

#### Standards/Guidelines Referred:

IS 456:2000	Code of Practice for plain and reinforced concrete (fourth revision)
IS 733 : 1983	Wrought Aluminium and Aluminium Alloy Bars, Rods and Sections (for General Engineering Purposes)
IS 875 (Pt.3):1987	Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures - Part 3 : Wind Loads
IS 1786:2008	High strength deformed steel bars and wires for concrete reinforcement-
IS 1893 (Pt.1):2002)	Criteria for Earthquake Resistant Design of Structures - Part 1 : General Provisions and Buildings
IS 1950: 1962	Code of practice for sound insulation of non-industrial buildings
IS 3792: 1978	Guide for heat insulation of non-industrial buildings
IS 10151:1982	Polyvinyl Chloride (PVC) and its Copolymers for its Safe Use in Contact with Foodstuffs, Pharmaceuticals and Drinking Water
IS 13920 : 1993	Ductile detailing of reinforced concrete structures subjected to seismic forces - Code of practice
IS 14687:1999	Guidelines for Falsework for Concrete Structures
BMTPC Guidelines : 2011	Guidelines on Monolithic Concrete Construction
PAC No. 1006-A/2011	Performance Appraisal Certificate issued by BMTPC on Formwork for Monolithic Construction

#### 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:



The Executive Director  
**BUILDING MATERIALS & TECHNOLOGY PROMOTION COUNCIL**  
Ministry of Housing & Urban Poverty Alleviation, Government of India  
Core 5 A, 1<sup>st</sup> Floor, India Habitat Centre, Lodhi Road, New Delhi – 110003  
Phone: +91-11- 24638096, 24636705; Fax: +91-11-24642849  
E-mail: bmtpc@del2.vsnl.net.in, Website: www.bmtpc.org



Prospective Construction Systems for Mass Housing

No.  
1/2014

## TECHNOLOGY PROFILE

### Monolithic Concrete Construction System using Plastic - Aluminium Formwork



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

## System in Brief

In this system, in place of conventional RCC framed construction of columns and beams; all walls, floors, slabs, columns, beams, stairs, together with door and window openings are cast in place monolithically using appropriate grade of concrete in one operation on site by using specially designed, easy to handle (with minimum labour and without use of any equipment) modular formwork made up of Aluminium/Plastic/Aluminium-Plastic Composite. Using the formwork system, rapid construction of multiple units of repetitive type can be achieved.

Basic Material Requirements	Formwork system	Concrete	Reinforcement
<b>Basic Material Required</b>	Formwork system is propriety system and designed as per loading requirements of the structure. It should have adequate stiffness to weight ratio, yielding minimum deflection under concrete loading. The panel should fix precisely, securely and require no bracing. IS 14687 : 1999 Guidelines for falsework for concrete does not cover requirements by special type of formwork system.	Shall be of appropriate grade based on environment condition as per IS 456:2000	Shall conform to IS 1786:2008
<b>Details of Formwork</b>	<p>The formwork made of Aluminium Extruded Section conforming to IS 733:1983 and PVC conforming to Grade PVC 67G ER01 of IS 10151:1982. It consists of different sections including starter of MS Angle, top frame of aluminium channels, wall panels, slab panels &amp; truss.</p> <p>The Formworks are designed based on the structural requirements of building units. A quality control scheme is required to be followed for quality of raw materials used and formwork components manufactured.</p> <p>Under Performance Appraisal Certification Scheme, the Formwork System manufactured by M/s Sintex Industries, Ahmedabad, has been evaluated and certified by BMTPC (PAC No. 1006-A/2011).</p>		
<b>Structural Requirements of the Construction</b>	<p>The Monolithic Concrete Construction is considered as shear wall type construction. The maximum spacing between cross wall shall be limited to 1.5 times the floor height if supported on two edges and 2.0 times the floor height, when supported on all four walls.</p> <p>Walls are designed for vertical loading in plane shear loading and out of plane loading due to wind load and earthquake forces as per relevant Indian Standard Code IS 875(Pt.3):1987 and IS1893(Pt.1):2002 respectively. For out of plane loading, the plate can be assumed to be supported by floor slabs / diaphragm and cross walls and continuity can be assumed, wherever applicable.</p> <p>The detailing requirement is as per IS 456:2000 code of practice for plane &amp; Reinforced Concrete and IS 13920:1993 Code of Practice for ductile detailing of reinforced concrete structure.</p> <p>Thickness of wall below ground level should be minimum 200 mm with double layers reinforcement requirements.</p> <p>Guideline on Monolithic Concrete Construction giving material requirements &amp; design aspects prepared by BMTPC may be referred for design and other aspects of the system.</p>		
<b>Durability</b>	<p>Since concrete is main constituent material, durability of the structure can be achieved by using proper ingredient, Grade of concrete &amp; mix design as per IS 456:2000.</p> <p>Thickness of the wall is generally 100 mm with the reinforcement placed in the middle. Therefore, adequate cover is likely to be maintained.</p>		

<b>Thermal Behaviour of Structure</b>	100 mm RCC Walls and Roof has thermal transmittance ( $U$ ) value as 3.59 W/m <sup>2</sup> K) (as per IS 3792:1978) Since, it is more than the normal plastered brick wall (thermal transmittance ( $U$ ) 2.13 W/m <sup>2</sup> K), it is advised that implementing agency shall ensure proper planning for heat insulation and air ventilation in the housing units through proper orientation, shedding etc. (see IS 3792:1978 for guidance).
<b>Acoustic</b>	Average Sound reduction for 100 mm concrete is $\geq 45$ db (IS 1950:1962)
<b>Ease of fixing services</b>	All electric and plumbing fixtures, lines have to be pre-planned and placed before concreting is done. Post construction alternation is not desirable.
<b>Scale of Economy</b>	Scale of economy depends upon the volume of work and number of repetition of the formwork. Minimum 100 repetitions are desirable. For very small project of less than 500 units, this system may not prove to be economical.
<b>Other features</b>	<ol style="list-style-type: none"> <li>1) Pre designed formwork acts as assembly line production and enables rapid construction of multiple units of repetitive type.</li> <li>2) Various work cycle is possible, however, for speed and economy 3-4 days cycle are desirable.</li> <li>3) It is flexible in design and can form any architectural or structural configuration, such as stairs, windows, etc.</li> </ol>
<b>Limitation</b>	<ol style="list-style-type: none"> <li>1) A lead time of about 3 months is required for initiation of work, as the formwork are custom designed, manufactured and prototype approved before manufacturing required number of sets of formwork.</li> <li>2) Capital cost to initiate construction is high and may require regular flow of funds.</li> <li>3) Post construction alterations are difficult.</li> <li>4) All the service lines are to be pre-planned in advance.</li> <li>4) Not much saving in construction in one storey structure.</li> </ol>
<b>Major Completed Project</b>	<ol style="list-style-type: none"> <li>1) 5008 No. of houses at Kanjhawala Narela, Delhi for DSIIDC.</li> <li>2) 512 No. of houses in Bawana, Delhi for DSIIDC.</li> <li>3) 3000 houses in Ahmedabad for Ahmedabad Municipal Corporation.</li> <li>4) 3000 houses in Lucknow for Lucknow Development Authority &amp; other projects in major Indian Cities and many others....</li> </ol>

