diameter along the length of planks as main reinforcement. Distribution reinforcement shall be equal to or more than the minimum recommended for slabs in IS 456 : 1978. The main reinforcement shall also fulfil the requirement of maximum permissible spacing given in IS 456 : 1978.

5.2.2 Reinforcement for planks for roofs and floors of residential buildings for spacing of joists at 1.5 m, shall comprise 3 bars of 6 mm of mild steel grade I conforming to IS 432 (Part 1) :

1982 as main reinforcement and 6 mm dia bars, of mild steel grade I conforming to IS 432 (Part I) : 1982, at 200 mm c/c as transverse reinforcement. In the absence of detailed design same reinforcement may be used for spacing of joist smaller than 1.5 m.

5.2.3 Reinforcement for RCC joist shall be provided as per design (see IS 13994 : 1994).

6 CASTING AND CURING OF PRECAST ELEMENTS

6.1 Precast RC Planks

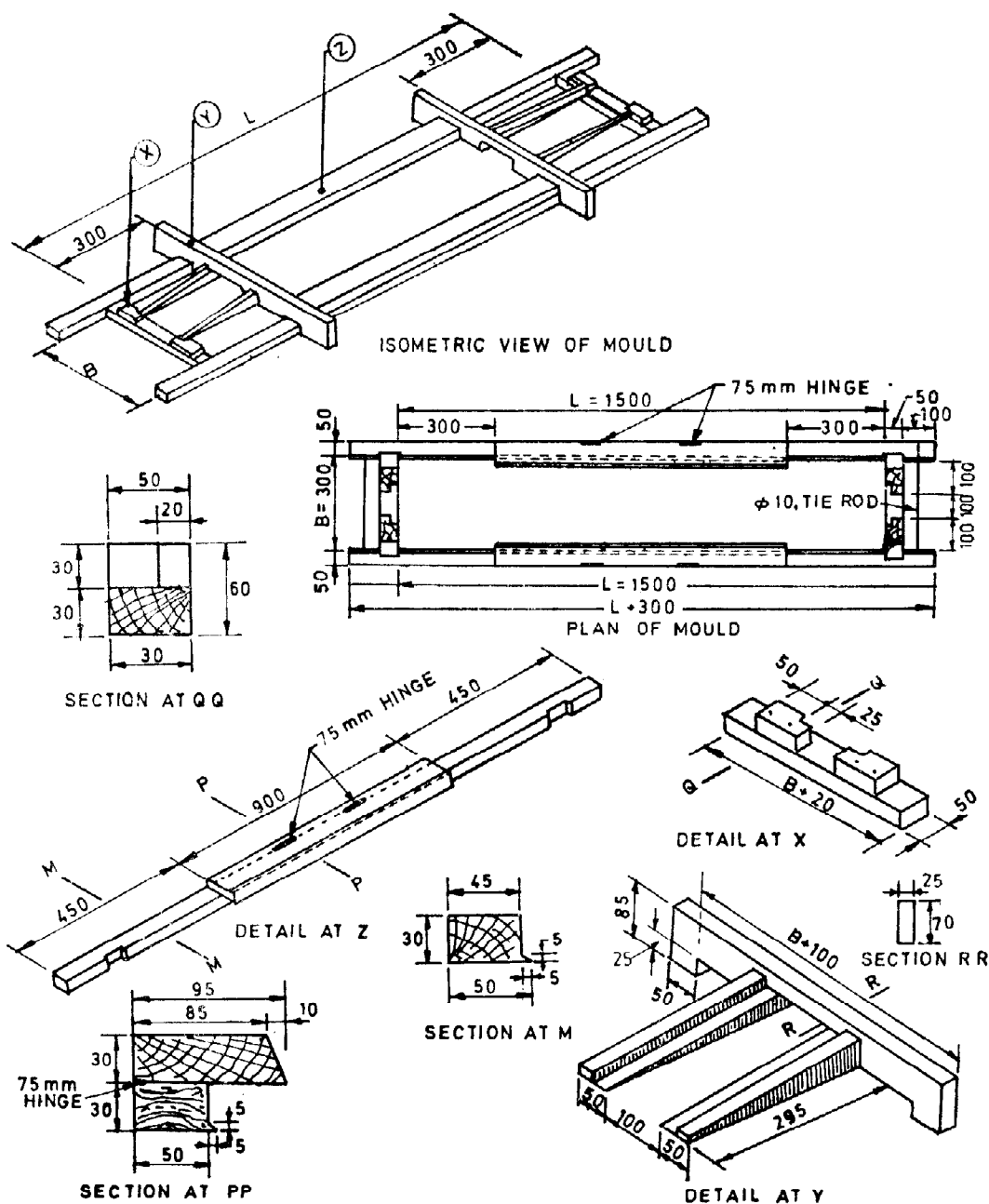
6.1.1 Moulds

Moulds may be generally made from well seasoned

good quality timber or an equivalent wood substitute. However, in case of mass production, steel, plastic or FRP moulds may be used with advantage. Any material used for making moulds shall be rigid, non-absorbant and non-corrodible and shall maintain the dimensions within the specified limits. Typical sketches of timber as well as steel moulds are shown in Fig. 2A and Fig. 2B.

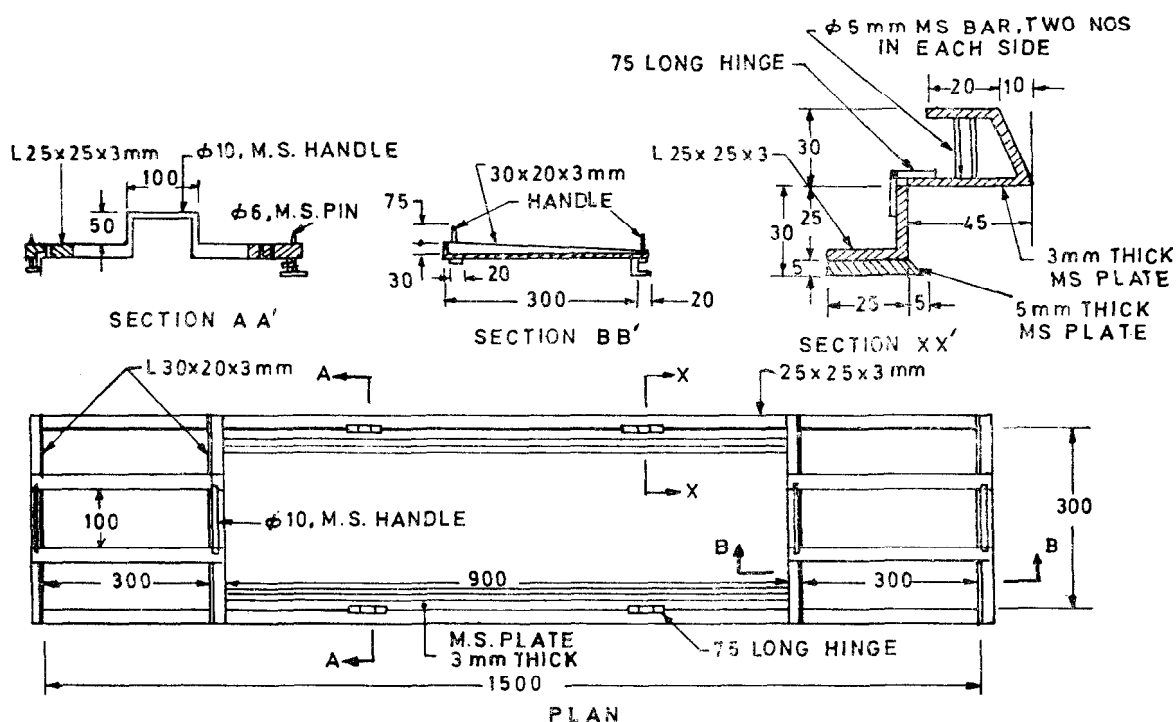
6.1.2 Casting

Inner sides of mould shall be applied with a suitable bond release agent and it shall be kept



All dimensions in millimetres.

FIG. 2A TYPICAL SKETCH OF TIMBER MOULD FOR RC PLANK



All dimensions in millimetres.

FIG. 2B TYPICAL SKETCH OF STEEL MOULD FOR RC PLANK

on a smooth concrete platform coated with the bond release agent. Alternatively wrinkle free old newspaper may be used over the concrete platform. Reinforcement cage shall be placed inside the mould in such a way as to provide a cover of 15 mm. Concrete with well graded aggregate of maximum size 10 mm shall be poured to a depth such that after compaction with a plate vibrator, shall become 30 mm. The upper side of the longitudinal members of the mould and the two tapering members shall be then placed over the mould. Concrete shall then be poured in middle and the sides and compacted with a plate vibrator. Concrete shall be finished level with the mould and the top surface shall be made rough by trowel markings. After about half an hour of casting, the two tapering members may be lifted off. The mould may be stripped off in about 2 hours (depending on the weather). About 24 to 30 hours after casting (depending on the weather), the cast unit shall be first slid by push and then tilted through right angles on long edge. It shall then be transported in vertical position for curing.

6.1.3 Curing

The units shall then be stacked against a vertical support in nearly vertical position and cured for at least two weeks by sprinkling water. It shall further be air-cured for another two weeks before it can be used for construction.

6.2 Partially Precast RC Joists

6.2.1 Moulds

Moulds may be made from the same material as recommended for moulds for planks (see 6.1.1). Typical details of timber and steel moulds are shown in Fig. 3A and 3B.

6.2.1.1 Tolerances on mould dimensions shall be as given below:

Dimension	Tolerance (mm)
Length	± 4 mm
Width	± 2 mm
Depth	± 2 mm

6.2.2 Casting

The mould shall be assembled and bond release agent applied on the inner side. Reinforcement cage with a gap from bottom of 25 mm for cover shall be placed in the mould with the stirrups projecting out as shown in Fig. 4. The top spacer pieces shall be fixed over the mould. Cement concrete with well graded aggregate of 20 mm maximum size shall then be poured in the mould and compacted either with a plate vibrator by placing it on the top of the mould or by inserting a needle

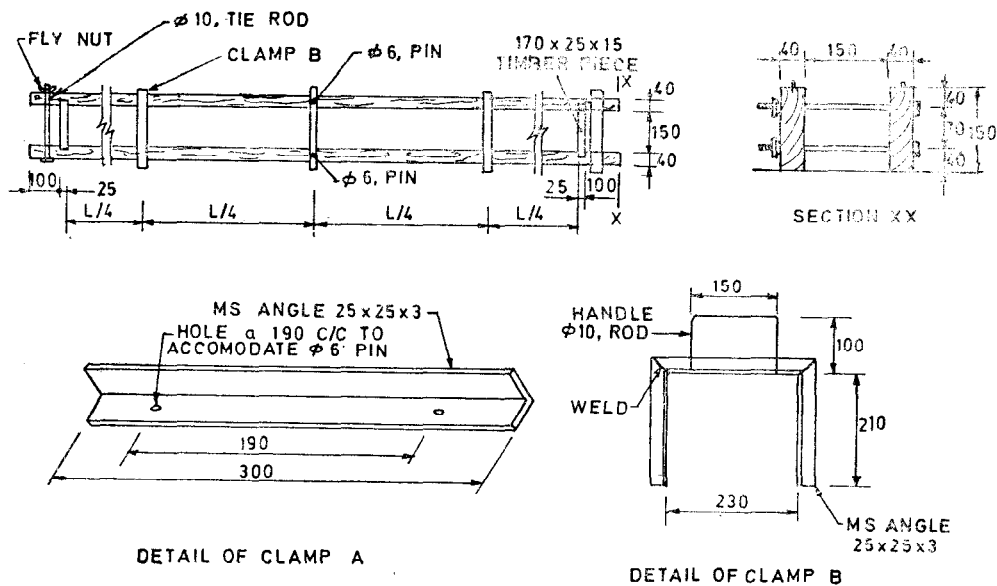
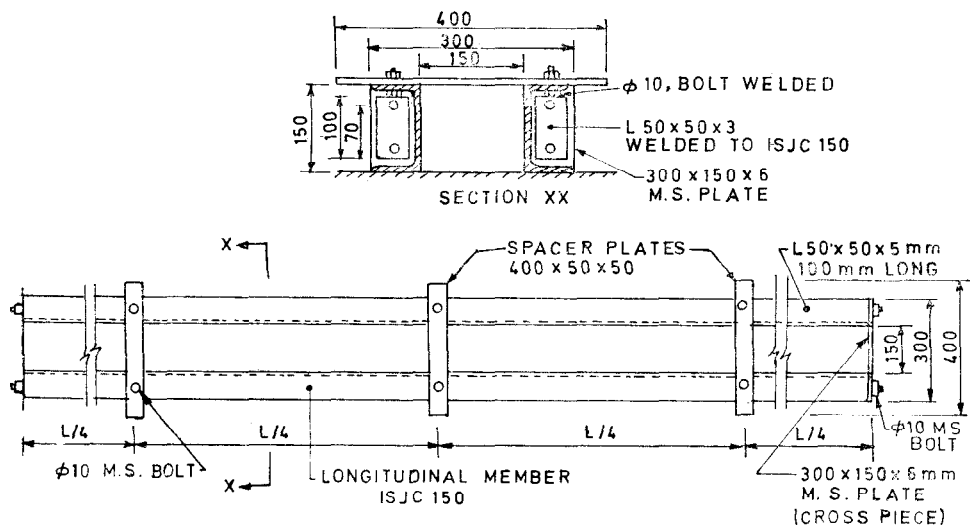


FIG. 3A TYPICAL SKETCH OF TIMBER MOULD FOR PARTIAL PRECAST JOIST



All dimensions in millimetres.

FIG. 3B TYPICAL SKETCH OF STEEL MOULD FOR PRECAST RC JOIST

vibrator. The mould may be stripped after 3 to 4 hours depending on weather. After 48 to 72 hours (depending on weather), the joists shall be first slid by push and then transported to the curing area by holding them near the ends.

6.2.3 Curing

The precast joists shall be water cured for a minimum period of two weeks and aircured further for at least two or more weeks before they can be used for construction.

7 SAMPLING

7.1 All the precast reinforced concrete units of the same size, manufactured from similar condition of productions shall be grouped together to constitute a lot.

7.2 Five units shall be selected at random out of a lot consisting of 300 units or less. For lot bigger than 300 units 5 units shall be selected for every additional 300 units or part thereof. In order to ensure randomness of selection, procedure given in IS 4905 : 1968 may be followed.

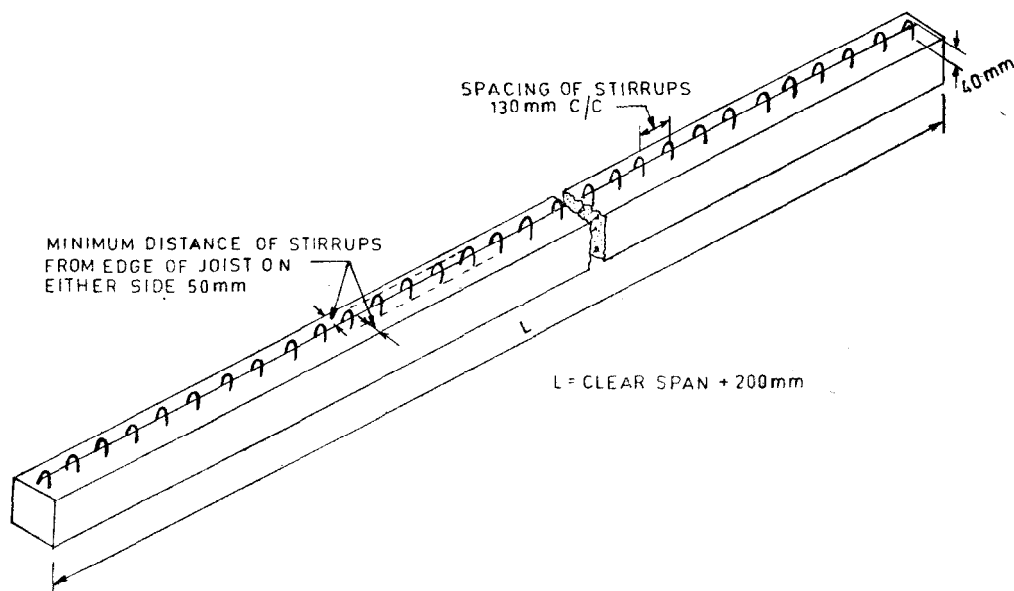


FIG. 4 ILLUSTRATIVE SKETCH OF PARTIALLY PRECAST JOIST

7.3 The samples shall be suitably marked for future identification of the lot it represents.

8 TEST

Tests shall be conducted on samples of the units as given in Annex A.

8.1 Dimensional test and deflection recovery test shall be routine test whereas failure load test shall be a type test. Type test is intended to prove the suitability and performance of a new design and size of a component. Failure load test be applied at the time of design of a component of a particular size or at the time of any change in the design/size.

9 CRITERIA OF CONFORMITY

9.1 If four out of the five samples satisfy the shape and dimensional requirements given in 4, the lot represented by the sample shall be deemed to have passed the dimensional requirements given in 4, otherwise it shall be rejected.

9.2 In the deflection recovery test performed in accordance with Annex A, if the deflection after 24 h of the removal of the imposed load is at least 75 percent of the deflection under the load for 24 h, the units shall be deemed to have passed the test. If the deflection recovery is less than 75 percent the lot represented by the unit shall be rejected. If the maximum deflection in mm, shown during 24 h under load is less than $40 l^2/D$,

where l is the effective span in mm and D , the overall depth of the section in mm, it is not necessary for the deflection recovery to be measured and the recovery provision mentioned in this clause earlier shall not apply

In case of the failure load performed in accordance with Annex A, the unit shall carry a load at least equal to 1.33 times the characteristics load to pass the test. If the load at failure is less than 1.33 times the characteristic load, the lot represented by the sample shall be rejected.

10 MARKING

10.1 Each component shall be legibly and indelibly marked with the following:

- a) Identification of the source of manufacturer, and
- b) Month and year of manufacture.

10.2 BIS Certification Marking

The components may also be marked with Standard Mark.

10.2.1 The use of Standard Mark is governed by the provisions of Bureau of Indian Standards Act, 1986 and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

ANNEX A

(Clauses 8 and 9)

TEST FOR PRECAST REINFORCED CONCRETE PLANKS AND JOISTS

A-1 AGE OF TESTING

The precast reinforced concrete planks shall be tested at an age of 28 days after *in-situ* concrete has been laid in the haunch portion as mentioned in A-3. Precast joists shall be tested at an age of 28 to 33 days after casting.

A-2 DIMENSIONAL CONFORMITY

5 Samples of planks and joist selected in accordance with 7.2 shall be checked for conformity with the shape and dimensional requirements as given in 4. Length of unit shall be measured with a steel tape at least 5 m long having graduation in mm. Other dimensions shall be measured with 1 m long steel scale having graduation in mm.

A-3 DEFLECTION RECOVERY TEST OF REINFORCED CONCRETE PLANK

A-3.1 One unit selected at random out of the units which have satisfied shape and dimensional requirements shall be subjected to deflection recovery test. The precast units shall be simply supported with a bearing of 50 mm over brickwall finished level and smooth with cement mortar 1 : 4 as shown in Fig. 5. The haunches around the plank shall be filled with M15 concrete using 10 mm and down graded aggregate. The haunch concrete shall be water cured for 14 days. Design dead load other than due to self weight of the unit shall be applied uniformly over the unit through loading blocks or by other means. A dial gauge having least count of 0.02 mm or less and a range of 50 mm or more shall be fixed at mid-span of the units. The dial gauge shall be adjusted to indicate zero reading under self weight of the units and applied dead load.

A-3.2 The plank shall be subjected to a uniformly distributed load equal to 1.25 times the imposed design load, applied through loading blocks of

concrete or steel. Alternatively, uniform load can be applied by hydraulic jacks through a self reacting frame and a set of beam to distribute the load. The load shall be retained for 24 h. After recording deflection at the end of this period, the load shall be removed.

The residual deflection shall be recorded again after twenty-four hours of removal of the load for deflection recovery.

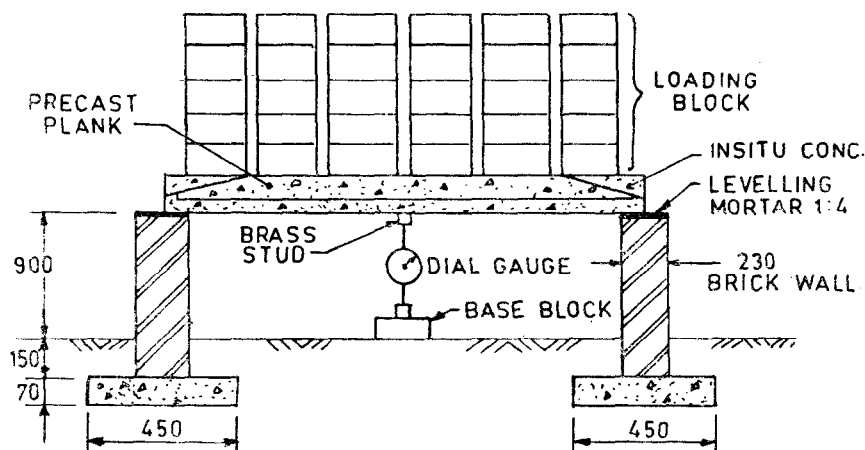
A-4 FAILURE LOAD TEST

A-4.1 The RC plank which has passed the deflection recovery test shall be subjected further to failure load test. Loading shall be done uniformly through loading blocks or through hydraulic jacks and a set of beams to distribute the load. If loading is done through blocks to sufficient gap shall be provided between adjacent tiers of blocks to ensure that they do not touch each other even at the final stages of loading, to prevent transfer of load to supports of units through arch action. Loading shall be preferably done from an independent scaffold as a safety precaution.

A-4.2 The loading shall continue till the plank fails. If no failure occurs by crushing or breaking of the unit, the load causing a deflection equal to 1 in 60 of clear span of the unit shall be considered as the failure load. To check that the limiting deflection is not exceeded, a steel marker shall be fixed below the unit at midspan, leaving a gap of 1 in 60 of clear span before the start of the test.

A-4.3 Load Test for RC Joist

The test shall be done similar to the test for RC planks, except that instead of uniform load, point loads shall be applied at middle third points and the bearing of the joist at each ends shall be 100 mm.



All dimensions in millimetres.

FIG. 5 LOADING TEST

ANNEX B

(Foreword)

COMMITTEE COMPOSITION

Composition of Housing Sectional Committee, CED 51

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(Continued on page 9)

(Continued from page 8)

**Composition of the Panel for Modular Coordination and Prefabrication for
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Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition.

This Indian Standard has been developed from Doc No. CED 51 (5041).

Amendments Issued Since Publication

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