IS 14142 (1994): Code of practice for design and construction of floors and roofs with prefabricated brick panel [CED 51: Planning, Housing and pre-fabricated construction]

BLANK PAGE

IS 14142 : 1994
(Reaffirmed 2005)

भारतीय मानक

पूर्व निर्मित ईंट पैनल एवं आंशिक पूर्वढलित जॉइस्ट से बनी फर्श एवं छत के डिजाइन एवं निर्माण — रीति संहिता

Indian Standard

DESIGN AND CONSTRUCTION OF FLOORS AND ROOFS WITH PREFABRICATED BRICK PANEL — CODE OF PRACTICE

UDC 691·328-413·692·4 : 006·76

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

July 1994

Price Group 3

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 greatest stress is being laid on housing for these target groups.

This standard is one of a series of standards being published by BIS 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 to be published in the series are:

a) Prefabricated brick panel and partially precast concrete joist for flooring and roofing — Specification

b) Precast reinforced conerete channel unit for construction of floors and roofs — Specification

c) Design and construction of floors and roofs with precast reinforced concrete channel units — Code of practice

d) Precast reinforced concrete planks and joists for roofing and flooring — Specification

e) Design and construction of floor and roof with precast reinforced concrete planks and joists — Code of practice

f) Design and construction of roof with precast reinforced concrete L-panel units — Code of practice

g) Precast reinforced concrete L-panel units for roofing — Specification

The use of reinforced brick roofs had been quite common in Northern parts of India. Its design was based on the crushing strength of brick. The large variation in crushing strength of bricks had however, inhibited their use and raised doubts about the feasibility and performance of reinforced brick roofing/flooring slab. Further, the corrosion of reinforcement due to contact between mild steel bars and bricks also cause reduction in the life of roof. Also, the crushing strength of bricks usually being low, the thickness of slab increases causing an increase in dead load too.

Central Building Research Institute (CBRI), Roorkee has developed prefabricated brick panel system which is a combination of concrete, bricks and reinforcement such that concrete is used in the zone of maximum compressive stresses and hence bricks of lower compressive strength may also be used. T-beams action develops between partially precast joist and the *in-situ* concrete. Considerable assistance has been rendered in the preparation of this standard by CBRI, Roorkee.

The technical 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

DESIGN AND CONSTRUCTION OF FLOORS AND ROOFS WITH PREFABRICATED BRICK PANEL — CODE OF PRACTICE

1 SCOPE

This standard lays down recommendations for design and construction of floor and roof with prefabricated brick panels.

2 REFERENCES

The Indian Standards listed in Annex A are necessary adjuncts to this standard.

3 ELEMENTS OF ROOF/FLOOR

3.1 Prefabricated Brick Panels and Partially Precast Joist

The prefabricated brick panels and partially precast joist used for construction of roofs and floors shall conform to IS 14143 : 1994.

3.2 Concrete

Concrete used for *in-situ* concrete shall conform to grade M15 or higher conforming to IS 456 : 1978. The aggregate used for concrete shall be well graded with a maximum size of 20 mm and 10 mm for joists and *in-situ* concrete respectively.

3.3 Reinforcement

Reinforcing steel shall be as recommended in IS 456 : 1978.

4 DESIGN CRITERIA

4.1 Prefabricated Brick Panels

4.1.1 The prefabricated brick panel shall be designed as simply supported between two joists or a joist and a wall

4.1.2 The panel shall be designed for three stages as follows:

i) Precasting, lifting, transportation and handling (Stage I)

ii) Placing and accidental loading during construction (Stage II)

iii) Final loading condition (Stage III)

4.1.2.1 The following loads shall be considered for different stages of design:

i) For stage I, self weight of panel without *in-situ* concrete plus 50 percent of self weight of panel for impact or vibration during handling and transporting.

ii) For stage II, self weight of panel including weight of *in-situ* concrete and an accidental load, which, in absence of more accurate information, may be taken as half the imposed load given for stage III

iii) For stage III, self weight of panel including *in-situ* concrete and imposed load as specified in IS 875 (Part 2): 1987 and a load of 200 kg/m^2 or 100 kg/m^2 for roofs or floors respectively. Load of 200 kg/m^2 is taken for weight of waterproofing and insulation treatment while the load of 100 kg/m^2 in case of intermediate floors is taken for weight of floor finish. In case other specification being followed the loads for the floors or roofs may be accordingly considered in the design.

4.1.2.2 While designing the panel for stage II, the *in-situ* concrete *shall not* be considered as sharing the compression because it does not attain strength at this stage. While designing for stage III, the *in-situ* concrete of 3·5 cm depth shall be considered as acting together with brick panels in the compression zone.

4.2 Partially Precast Joists

4.2.1 The partially precast joist shall be designed for three stages as follow:

i) Precast. lifting, transportation and handling (Stage I)

ii) Placing and accidental loading during construction (Stage II)

iii) Final loading condition (Stage III)

4.2.1.1 The following loads shall be considered for different stages of design:

i) Stage I, self weight of joists plus 50 percent of self weight of joist for impact or vibration during handling and transportation.

ii) Stage II, joist shall be propped at two points at 1$\frac{1}{3}$rd span before laying bricks panel and 1/3 span shall be taken for design purpose and self weight of joist and panel including *in-situ* concrete and accident load, which in the absence of more accurate information, may be taken as half the imposed load given for stage II.

iii) Stage III, self weight of joist, dead weight of brick panels including *in-situ* concrete, imposed load in accordance with IS 875 (Part 2) : 1987 and load of roof or floor.

4.2.2 The partially precast concrete joist shall be designed as T-beam with 35 mm flange thickness for stage III of loading and as a partially precast beam for stage I and II of loading. Reinforcement required with normal loading for various span of joist for a spacing of 1 200 mm c/c may be taken from Table 1.

4.2.3 The joist shall be designed as continuous beam, it may be designed either as simply supported or continuous T-beam in accordance with IS 456 : 1978.

4.2.3.1 When the joist is designed as continuous beam, it may be designed as doubly reinforced beam. When it is possible to weld the bottom reinforcement at supports the same shall be kept projecting. If the welding is not possible, the joist shall be designed as singly reinforced for hogging bending moment at support, In such a case, redistribution of moment in accordance with IS 456 : 1978 may be resorted.

4.2.4 A clear cover of 25 mm shall be provided for longitudinal reinforcement.

4.3 When precast units are used for construction of building in high seismic zones, the roofs/floors shall be strengthened as per the provision of IS 4326 : 1993.

5 TRANSPORTATION AND HANDLING

5.1 The prefabricated brick panel shall be transported by placing them vertically against the side of the truck/trailer or any other carriage. The prefabricated brick panel shall be handled in the horizontal position using suitable rope slings. They should be lifted and transported without jerks and vibration.

The RC joist shall be lifted by placing slings at either ends. These shall be placed in carriage in such a way that the overhang is not more than 1/5 of the length.

6 ERECTION

6.1 Joists and panels shall be cleaned properly to remove dust and loose particles before placing these in position.

6.2 Surface of the wall on which joists are to be placed shall be overlaid by a 10 to 15 mm thick layer cement coarse sand (1 : 4) mortar. Top of the mortar shall have smooth finish. The joists shall be placed above this and properly aligned. The joist shall be propped, immediately after placing, at two places dividing the length of joist in three equal parts. The props shall not be removed before the *in-situ* concrete has hardened. Minimum bearing of joists over walls shall be 75 mm. The wall in between the joists shall be raised up to the level of joists using cement sand (1 : 6) mortar.

6.3 The brick panels shall then be placed over the joists/walls, side by side after laying a 6 mm thick layer of cement coarse sand (1 : 4) mortar over the joists/walls to ensure proper setting of panels. Frogs of bricks should be kept upward while casting and placing brick panel on joist. The minimum bearing 40 mm shall be provided for panels. A gap of 20 to 40 mm shall be left in between adjacent panels. These gaps between the panels shall be filled up with M 15 concrete with the help of wooden strip placed below the joist and held in position during filling of concrete. The strip can be removed immediately by sliding horizontally.

6.4 Distribution/temperature reinforcement shall then be laid over the panels in both the directions, that is, parallel and perpendicular to the joist. This may consist of atleast one 6 mm mild steel grade I bar conforming to IS 432 (Part 1) : 1982 in each direction.

6.5 Concrete shall then be laid over the panels and joists up to a depth of 135 mm above the top of panels. The roof shall then be finished with a floating coat of 1 : 3 cement fine sand mortar of not more than 6 mm thickness just after laying the *in-situ* concrete. The *in-situ* concrete shall be cured for atleast 2 weeks by ponding.

6.6 The sprouts for rain water shall be made while laying the deck concrete to avoid any seepage through this joint.

6.7 To have proper drainage in case of roof, a slope of 1 : 40 shall be given to the roof either by raising the joists on one side, or, if needed otherwise, by completing and finishing the walls with the required slope.

6.8 A typical section through the assembled roof is shown in Fig. 1.

7 FLOOR/ROOF FINISH

7.1 Floor/roof finish shall be provided after the *in-situ* concrete has hardened. Guidance for providing different types of floor/roof finishes may be taken from relevant Indian Standard. Waterproofing treatment to the roofs shall be provided as desired. Guidance for this may be taken from relevant Indian Standards. For waterproofing using bitumen felts, bitumen mastic, glass fibre tissue reinforced bitumen and lime concrete, IS 1346 : 1978, IS 4365 : 1967, IS 9918 : 1981 and IS 3036 : 1992 may be referred.

Table 1 For Steel Reinforcement Requirement for Various Spans for Joists for a Spacing to 1 200 mm c/c

(*Clause* 4.2.2)

Reinforcement at	Clear Span of Joists in mm								
	1 800	2 100	2 400	2 700	3 000	3 300	3 600	3 900	4 200
Bottom	2-8 ϕ or 2-8 $\overset{\frown}{\phi}$	2-10 ϕ or 2-8 $\overset{\frown}{\phi}$	2-10 ϕ or 3-8 $\overset{\frown}{\phi}$	2-12 ϕ or 1-10 $\overset{\frown}{\phi}^{+}$ 2-8 $\overset{\frown}{\phi}$	3-10 ϕ or 1-I2 $\overset{\frown}{\phi}^{+}$ 2-8 $\overset{\frown}{\phi}$	3-12 ϕ or 2-I2 $\overset{\frown}{\phi}^{+}$ 1-10 $\overset{\frown}{\phi}$	2-16 ϕ or 3-12 $\overset{\frown}{\phi}$	2-16 ϕ 1-10 Φ or 2-16 $\overset{\frown}{\phi}$	3-16 ϕ or 1-16 $\overset{\frown}{\phi}^{+}$ 2-12 $\overset{\frown}{\phi}$
Middle	1 No. 6 ϕ	1 No. 6 ϕ	1 No. 6 ϕ	1 No. 6 ϕ	1 No. 8 ϕ^{+}	1 No. 8 ϕ^{+}	1 No. 8 ϕ^{+}	1 No. 10 ϕ^{+}	1 No. 10 ϕ^{+}
Top	1 No. 6 ϕ	1 No. 6 ϕ	1 No. 6 ϕ	1 No. 6 ϕ	1 No. 6 ϕ	1 No. 6 ϕ	1 No. 6 ϕ	1 No. 6 ϕ	1 No. 6 ϕ
Stirrups	6 ϕ 130 mm c/c	6 ϕ 130 mm c/c	6 ϕ 130 mm c/c	6 ϕ 130 mm c/c	6 ϕ 130 mm c/c	6 ϕ 130 mm c/c	6 ϕ 130 mm c/c	6 ϕ 130 mm c/c	4 No. 6 ϕ 100 mm c/c at ends and 130 mm c/c in middle portion

$^{+}$ = Can be reduced to 6 ϕ if proper handling is ensured.

ϕ = Mild steel bars.

$\overset{\frown}{\phi}$ = Deformed bars.

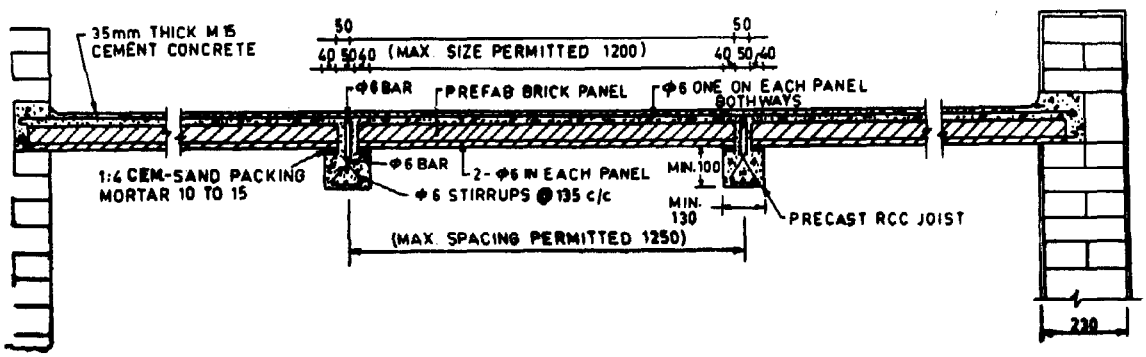

FIG. 1 TYPICAL SECTION THROUGH BRICK PANEL ROOF

ANNEX A

(*Clause* 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
432 (Part 1) : 1982	Specification for mild steel and medium tensile steel bars and hard-drawn steel wire for concrete reinforcement : Part 1 Mild steel and medium tensile steel bars (*third revision*)
456 : 1978	Code of practice for plain and reinforced concrete (*third revision*)
875 (Part 2) : 1987	Code of practice for design loads (other than earthquake) for buildings and structures : Part 2 Imposed loads (*third revision*)

IS No.	*Title*
1346 : 1991	Code of practice for waterproofing of roofs with bitumen felts (*second revision*)
3036 : 1992	Code of practice for laying lime concrete for a waterproofed roof finish (*second revision*)
4326 : 1993	Code or practice for earthquake resistant design and construction of buildings (*second revision*)
4365 : 1967	Code of practice for application of bitumen mastic for waterproofing of roofs
9918 : 1981	Code of practice for *in-situ* waterproofing and damp-proofing treatments with glass fibre tissue reinforced bitumen
14143 : 1994	Prefabricated brick panel and partially precast concrete joist for flooring and roofing — Specification

ANNEX B

(*Foreword* and *Clause* 9.3)

COMMITTEE COMPOSITION

Housing Sectional Committee, CED 51

Chairman	*Representing*
DR P. S. A. SUNDARAM	Ministry of Urban Development, New Delhi
Members	
SHRI G. R. AMBWANI	Municipal Corporation of Delhi, Delhi
SHRI AROMAR RAVI	The Action Research Unit, New Delhi
PROF H. P. BAHARI	School of Planning and Architect, New Delhi
PROF SUBIR SAHA (*Alternate*)	
SHRI K. K. BHATNAGAR	Housing and Urban Development Corporation, New Delhi
SHRI M. N. JOGLEKAR (*Alternate*)	
SHRI H. U. BIJLANI	In personal capacity (*1, Sadhna Enclave, Panchsheel Park, New Delhi 110017*)
SHRI S. N. CHATTERJEE	Calcutta Municipal Corporation, Calcutta
CHIEF ARCHITECT	Central Public Works Department, New Delhi
SR ARCHITECT (H & T P-1) (*Alternate*)	
CHIEF ENGINEER, AUTHORITY	Maharashtra Housing and Area Development Authority, Bombay
ARCHITECT, AUTHORITY (*Alternate*)	
CHIEF ENGINEER (D)	Central Public Works Department, New Delhi
SUPERINTENDING ENGINEER (D) (*Alternate*)	
ENGINEER MEMBER, DDA	Delhi Development Authority, New Delhi
SHRI Y. K. GARG	National Housing Bank, New Delhi
SHRI CHETAN VAIDYA (*Alternate*)	
SHRI O. P. GARVALI	National Council for Cement and Building Materials, New Delhi
DR N. K. JAIN (*Alternate*)	
SHRI T. N. GUPTA	Building Material and Technology, Promotion Council, New Delhi
SHRI HARBINDER SINGH	Public Works Department, Government of Rajasthan, Jaipur
SHRI R. N. AGRAWAL (*Alternate*)	
DR K. S. JAGDISH	Centre for Application of Science and Technology to Rural Areas (ASTRA), Bangalore
DR B. V. VENKATARAMAN REDDY (*Alternate*)	
SHRI N. N. JAVDEKAR	CIDCG, Maharashtra
SHRI P. M. DESHPANDE (*Alternate*)	
SHRI T. P. KALIAPPAN	Tamil Nadu Slum Clearance Board, Government of Tamil Nadu, Madras
SHRI J. BHUVANESWARAN (*Alternate*)	
MISS NINA KAPOOR	The Mud Village Society, New Delhi
SHRI A. K. M. KARIM	Housing Department, Government of Meghalaya, Shillong
SHRI K. R. S. KRISHNAN	Department of Science and Technology (DST), New Delhi
COL D. V. PADSALGIKAR	M/S B. G. Shirke and Co, Pune
SHRI RAJA SINGH	IRCON, New Delhi
SHRI S. SELVANTHAN (*Alternate*)	
DR A. G. MADHAVA RAO	Structural Engineering Research Centre (CSIR), Madras
SHRI I. K. MANI (*Alternate*)	
SHRI T. K. SAHA	Engineer-In-Chief's Branch, New Delhi
SHRI R. K. MITTAL (*Alternate*)	
SHRI J. S. SHARMA	Central Building Research Institute (CSIR), Roorkee
SHRI B. B. GARG (*Alternate*)	
SHRI J. VENKATARAMAN, Director (Civil Engg)	Director General, BIS (*Ex-officio Member*)

Member Secretary

SHRI J. K. PRASAD
Joint Director (Civil Engg), BIS

Panel for Modular Coordination and Prefabrication for Mass Scale Housing, CED 51 : P2

Convener	
SHRI T. N. GUPTA	Ministry of Urban Development, New Delhi
Members	
SHRI Y. K. GARG	National Housing Bank, New Delhi
SHRI SUNIL BERRY (*Alternate*)	
SHRI M. N. JOGLEKAR	Housing and Urban Development Corporation, New Delhi
PROF V. P. RAORI	School of Planning and Architects, New Delhi
PROF P. K. CHOUDHARY (*Alternate*)	

(*Continued on page* 6)

(*Continued from page 5*)

Members	*Representing*
SHRI G. S. RAO	National Building Construction Corporation, New Delhi
REPRESENTATIVE	M/s B. G. Shirke and Co, Pune
DR A. G. MADHAVA RAO	Structural Engineering Research Centre, Madras
SHRI K. MANI (*Alternate*)	
SHRI S. ROY	Hindustan Prefab Ltd, New Delhi
SHRI M. KUNDU (*Alternate*)	
SHRI J. S. SHARMA	Central Building Research Institute, Roorkee
SHRI M. P. JAI SINGH (*Alternate*)	
SUPERINTENDING, ENGINEER (D)	Central Public Works Department, New Delhi
EXECUTIVE ENGINEER (HQ) (*Alternate*)	

Bureau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act, 1986* to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

Review of Indian Standards

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 a 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 by referring to the latest issue of 'BIS Handbook' and 'Standards Monthly Additions'.

This Indian Standard has been developed from Doc: No. CED 51 (5058)

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones : 331 01 31, 331 13 75

Telegrams : Manaksanstha
(Common to all Offices)

Regional Offices:	Telephones
Central : Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 110002	331 01 31 331 13 75
Eastern : 1/14 C.I.T. Scheme VII M, V.I.P. Road, Maniktola, CALCUTTA 700054	37 84 99, 37 85 61 37 86 26, 37 86 62
Northern : SCO 335-336, Sector 34-A, CHANDIGARH 160022	60 38 43 60 20 25
Southern : C.I.T. Campus, IV Cross Road, MADRAS 600113	235 02 16, 235 04 42 235 15 19, 235 23 15
Western : Manakalaya, E9 MIDC, Marol, Andheri (East) BOMBAY 430093	632 92 95, 632 78 58 632 78 91, 632 78 92

Branches : AHMADABAD. BANGALORE. BHOPAL. BHUBANESHWAR. COIMBATORE. FARIDABAD. GHAZIABAD. GUWAHATI. HYDERABAD. JAIPUR. KANPUR. LUCKNOW. PATNA. THIRUVANANTHAPURAM.

Printed at Paragon Enterprises, Delhi, India