



Indo-Norwegian Training Programme on Seismic Design of Multi-Storey Buildings: IS 1893 vs. Eurocode 8

BMTPC has been organising Training Courses jointly with IIT Roorkee since 2006 on regular basis for educating and creating mass awareness amongst common men and professionals. IIT Roorkee is one of the premier organization having excelled in the area of earthquake resistant design and construction and one of the first School of Earthquake Engineering in India.

In 2014, NORSAR, Norway under Indo-Norwegian Collaboration Project "EQRisk" supported by the Norwegian Embassy to India, New Delhi collaborated with IIT Roorkee for the project. NORSAR, Norway is an independent research foundation specialized in seismological research and engineering services relevant for the society and their efforts have over the past years included seismic hazard and risk projects in many earthquake exposed countries. They are also instrumental in imparting training to professionals in India on design and earthquake resistant structures.

BMTPC, IIT Roorkee and NORSAR, Norway conceptualised the three-days Indo-Norwegian Training Programme on Seismic Design of Multi-storey Buildings: IS 1893 vs. Eurocode 8. The two programmes conducted so far have been very successful.

The third programme in the series was organised from May 27 to 29, 2015 at New Delhi. The three days Training Programme was inaugurated by Dr. Nandita Chatterjee, Secretary, Ministry of Housing & Urban Poverty Alleviation, Government of India. The programme was attended by around 100 participants from various parts of the country. The course was specifically targeted to Structural & Geotechnical Engineers and Designers in public and private sectors with emphasis on real-life problems and tackling them through hands-on training.



Capacity Building Programme for Engineers & Architects on Earthquake Resistant Structures and Retrofitting of Buildings at Panchkula, Haryana

A Capacity Building Programme on Earthquake Resistant Structures and Retrofitting of Buildings for the State of Haryana was organized on May 22-23, 2015 at Haryana Regional Chapter (ITPI), Panchkula, Haryana. The Programme was inaugurated by Shri P. Raghavendra Rao, IAS, Additional Chief Secretary to Govt. of Haryana, Town & Country Planning Department and addressed by Shri J. S. Redhu, Chief Co-ordinator Planner (NCR), Directorate of Town & Country Planning, Haryana and Dr. Shailesh Kr. Agrawal, Executive Director, BMTPC. The programme was attended by more than 70 participants mainly State Engineers & Architects of Government of Haryana. The faculty from IIT Roorkee and other Institutions include Prof. D. K. Paul, Professor Emeritus, Prof. Y. Singh, Prof. R. N. Dubey from Department of Earthquake Engineering, IIT Roorkee; covered various topics on Earthquake Resistant Structures and Retrofitting of Buildings.



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From the Desk of the Executive Director

One of the key component of technology transfer cycle is demonstration construction and BMTPC in its quest of promoting new prefab construction systems has written to all the state governments to participate in the demonstration housing project where land along with outside infrastructures need to be provided by state free of cost & BMTPC through its own resources will construct 40 houses along with onsite infrastructure. The structural configuration along with layout & construction technology will be decided in consultation with state govt. keeping in mind the prevailing practices in the region. Also, during the construction, the professionals along with artisans in the area will be imparted training so as to make them aware about the nuances of new construction systems. Also, the project will be documented right from the inception so that the cost and implementation issues can be captured for later use by the states. The demonstration project concept has evoked interest in most of the states and already projects are being initiated at Nellore, AP using GFRG panel system and at Bhubaneswar, Orissa using EPS core panel system. I sincerely believe through demonstration construction, we along with state will get better insights about the new systems and will be better prepared to adapt them in the states for fulfilling Govt. of India dream of pucca house to all by 2022.

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Demonstration Housing Project using GFRG Panel System at Nellore, Andhra Pradesh

BMTPC is into promotion of promoting proven and emerging building materials & technologies in different regions of the country through identification, evaluation, standardization, certification, capacity building, training and field level application of such technologies. The efforts of BMTPC have helped in building up confidence and acceptability of proven and emerging technologies among public and private construction agencies, professionals and others.

After evolving the methodology for construction of demonstration housing projects in different parts of the country, the Ministry of Housing & Urban Poverty Alleviation, Govt. of India requested a number of States for participation in the "Demonstration Housing Project" of BMTPC to further popularize the proven and Emerging Technologies in construction. BMTPC has so far received requests from the State Government of Andhra Pradesh, Telengana, Odisha, Haryana, Maharashtra, Uttar Pradesh, Bihar and Karnataka for construction of Demonstration Houses and Community Buildings using emerging building technologies.

The District Magistrate and Collector, SPS Nellore, Government of Andhra Pradesh has allotted land admeasuring 1.85 acres for construction of Demonstration Houses and a Demonstration Community Building at Saraswathi Nagar, Chowtapalem Village, Venkatachalam Mandal, SPS Nellore District. The foundation stone of the project was laid by Shri M. Venkaiah Naidu, Hon'ble Minister of Housing and Poverty Alleviation, Urban Development and Parliamentary Affairs on 31st May, 2015.

The Demonstration Housing Project will be constructed using one of the Emerging Technologies i.e. Glass Fibre Reinforced Gypsum (GFRG) Panel System and comprise 36 houses in cluster in G+1 having minimum carpet area of 30 Sq.mts. consisting of Living room, Bedroom, Kitchen, Bath, WC and Balcony including on site infrastructure development like internal roads, pathways, boundary wall, UG tank, electrification etc. Apart from this, a Community Building having an area of 6900 sq.ft. is being constructed using green technologies like flyash bricks, filler slabs, etc. The structural design of the houses will be undertaken by IIT Madras. While designing the layout and the housing units, provision of adequate natural lighting and ventilation to each area have been planned with Vastu friendly unit design. The project is done by BMTPC with technical support from IIT Madras whereas APSHCL & FRBL Cochin are undertaking construction work.



Alternate Building Materials & Technologies

Brick Panel System for Roofs/Floor: An alternate to the conventional RC Slab

The system consists of spanning the partially precast joists across the walls and filling the space in between with Brick Panels and finally spreading Cement Concrete to get an even surface. The steps involved are Casting of Partially Precast Elements i.e. Brick Panels and Joists; Roof Assembly; Filling concrete in haunches and Spreading cement concrete over the flat surface.

Precast brick panel are made of good quality bricks, concrete reinforced with two M.S.bar of 6mm dia and concrete.

Length : ≥ 1.1 m for brick strength < 40 N/mm²
 ≥ 1.2 m for bricks strength > 40 N/mm²
 minimum economy length is 0.9 m

Width: 530 mm with 230 x 110 x 75 mm brick
 450 mm with 190 x 90 x 90 mm brick

Each panel of 530 x 900 mm dimension require 16 bricks and 530 x 1150 mm dimension require 18 bricks.

Joist : Rectangular in shape. Width sufficient to support two successive spans of brick panels with necessary bearing. Minimum recommended 130 mm.

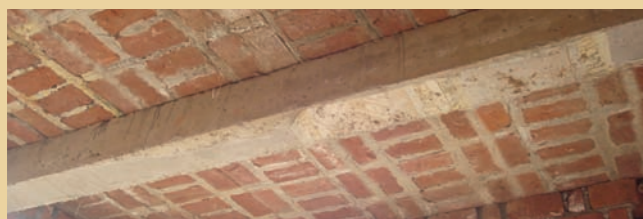
Recommended Depth: 100 mm for clear span 4200 mm.

Roof Assembly

- The Joists are spanned across the walls at the desired intervals and placed on 10-15 mm layer of cement concrete provided on the wall. Two supports are provided for the joist dividing the length of the joist in three equal parts
- Brick Panels are then placed across the joists to cover the entire roof area. Fan hooks and electrical conduits are also placed appropriately
- Joints between the panels are filled with M20 concrete and the design negative reinforcement is placed in the haunches and concreting done to get a flat surface. Concrete is vibrated in a manner that the reinforcement is not disturbed.
- Concrete layer of about 140mm will then be laid over the surface obtained
- Terracing course/flooring is then provided in the normal manner

Machine Manufacture of Planks and Joists

These components can also be manufactured by machines. 80-100 Planks can be manufactured in an 8 hour shift and four RC Joists can be manufactured in 8 Hour shift from the machines. The machines are easily available and primarily consist of moulds and a vibrating mechanism.



Emerging Technologies for Building Construction

Waffle-Crete Building System

Waffle-Crete building system consists of factory made large, structural, ribbed panels of reinforced precast concrete, bolted together. The joints between the panels are caulked to form the walls, floor and pitched or flat roofs of buildings. The surface of each panel consist of 51 mm thick slab or skin, stiffened with the ribs around the perimeter and across the panel, giving an overall panel thickness of 152 mm or 203 mm. In single storey buildings, floors are constructed using precast reinforced concrete floor panels supported on precast concrete grade beams on well-compacted earth. The walls are constructed of 152 mm thick wall panels of precast reinforced dense concrete. For buildings of more than one storey, the walls are supported on foundations designed by the engineer.

Metal or timber window and door frames are incorporated into the wall panels during casting or fitted after erection into openings that are formed in the panels during casting.

Services like water supply and electricity are normally accommodated in preformed slots in the ribs of panels, before the walls are lined.

The casting should generally be carried out in the casting yard of the site for mass housing while foundation is done, which reduces the construction time. Curing time is reduced by suitably trapping the moisture generated from the concrete.

The building after construction can be shifted from one place to another as the structure is joined using bolt connections.

The Waffle-Crete system consists of the following core elements:

- Lightweight insulated precast insulated molds
- Insulated curing covers that shall be used in conjunction with Waffle-Crete molds
- Specialized equipment shall be designed for use with Waffle-Crete molds and covers
- A construction methodology for casting and erecting concrete panels with molds and equipment.

Concrete panels cast in molds and then covered with a curing cover are removed from the mold and erected. Modular panels and bolted connections speed the erection process. The system can be utilized for a variety of structural applications.



Skill Development and Capacity Building

Training of Trainers (TOT) Programme on Earthquake Resistant Design & Construction for State Engineers and Architects in Bihar

The Bihar Institute of Public Administration and Rural Development (BIPARD), Government of Bihar at the behest of the Bihar State Disaster Management Authority requested BMTPC's assistance in conducting Training of Trainers (TOTs) on Earthquake Resistant Design and Construction. Two batches of TOTs were organized from 8-11 June, 2015 and another two batches from 15-18 June, 2015 at BIPARD Campus, Patna.

So far fifteen batches of Training of Trainers (TOT) programme for engineers have been organised at Patna. The resource persons are from IIT Roorkee, IIT Mumbai, NIT Patna, BMTPC including other experts in the field. During the four-days programme, the variety of topics were covered, namely, Understanding Earthquakes (including explanation of terms like Magnitude and Energy, Intensity, focus and epicentre, seismograph and accelerograph, iso-seismal); Lesson Learnt from Earthquake Damage of Masonry and RC Buildings; Architectural Considerations for Earthquake Resistant Design of Buildings; Basic terms including natural frequency, Natural period of structure, Earthquake Spectra and calculation of earthquake forces on structures as per IS: 1893-2002 Part I; Soil investigations for foundations, foundation types, earthquake effects on foundations and foundation design; Seismic Vulnerability Assessment and Retrofitting of RC Buildings; Design Practices as per IS : 1893 / Ductility Provisions for Better Seismic Performance of RC Buildings (IS:13920); Seismic Vulnerability Assessment and Retrofitting of Masonry Buildings, IS:13935; Design of buildings as per IS:1905, IS:4326; Multi-hazard Resistant Building Construction for safety under earthquakes, flood and cyclonic winds; Preparation of Structural Design basis Report, essential details in Structural Drawings & Quality Control; Rapid Visual Screening of Masonry and RC Buildings; etc. At the end of training of each batch, evaluation of trainees has also been conducted through examination.



Performance Appraisal Certification Scheme

The activities carried out under Performance Appraisal Certification Scheme (PACS) during the period from April to June 2015 are highlighted below:

Issuance of PACs

Performance Appraisal Certificates for the following products/systems were approved by the Technical Assessment Committee in its 8th Meeting held on 9th April, 2015:

- Roof Insulation Tiles-Insulla,
- Bamboowood Flooring,
- QuickBuild 3D Panels
- Modular Tunnelform

The Performance Appraisal Certificates has been issued to the respective manufacturers.

Inspection of works

Inspection of works of the following new products/systems has been carried out by the officers of BMTPC and TAC members:

1. Ultra Sound Pipes & Fittings
2. SRPL Building System (Waffle-Crete)
3. Expanded Polystyrene (EPS) Core Panel System
4. Walltec Concrete Hollowcore Wall Panels
5. Plastic Honeycomb Toilet Structures

Surveillance Inspection

Surveillance Inspection of Works of the following products/systems for renewal of the following PACs has been carried out by the Officer of BMTPC:

1. Underground Water Storage Tank (Sump)
2. Insulated Roof Panel
3. Plastocrete Panel
4. PVC Profile Door
5. Formwork for Monolithic Concrete Construction

New Applications

Application received for issue of PAC for Composite Plumbing Pipes is under process.

