Prospective Construction Systems for Mass Housing

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TECHNOLOGY PROFILE

Speed Floor System

bmtpc

Building Materials & Technology Promotion Council
Ministry of Housing & Urban Poverty Alleviation
Government of India
New Delhi

System in Brief

The Speedfloor system is a suspended concrete flooring system using a roll formed steel joist as an integral part of the final concrete and steel composite floor. It is essentially a hybrid concrete/steel tee-beam in one direction and an integrated continuous one-way slab in other direction. The joists of different depths are manufactured from pre-galvanized high tensile steel in a one pass roll former, where it is roll formed, punched, pressed and slotted in a fully computerized machine manufactured in New Zealand. The joist depth and the concrete thickness are varied depending on the span, imposed loads and other functional considerations. The Speedfloor composite floor system is suitable for use in all types of construction. The Speedfloor joists are designed and custom manufactured to suit particular job conditions.

Design

The design of the speed floor system is based on NZS 3404 (Part 1 &2) 1997, AS/NZS 4600, 1996 and the Australian Composite Standard AS 2327 (Part-I). The design load shall be taken as prevalent in IS 875 (Part 1 & 3):1987. Earthquake forces shall be taken in accordance with IS 1893 (Part-1):2002.

The section properties and design parameters are calculated from the section geometry, supplementary full side tests and finite elements analysis.

The Joist

The joist is manufactured from G 350 Z 275 pre-galvanized steel conforming to AS 1397:2001. Size may be any one of the following i.e. 200mm, 250mm, 300mm, 350mm and 400mm, depending upon the design requirements. Concrete thickness may be 75mm or 90mm as required.

The joist weight vis-à-vis the depth are given below:

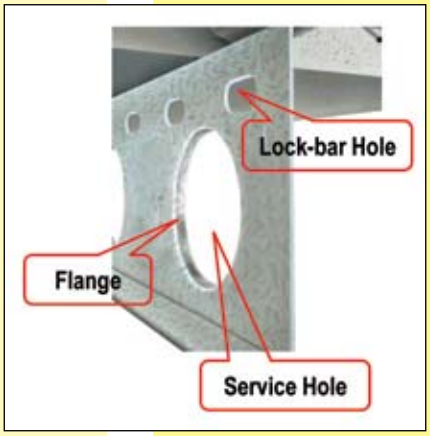
Depth (mm)	*Weight (kg/ ln m)*
200	9.41
250	10.59
300	11.76
350	12.94
400	14.12

The ***top section*** of the joist is embedded in concrete and has following functions:

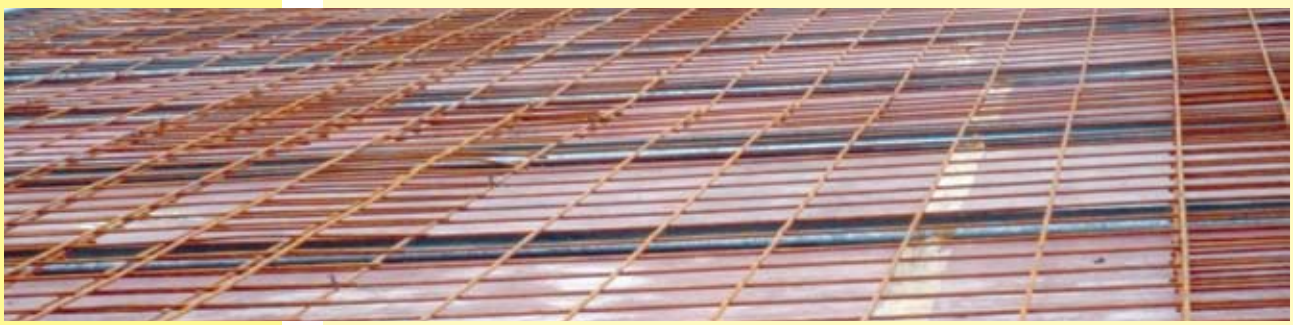
- It is the compression element of the non-composite joist during construction
- It is a 'chair' for the welded mesh or the reinforcement which develops negative moment capacity in the concrete slab over the joist
- It locks in and supports the slab shuttering system (lock bar and plywood forms)
- It becomes a continuous shear connector for the composite system. The bottom section of the joist acts as a tension member both during the construction phase and when the joist is acting compositely with the slab.

The ***mid section*** or web of the joists has the flanged service hole and the lock-bar hole punched into it. The flanging of the service hole provides stability to the web and services can pass through without requiring protection from the sharp edges of the punched material.

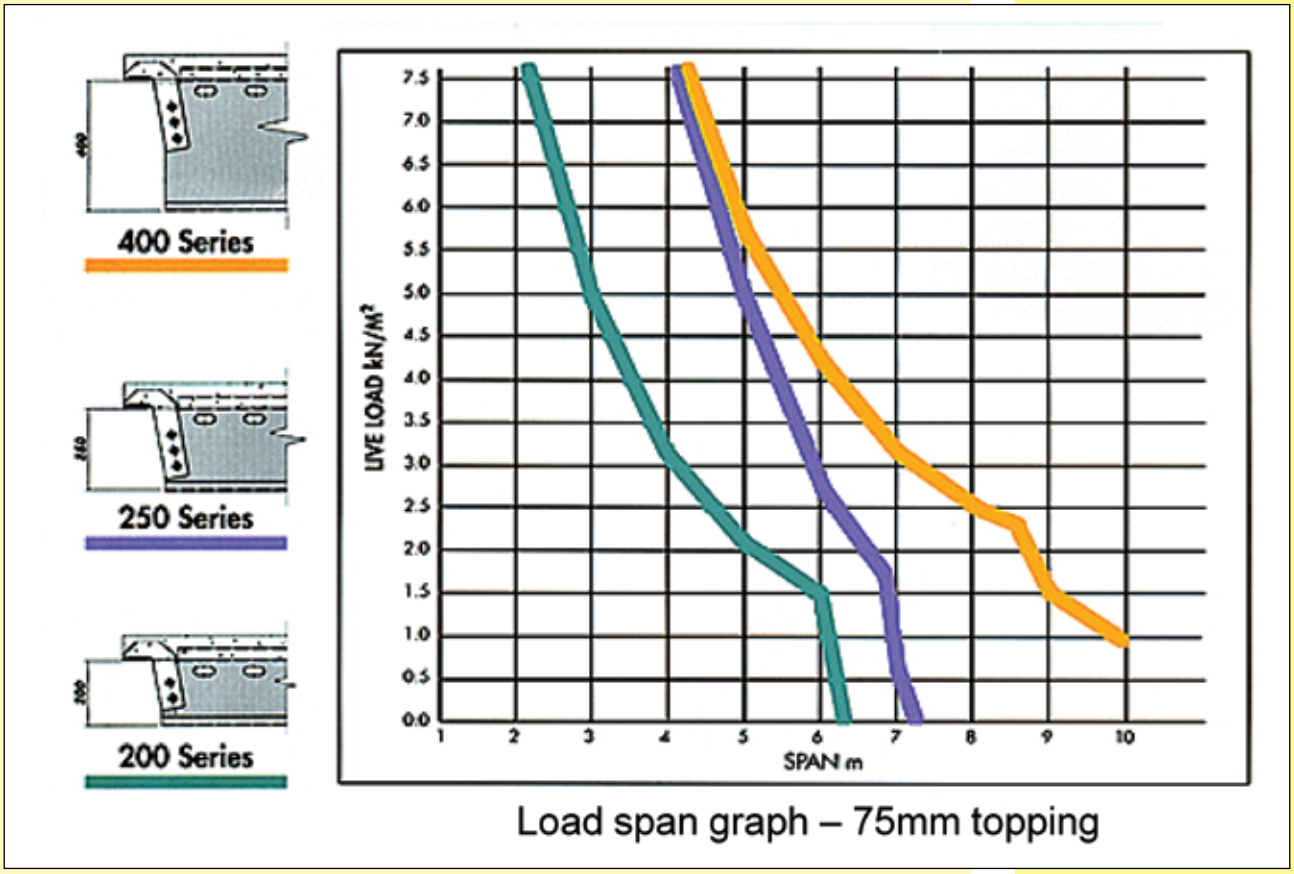
The ***bottom triangular*** section of the joist acts as a tension member both during construction phase and when the joist is acting compositely with the slab.



The Lockbar	The lockbars support the temporary plywood formwork between the joists during construction. They shall be spaced approx. 300mm apart and engage in the slotted holes punched in the top section of the joist. They also maintain the exact spacing of the joists. The standard lockbars when installed will position the joists 1230mm, 930mm or 630mm apart. There are also special adjustable lockbars that will position the joists in increments of 50mm from 330mm to 1530mm. Other type of lockbars are provided for special situations such as cantilevers or lowered soffits.
Temporary plywood formwork	High density paper overlaid 12mm shuttering plywood conforming to IS 4990:2011 or equivalent is used as formwork to produce a good finish to the underside of the slab. The rigid plywood sheets are used in conjunction with the lockbars and when locked in place, provide lateral stability to the entire Speedfloor system during the construction phase.
Reinforcing mesh	Welded reinforcement mesh made of 8mm dia bar (fy 415 N/m^2) placed @ 200mm c/c in both directions, is laid and tied into place. No chairs are required as it is held off the plywood forms by the top section of the joist, which becomes embedded in the concrete.
Concrete	(i) Minimum grade of concrete shall be M25 as per IS 456:2000. It should preferably be batched at 60mm and super plasticized to 110mm slump to provide good placement and shrinkage characteristics. A curing compound should be used and an expanding agent may be introduced in consultation with the engineer to further control shrinkage during the curing period. (ii) The concrete should initially be placed evenly and continuously over the area to be formed. Special attention should be given to ensure the concrete is screened and finished to the specified thickness so that designed deflections are achieved in the Speedfloor joists and the supporting structures. (iii) In structures for carparking, an expanding agent is generally used to reduce the effect of shrinkage during initial cure and a curing compound is used to help control the curing process.



Accessories	***Edge angles*** A standard edge form is available in two heights – 75mm & 90mm.Special heights and specially shaped edge angles may be manufactured but would require longer lead times. ***Jointers*** Precut sections of galvanized sheet steel may be supplied to overlay joints in the ply to ensure they are flush and remain well supported while the concrete is poured. ***Lockbar Hanger Angles*** A galvanized steel angle with pre-punched lockbar holes is used for situations where the lockbars need support on slab edges parallel to the joists.
Use of the Speedfloor System and Limitations	The system is used as framed steel structure in all types of construction for laying RCC roof. Maximum length of joist which can be used is 10m.
Durability	The technology provider shall provide necessary structural warranty ensuring durability of the system to the user, on demand.

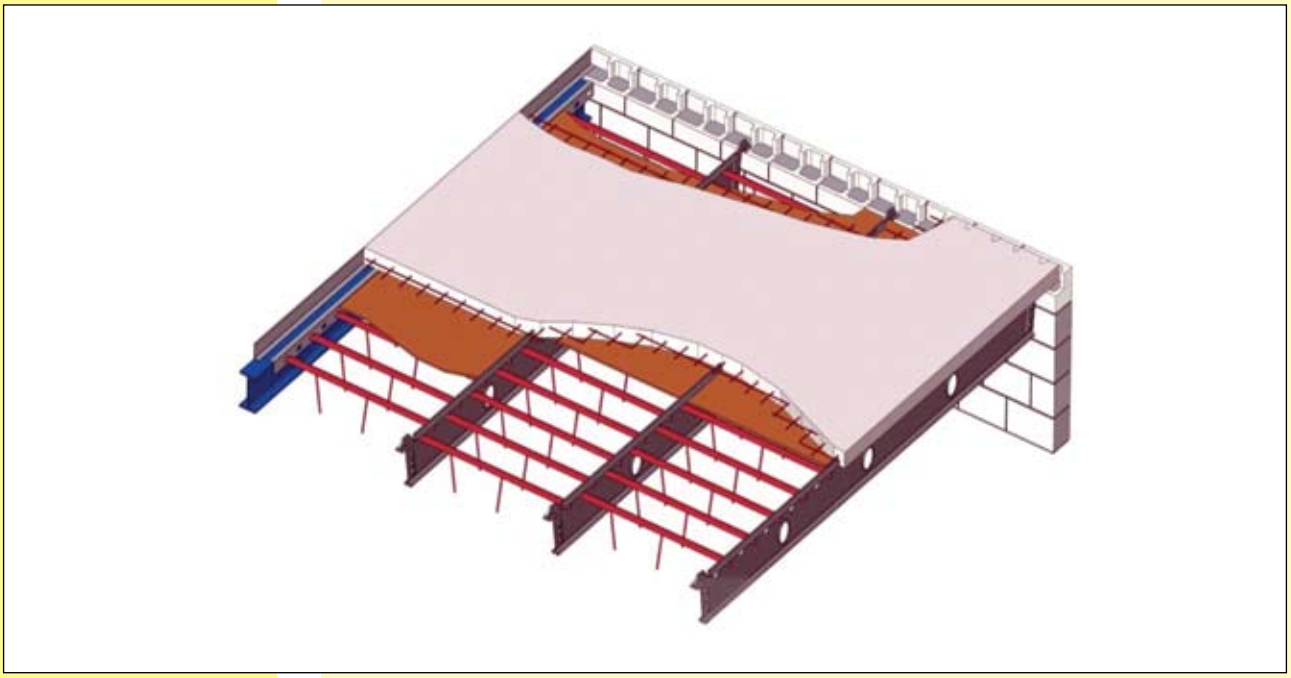


Load span graph – 75mm topping

Installation Process

Installation process is as follows:

(i) Lightweight bundles of joists is lifted into position and then individual joists are placed by hand.
(ii) Speedfloor joists are generally placed at 1250 mm c/c.
(iii) Joists are held in place using the lockbars which slip into slotted holes.
(iv) The lockbars is placed at 300mm apart to support plywood formwork. The propping is not required.
(v) Full sheets of 12.5mm plywood formwork is to be laid from above creating a working platform. Cam action of lockbars secures plywood.
(vi) Mesh is placed on top section of joist thereby embedded in the concrete poured thereafter.
(vii) After three days of concreting, lockbars and plywood are removed from the underside revealing a clean surface ready for services or a fire rated suspended ceiling.



Maintenance Requirements

Speedfloor is a composite floor system using both steel and concrete. The two materials must be treated and maintained separately.

Steel : If the joists are in a clean and dry environment, they may not require any maintenance. If they are exposed, they shall require maintenance to ensure the expected performance is achieved. Guidelines given below should be followed for maintenance

a) Keep surfaces clean and free from continuous contact with moisture, dust and other debris.

b) Periodically inspect the joists for any signs of corrosion. Remove any by-products of the corrosion by mechanical means and spot prime the exposed steel substrate with an approved steel primer. Repaint the area using an appropriate paint to manufacturer's recommendations.

Concrete: During the service life of the Speedfloor system, if any cracks appear in the concrete floor, they should be filled using an epoxy injection system or equivalent, to completely close the crack and prevent moisture ingress.

For detailed Installation process, manufacturer's Installation Manual shall be referred.

Speed Floor Applications

The Speed floor composite flooring system is suitable for use in all types of construction including:

- Steel frames structures
- RCC frame buildings
- Poured insitu or precast concrete frames
- Light gauge steel frames
- Conventional Structural brick wall constructions etc

The range of end uses include :

- General individual Houses
- Multi-storey residential blocks
- Single and multi-storey retail developments
- Mezzanine floors
- Car parks and storage buildings
- Multi-storey office complexes etc.

Standards to be Referred:

IS 277:1992	Specifications for Galvanized Steel Sheets (Plain & Corrugated)
IS 456:2000	Code of Practice for plain & reinforced Concrete (Fourth revision)
IS 875 (Parts1to3):1987	Code of Practice for Design Loads (other than earthquake) for buildings & structures
IS 1893 (Part-1):2002	Criteria for Earthquake Resistant Design of Structures - Part-1: General Provisions and Buildings
IS 2062:2011	Specifications for hot rolled medium & high tensile structural steel
IS 11384:1985	Code of Practice for Composite Construction in Steel and Concrete
AS/NZS 1170-2 (Parts 0 & 2):2002	Structural Design Actions—General principles and Wind actions
AS 2327(Part1):1996	Design of simply supported Composite structures
NZS 3101(Part1):2006	Design of Concrete Structures
NZS 3404 (Part1):1997	Design of Steel Structures
AS/NZS 4600:2005	Design of Cold Formed Steel Structures
AS/NZS 4671: 2001	Specifications for Steel reinforcing materials

About BMTPC

Set up in 1990, Building Materials & Technology Promotion Council (BMTPC) an autonomous organisation under the Ministry of Housing & Urban Poverty Alleviation strives to bridge the gap between laboratory research and field level application in the area of building materials & construction technologies.

Vision
"BMTPC to be world class knowledge and demonstration hub for providing solutions to all with special focus on common man in the area of sustainable building materials, appropriate construction technologies & systems including disaster resistant construction."

Mission
"To work towards a comprehensive and integrated approach for promotion and transfer of potential, cost-effective, environment-friendly, disaster resistant building materials and technologies including locally available materials from lab to land for sustainable development of housing."

For more information, kindly contact:

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