

Standards/Guidelines Referred:

IS 456:2000	Code of Practice for plain and reinforced concrete (fourth revision)
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 - Specification
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 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

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, 1st 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



Emerging Housing Technologies for Social Mass Housing

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TECHNOLOGY PROFILE

Monolithic Concrete Construction System using 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 column and beam; 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 at site by use of specially designed, easy to handle (with minimum labour and without use of any equipment) modular form work made of Aluminium. Using the formwork system, rapid construction of multiple units of repetitive type can be achieved.

Basic Material Requirements	Formwork system	Concrete	Reinforcement
Basic Material Required	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
Details of Formwork	The formwork systems used are made of light weight Aluminium. The recommended concrete forms generally use robotics welding system for manufacturing. A soft alloy weld wire is utilized in the concrete form weld process. Fixing of the formwork is done using tie, pin & wedges system. Does not require very skilled labour to do the job. The formwork can be designed based on requirements of dwelling unit and the project. A repetition of about 1000 cycle is claimed (This, however, needs, verification).		
Structural Requirements of the Construction	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. 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 wall can be assumed to be supported by floor slabs / diaphragm and cross walls and continuity can be assumed, wherever applicable. The detailing requirement is as per IS 456:2000 code of practice for plane & Reinforced Concrete and IS 13920:1993 Code of Practice for ductile detailing of reinforced concrete structure. Guideline on Monolithic Concrete Construction giving material requirements & design aspects prepared by BMTPC may be referred for design and other aspects of the system.		
Durability	Being constructed using concrete, durability of the structure can be achieved by using proper ingredient, grade of concrete & mix design as per IS 456:2000. Thickness of the wall is generally 100 mm with the reinforcement placed in the middle. Therefore, adequate cover is likely to be maintained.		
Thermal Behaviour of Structure	100 mm RCC Walls and Roof has thermal transmittance value as 3.59 W/m²K (IS 3792:1978). Since, it is more than the normal plastered brick wall (thermal transmittance 2.13 W/m²K), it is advised that implementing agency shall ensure proper planning for air ventilation provisions in housing units (IS 3792:1978).		
Acoustic	Average Sound reduction for 100 mm concrete is ≥ 45db (IS 1950:1962).		
Ease of fixing services	All electric and plumbing fixtures, lines has to be pre-planned and placed before concreting is done. Post construction alternation is not desirable.		

Scale of Economy	Scale of economy depends upon the volume of work and maximum number of repetition of the formwork achievable for the estimated time period of construction. Minimum 100 repetition of the formwork is desirable. For small project of less than 500 units, this system may not prove to be economical.
Other features	1) Pre designed formwork acts as assembly line production and enables rapid construction of multiple units of repetitive type. 2) With proper planning, a slab cycle of 4 days can be achieved, which reduces the construction time considerably. 3) It is flexible in design and can form any architectural or structural configuration, such as stairs, windows, etc. 4) The formwork are manually handled. There is no need for heavy equipment & cranes etc. 5) Finish is such that it requires no separate plaster.
Limitation	1) Initial investment for the formwork system is high compared to other forms & minimum of 500 houses in a year need to be built for economy. 2) Not much saving in construction in one storey structure. 3) A lead time of about 3 months is required for initiation of work, as the formwork are custom designed and manufactured as per the requirement of the structure. 4) Post construction alterations are difficult. 5) All the service lines are to be pre-planned in advance.
Major Completed Project	1) Houses in Bangalore for Karnataka Slum Development Board. 2) Houses in Mysore for Karnataka Slum Development Board. 3) Houses in Bangalore for Bangalore Development Authority & several other projects in major cities of India.

