CPWD

Azadi Ka Amrit Mahotsav

CENTRAL PUBLIC WORKS DEPARTMENT

Compendium of Technical Session on 'New Technologies'

July 12, 2022

आज़ादी का अमृत महोत्सवः

के.लो.नि.वि. की 168 वर्षों से राष्ट्र को समर्पित सेवा

CPWD

COMPILATION OF TECHNICAL SESSION

July 12, 2022

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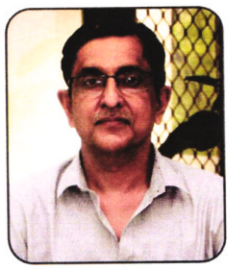
Central Public Works Department
Ministry of Housing and Urban Affairs

MESSAGE



Shailendra Sharma
Director General

सत्यमेव जयते

भारत सरकार
Government of India

CPWD

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MESSAGE

Construction industry plays a vital role in the growth and development of our country. There is an increased focus on adopting sustainable construction technologies to mitigate detrimental environmental impacts of built assets. Knowledge sharing through technical seminars is an important tool to improve synergy, enhance productivity and promote best practices.

I am happy to note that this Technical Session is being organized on 12th July, 2022 on the occasion of 168th Annual Day of CPWD. We have chosen knowledge sharing on new construction technolgoies to further delve on the constraints/issues faced for selection of suitable technolgies. The topics include suitability of Precast technology for buildings projects; Precast Large Concrete Panel System; 3D modular precast; AAC wall panels; Hybrid Precast Panel Building System; System Formworks; Composite Building construction using Speed floor Slab system; Light Gauge Steel Structural System & Pre-engineered Steel Structural System and E&M New Technologies used at New Parliament Building. This compilation will provide an opportunity of knowledge sharing and experiential learning.

I congratulate Shri Dharmesh Chandra Goel, ADG (Tech) and his team for organizing the Technical Session and bringing out this compilation.

(Shailendra Sharma)

CPWD

MESSAGE

Dharmesh Chandra Goel
Additional Director General (Technical)

भारत सरकार
Government of India

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PREFACE

It is a matter of great pride for me to be associated with organising technical session on the occasion of 168th Annual Day of CPWD.

Ministry of Housing and Urban Affairs had carried out Global Housing Technology Challenge (GHTC) under which best of the construction technologies were shortlisted. The baton of promoting new technologies now rests with Shri Manoj Joshi, Secretary, HUA, who is fervently taking the cause forward.

CPWD is adopting advanced technologies in the field of construction. Now decision has been taken that choice of technology for the project will be decided by the building construction agency (bidder), for empowering the citizen and ensuring ease of business along with competitive rates for public works based on the technology, items and item rates of the project. We are grateful to Shri Manoj Joshi Ji for his guidance and vision in this regard.,

Shri Shailendra Sharma, DG CPWD has lent total support to the objective of new technologies for public works. But for his detailing, it would not have been possible to come out with technology adaptive systems and policies sync with the varying landscape of our motherland. His mentoring is acknowledged with deep reverence.

This technical session is being attended by experts and senior officers of various central government organization including CPWD. Hence, the compendium of the technical seminar will prove to be a milestone in taking these construction technologies to the field for speedy, quality and environment friendly construction.

I am thankful to my colleagues – Shri Vinayak Rai, CE CSQ Civil, Shri Vimal Kumar CE CSQ Electrical, Shri Diwakar Agarwal, SE TAS Civil, Shri Saurabh Kumar, SE TAS Electrical, Shri Devendra Sachan, Director (Tech & PR) and all other staff and officers of CSQ Units of CPWD for arranging this technical session and bring out this publication.

"The adoption of new technology finally occurs when ease of use, economic savings, and trust all come together to work toward change." **- Alec J. Ross**

Place: New Delhi
Date: July, 2022

(Dharmesh Chandra Goel)

CONTENTS

OVERVIEW ON PARAMETERS FOR SELECTION OF PRECAST TECHNOLOGY FOR BUILDINGS PROJECTS

P.K. Verma

SELECTION OF PRECAST TECHNOLOGY FOR BUILDING PROJECTS

Deciding on an appropriate precast system for a project is a complex process with multiple parameters to be critically reviewed before arriving at most suitable and optimal solution.

The most important part is the conceptualization of the project itself. At present the precast industry in India is not prominent and most planners are not aware of availability of various facilities and its effective use.

The sequence of considerations for developing concept of project is required to be revisited for using available precast systems with other factors.

Currently, in most cases the project concept and architectural designs are finalized before finalization of precast system and the burden of making project viable with precast systems rests on precast manufacturer and precast designer, most of whom are unaware of various other factors governing the project execution. This leads to redundancy in design and complexity in use of precast technology.

In the countries, which are using precast construction techniques nearly at par with orthodox construction methods in terms of execution volumes, the projects with precast system are conceptualized with the available precast facility with transportation and assembly considerations. The architectural planning is done to maximize advantages of possible and suitable system. Thus avoiding possible shortcomings in above parameters.

It is advisable to narrow down to a precast system for large projects by giving a critical thinking, to various requirements and targeting the desired outcome of the project, even before start of Architectural planning. So that, the architectural designs can be done within the constraints of the technology and resource availability, best suited for the project.

Each of the stakeholder may have different proposals and suggestions, depending upon their own capability, which, sometimes may be conflicting with each other. These possibilities are to be carefully evaluated to get maximum advantage and best outcome for the project.

For deciding a precast system, following major aspects are considered:

1. Size of the project
2. Time for completion
3. Availability of various precast element manufacturing facilities in the vicinity
4. Legacy value of production facility if required to be established at project site
5. Possibility of transporting of elements without damage

6. Size and weight of proposed elements
7. Number of floors (High rise or low height)
8. Availability of assembly equipment and their reach requirements
9. Market sentiments considering end use of construction
10. Availability of skilled manpower

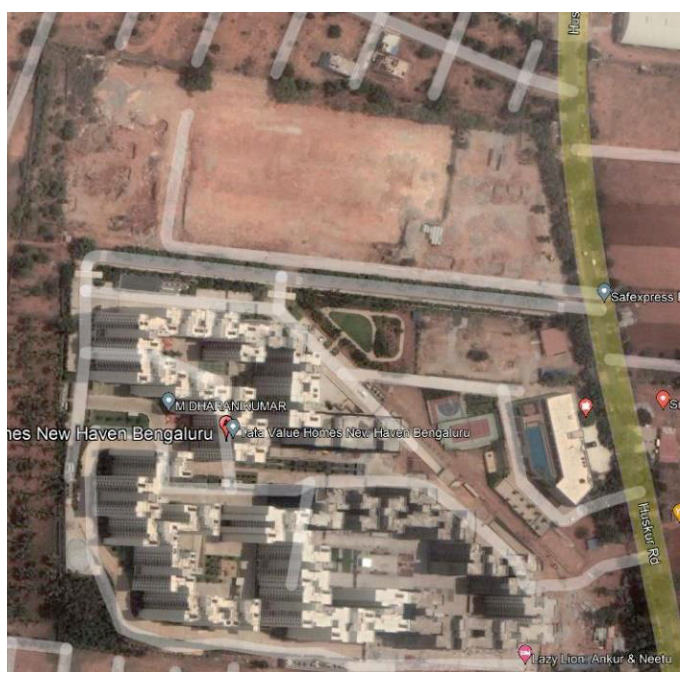
Some case studies are presented in brief to sensitize the importance of right planning

1. Construction of smart value homes at Bangalore

- Broad Project requirements were as follows
- The project was having large volumes of mid-range housing
- No precast production facility was available in feasible transportation distance
- Sufficient space was available at site for setting up a pre-casting yard
- Number of floors-10
- Maximum weight of element 6 T

Sufficient space for setting a production facility was available adjacent to the site. Therefore the production facility was established at site using flatbed carousal system, stacker curing arrangements, tilting tables etc.

Large panel walls and slab was used in precast system and the project was completed as planned.



PROJECT AFTER COMPLETION

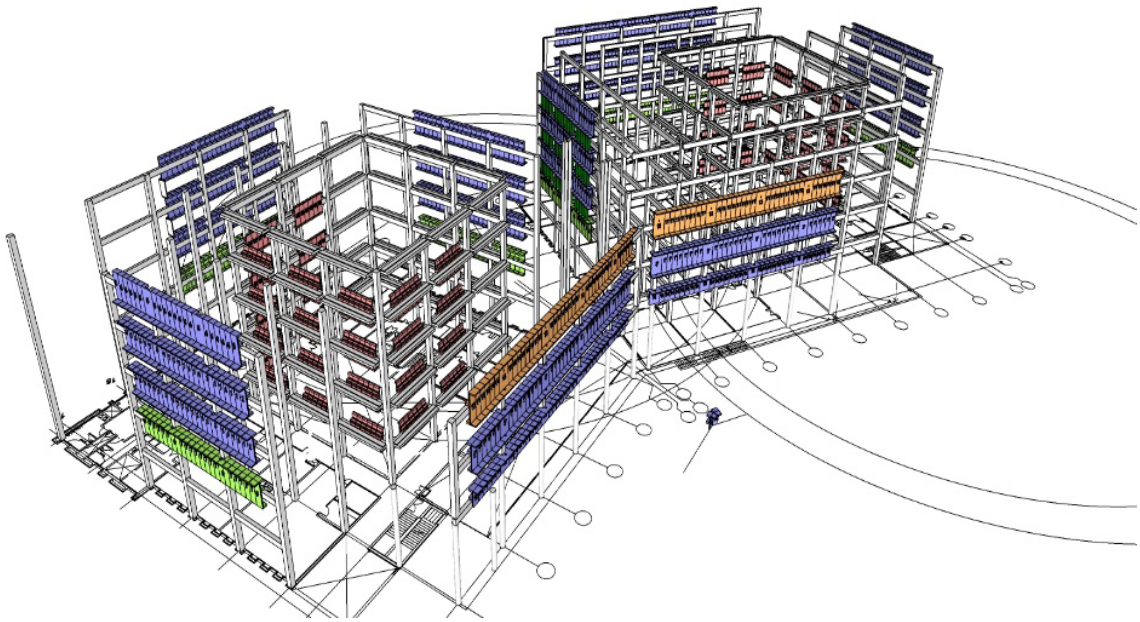
2. PRECAST FACIA FOR SOUTH ASIAN UNIVERSITY NEW DELHI

The architectural concept of project provided for precast facia with elements of multiple shapes.

The planning and shape of precast facia was conceived without assessing production requirements, connection details and assembly issues.

It became difficult to develop connections of appropriate strength, moulds for productions; as some of the elements were few in numbers to make development of mould viable.

It brought underutilization and redundancy in production facility although the same could be established in available space at site.

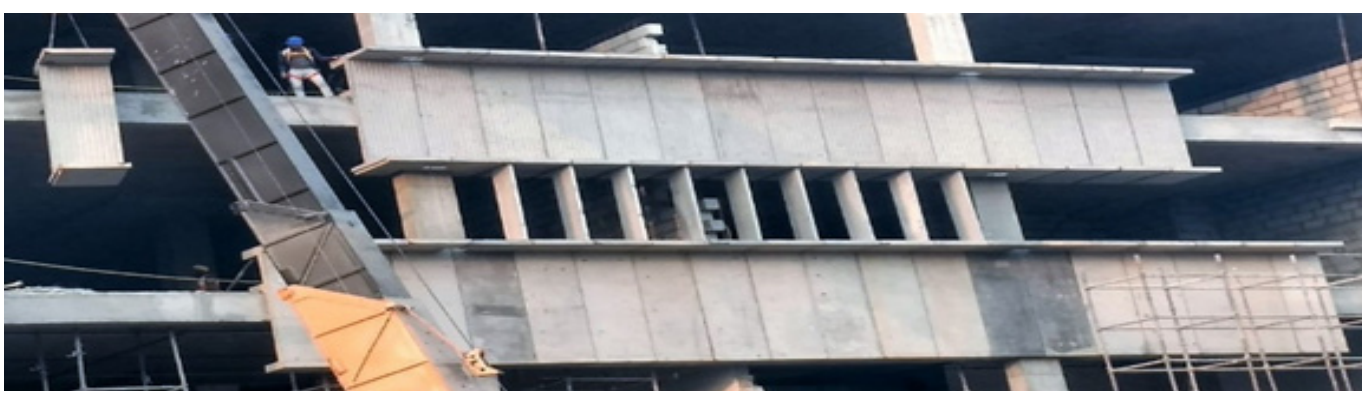


PRECAST FACIA ELEMENTS PLANNED FOR PROJECT

This made production and assembly difficult and uneconomical. The problem could have been avoided with critical thinking at initial stage.

TYPE AND NUMBER OF ELEMENTS REQUIRED

PRODUCTION AT SITE

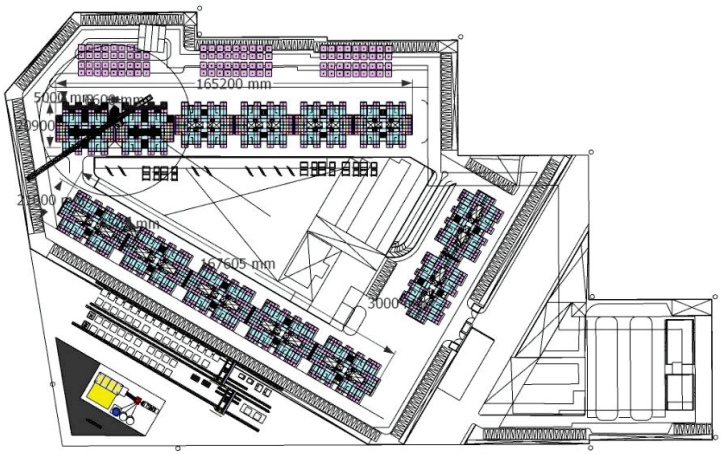


ASSEMBLY PICTURES

3. RESIDENTIAL PROJECT AT BAHADURGARH

Salient features of project

- 728 Residential units in 13 towers in stilt +14 configuration
- Structure must provide flexibility in internal changes in the units
- Avoiding concrete cage formation
- High speed of construction
- Small space is available for setting production facility
- Maximum weight of element 20 T at 20 meters



PROJECT LOGISTIC PLANNING

AREA AVAILABLE FOR PRODUCTION YARD

It was decided to go with Russian precast system which consists of structural arrangement using columns and slabs without beams, to achieve project requirements.

This system requires small area for production and almost no automation. The production units are modular and can be arrange in various ways.

The construction can be done with normal construction machinery.

The walls are of AAC blocks providing flexibility in making changes in future.

SUMMARY

Critical thinking in evaluating the technology to be adopted makes execution of projects simpler, cost efficient and viable.

MISSION 96 - ULTRA RAPID CONSTRUCTION OF 96 FLATS IN 96 DAYS USING PRECAST LARGE CONCRETE PANEL SYSTEM FOR A PMAY PROJECT

Amit Barde, L&T

Background

With a population of over one billion and an ever-increasing standard of living, provision of mass housing at affordable rates in the shortest possible time frame has been a burning issue that India has faced over the last couple of years. Moreover, the recent shortage of skilled workforce in the Indian construction industry leading to slower rate of construction has compounded this problem.

Pradhan Mantri Awas Yojana (PMAY) a flagship Mission of Government of India launched in 2015, addresses urban housing shortage among the EWS/LIG and MIG categories ensuring a pucca house, to all eligible urban households by the year 2022.This campaign by the Indian Government also puts additional pressure on the construction Industry to deliver projects in record time frames. To cater to this growing demand and supply gap, Indian construction industry is undergoing a paradigm shift to break away from conventional construction practices in search of innovative and efficient ways for constructing residential buildings. It is encouraging to see that the Government is also supporting adoption of various modern technologies through various channels such as Global Housing Technology Challenge (GHTC) and fast paced approvals through Building Materials and Technology Promotion Council (BMTPC). Mechanization and Digitization has been identified as a key mantra to be successful in this pursuit. Traditionally, residential houses in major cities of India have been multi-storied high-rise apartments suitable for modular construction. Thus, Cast-In-Place Aluminium Formwork and Precast Large Concrete Panel technologies provide a fitting answer for cost effective, durable, and rapid construction that suits to Indian needs compared to traditional construction with reduced workforce and lesser activities at site while exceeding quality and safety standards of conventional construction practices in India.

Figure 1 : *CIDCO – PMAY – Package 4 – Kharkopar Plot*

CIDCO PMAY Housing – Package 4

To fulfil the 'Housing for All' motto, City and Industrial Development Corporation (CIDCO) undertook the construction of about 23432 EWS and LIG houses under the Package-4 of the PMAY in Navi Mumbai at Bamandongri, Kharkopar and Taloja, with the help of L&T Construction. Out of the 187 towers to be constructed, the Kharkopar plot with 66 towers was selected to be constructed using L&T's Precast Large Concrete Panel (PLCP) technology that is touted as the future of residential construction for its mechanized rapid construction with superior quality based on controlled manufacturing in factory environment. All 66 towers in this phase will be delivered in the stipulated 42 months duration for the entire project.

Precast Large Concrete Panel System

The PLCP system focuses on construction of the modular superstructure of building using Precast Walls and Slabs. The entire floor, including the flats and the stair/elevator corridor core is constructed using precast elements. Figure 2 shows the typical precast elements that were adopted. The 3D PODs were used where the Toilet, Bath and Shaft units were combined to make a single 3D Volumetric element that reduced number of elements and joints. Similarly, two rooms external walls, chajjas and wardrobe elements were combined to make one external 3D wall element that helped greatly to improve construction speed. Figure 3 shows the typical elements that are produced in the factory and shipped. The system avoids use of time consuming second stage site activities such as blockwork and plastering to improve productivity as well as quality of the construction work. The emulative design philosophy adopted by L&T ensures required structural performance in terms of strength and serviceability. The structural detailing is provided to achieve necessary ductility in response to lateral seismic and wind loads as per the prevailing building codes. All building components such as walls, slabs, toilet pods and stairs are produced in the factory and assembled at site using on-site emulative connections that perform equivalent to conventional RCC Shear wall buildings. Once all elements of a floor are installed, the floor is completed using structural cast-in-place concrete topping that acts as a diaphragm to transfer the intended loads.

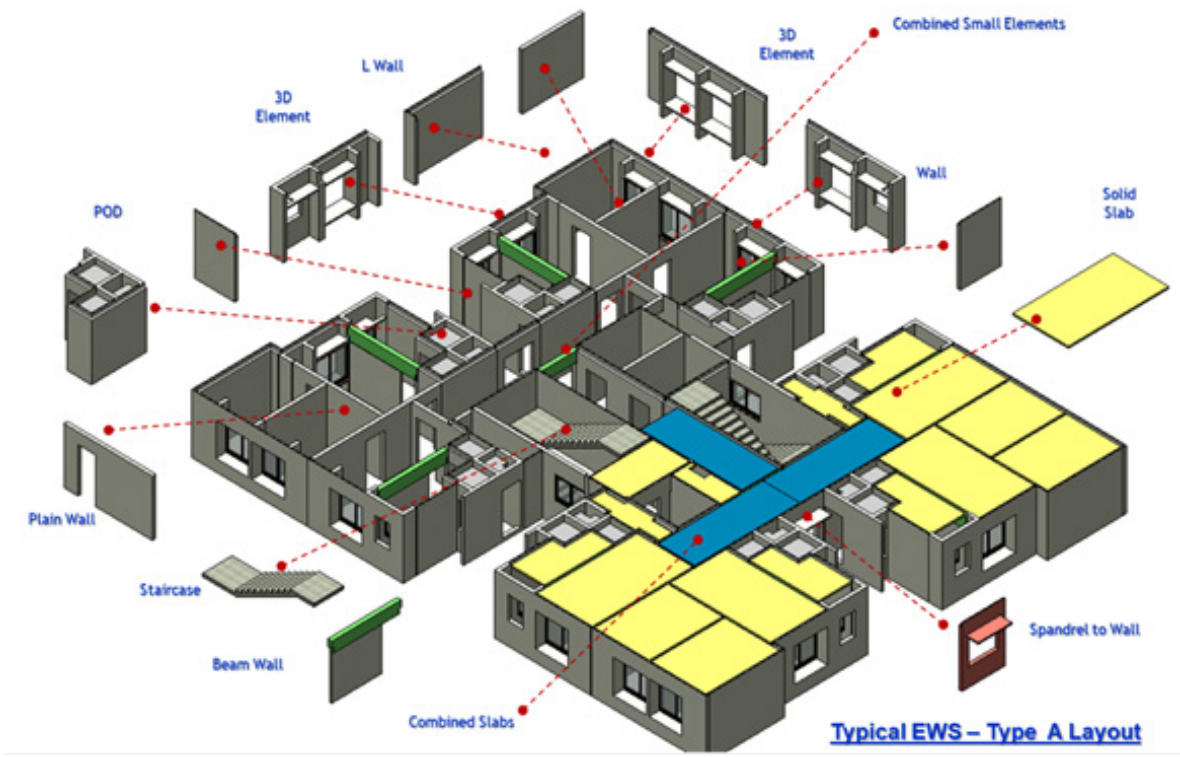


Figure 2 : *Typical Precast Element Framing Plan*

Figure 3 : *Typical Precast Elements*

Mission 96

The construction of the project started in January 2021 and about 10 towers have already been constructed as planned. To showcase the true potential of the PLCP system further, L&T took on 'Mission 96' challenge in late March 2022 to complete one Stilt+12 storey tower superstructure with 96 flats to be constructed in 96 days that will be handed over to CIDCO with all architectural and MEP finishing. The mission tower comprised of production and installation of 1985 precast elements of the superstructure along with Architectural Finishes and MEP works of the 64,000 sqft built-up area. Each floor is of about 4500 sq ft with 8 flats of about 300 sq ft carpet area per the PMAY norms.

The mission was accomplished by L&T well experienced Precast Team as the main contractor with unwavering support from Tata Consulting Engineers- Hiten Sethi and Associates JV serving as Project Management Consultants and Architect Hafeez Contractor, the Principal Architect for the entire CIDCO Package-4 under the Supervision of Mr. S. S. Dahedar, S.E., CIDCO.

The meticulous mission planning, carried out in merely 15 days, included deployment of two dedicated heavy-duty cranes in tight footprint of 450 sqm with state-of-the-art Anti-Collision Device. Strategic installation sequence for precast elements was devised for minimal interference. A Mobile Crane of 100MT capacity was exclusively deployed to decouple element unloading from Tower Cranes. Continuous supply of elements for two floors was ensured throughout the project duration, with stockyard having capacity to store about 300 elements at a time. Thus, the key to completion of each floor in exactly 3 days as planned for all 12 floors was to operate the towers cranes dedicatedly for element installation only with continuous availability of elements in the crane reach. This proved to be of great advantage over traditional precast construction approach where the elements are delivered at site sequentially and the tower cranes are engaged in installation as well as unloading and temporary storage of the elements. While the 'Just in Time' delivery approach may provide an alternate option, the logistics challenges in a multi tower construction project invariably reduce efficiency where the factory is catering to four to five cranes simultaneously. Thus, the option of pre-stocked elements was selected to reduce the risks of delayed panel availability.

Figure 4: *Mission 96 – Day 42*

The extra panels stock was maintained throughout the construction with the excellent support from L&T's massive 11000 sqm production facility at Ulwe with 2.2 mn sqft yearly capacity built specifically for the Kharkopar Plot. With a peak capacity of producing about 180 elements per day (240 cu-m), daily 20 trips to site ensured un-interrupted feeding of elements to both tower cranes.

Figure 5 : *Precast Factory*

Apart from multiple planning exercises and time motion studies, the site team also arranged exclusive workmen training sessions for step-by-step instructions and understanding to gear all trades with full commitment, preparation, and confidence to achieve the set target. Annexure A shows the broad milestones planned for the Mission.

Figure 6 : *Day 0 – Mission Launch*

The mission was flagged off by Mr. R. B. Dhayatkkar, C.E., CIDCO and Mr. M.V. Satish, Whole Time Director and Sr. Executive Vice President, L&T on April 4, 2022, and was slated for handover on July 9, 2022. In line with L&T's reputation, the very first floor itself was achieved in 3 days exactly as planned. The same momentum was carried through the construction where all subsequent floors, even the refuge floors with additional overhang elements with complex installation process were completed per the 3-day cycle norm. The work was continued day and night in both shifts. The tower cranes installed on an

average about 85 elements per day and 91 elements at peak. The team marked the achievement of 1st Milestone of 12 floors in 36 days on May 9, 2022, an unprecedented sustained 3-day floor cycle that has set a new global benchmark for RCC Residential Construction compared to Industry Norm of 8 to 12 days per floor. Mission 96 Tower marked the first residential tower in recent history where the delays were tracked in hours instead of weeks.

Figure 7 : *Day 36 – Terrace Topped Out Celebration*

Precast Construction also allowed to initiate internal finishing work of the tower as soon as the 3rd floor was completed where traditional construction of 12 story towers waits until most of the tower construction is completed. Thereafter, the team managed the herculean task of completing end to end finishing works in just 60 days with utmost attention to safety and quality.

Figure 8 : *Day 68 – Tower External Finishing*

In the interest of time, the team also adopted Total Precast Overhead Water Tank for the first time. The engineering team developed innovative connections specifically to deliver the same performance of the cast-in-situ approach. All four tanks at the terrace were constructed in just 7 days after Terrace slab was poured along with the parapet walls to complete the entire terrace work in only 10 days that traditionally goes on for months together.

Architectural features such as external grooves were intricately accommodated in the factory-made precast elements with superior surface finish and low maintenance high strength concrete to avoid long term issues seen in traditional plastered walls. Meticulous planning to assure continuous availability of work-front for all activities was the heart of this operation that allowed successful achievement of milestones after milestones to make Mission 96 a masterpiece of surgical execution.

Along with Mechanization, the Mission also highlighted adoption of modern digital ways in line with the digitalization vision of honorable Prime Minister. The project team adopted Concrete Maturity Method that monitored the concrete strength development in real time with digital meters that allowed seamless construction. The concrete strength of the topping screed becomes a critical path process as the next level work cannot start until the required strength is achieved. Traditional ways of cube testing have lower efficiency due to limited number of cubes. Thus, the quality team adds extra cushion times based on the past experience to test the cubes such that the required strengths are assured. This adds three to four hours of extra time that the Mission 96 philosophy could not afford. Concrete Maturity Method helped to monitor the screed strength digitally and in real time using the in-place sensors. As soon as the meter showed required estimated strength of the in-place concrete, the cubes were tested and the next floor work was initiated. The tower progress was monitored using the Digital Twin approach with the BIM model developed for the project.

Figure 9 : *Concrete Maturity Method for Realtime Strength Development Tracking*

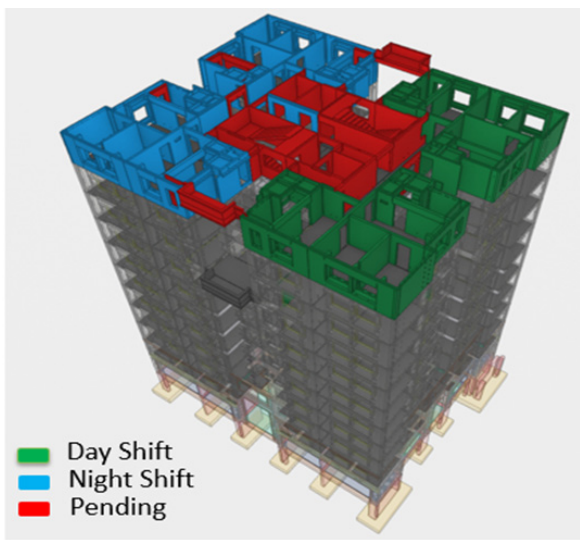


Figure 10 : *Digital Twin Approach for Progress Tracking*

Way forward: Successful completion of the Mission 96 has once again highlighted L&T's PLCP system capability to build tall residential buildings at an astonishing speed. While the earlier buildings in this project have been constructed with a cycle time of 6 to 8 days, the Mission 96 tower proved that the highly sought after 3 to 4 days of floor cycle time is not a figment of imagination but a proven reality. While few other options are available in Global Markets in alternative systems, RCC construction has been the only widely accepted system in Indian Residential sector. With meticulous planning, right selection of technology and resources, L&T's Mission 96 has opened a new avenue for ultra-rapid construction of tall residential buildings that will offer a fitting solution for India's Mass Housing needs through the next decade.

Annexure A: Mission 96 – Key Milestones

Day	Milestone
0	Crane Setup in Three days
3	First floor completion (148 elements installed)
10	Internal Finishing Commencement
22	8th Floor Refuge Floor Slab completion without shoring
39	Terrace floor completion
45	Over Head Water Tank and Terrace
47	Kitchen Finishes
71	MEP Stage-1
71	Toilet Bath Waterproofing
72	Floor Tiling
87	Toilet Bath Finishes
89	MEP Stage-2
90	Doors/Windows
94	Internal and External Painting

MAGICRETE 3D MODULAR PRECAST : BUILDING HOMES BETTER, FASTER, & CHEAPER

Siddharth Sharma, President, Magicrete Building Solution Pvt. Ltd.

Construction in India has been straggling. The need of the hour is to 'modernize' or 'industrialize' construction by shifting production and assembly from onsite to the confines of a technologically advanced factory. Presently, the majority of Indian structures are still being built in in-situ cast mode. Real estate construction is probably the last central area in the world where even after the 4th industrial revolution, much work is still done at sites and not at factories.

The shift from the site to the factory is happening now. The faster adoption of newer technologies is making labour more efficient and productive. Although precast construction has been extensively used in bridges, tunnels, etc., over the past thirty years, the infra service sector, like storm water drains, cable trenches, box culverts, boundary walls, etc., is now catching up fast. The reason for vast precast construction usage lies in its several advantages compared to conventional construction. Apart from speeding up the construction to a great extent, precast also ensures improved quality, safety, and productivity and is comparatively better sustainable construction.

Magicrete has been a flag-bearer of modern construction technology over the last decade. We are the leading player in the AAC Blocks industry that has transformed how construction happens across the country. In 2017, with the introduction of third-generation construction technology, 3D Modular Precast, we achieved 90% industrialisation.

In Magicrete 3D modular precast technology, the architectural layout of the building is divided into repetitive modules, which are then manufactured in the factory. These repetitive modules called PODs (3D Precast structures) are cast and finished in the factory under strict quality control and then brought to the construction site for installation. High-performance concrete & steel are used to cast these PODs. The casted modules are then transferred to the finishing line, where tasks like MEP works, door fixing, window fixing, tiling, and painting are executed. The Pods are then moved for Quality check and subsequently packed and shipped to the construction site for installation.

The foundation of the building is kept ready while production of PODs is happening at the factory. Factory finished Bathpods, Kitchenpods, and Ipods are installed on the site with the help of tower cranes. Gable end walls are positioned to terminate the sides of the building. Pre-stressed slabs are installed as flooring elements. Rebar mesh is placed for structural screed, thereby connecting all the elements together. Consecutive floors are built in a similar manner.

It has proven to be an extremely cost and labour-effective model, making this a preferred choice for sustainability and convenience. In addition, 3D Modular Precast Technology has sped up the construction time by 50%, provides multiple design possibilities using the same components, and makes the process of waterproofing, tiling, plumbing, etc., very convenient for builders.

The Magicrete guarantee also assures quality, thereby making it a viable option. Some of the key features are:

- Speedy Installation
- Modular Architecture
- Stringent Quality Control
- Sturdy & Durable
- Structural Convenience
- Latest Fittings
- Easy Transportation

Magicrete has witnessed a year-on-year jump in demand by 100%. The most important reason being the average delivery time of construction projects in India is 3-5 years. Time overrun is a major roadblock in the growth of the Indian economy. Therefore, adopting innovative construction technologies will be imperative to keep the construction affordable and ensure project timelines are met.

Here lies a massive opportunity for precast technology which can reduce the project delivery time by 300 to 500%. Precast penetration is just 2% in the Indian market which is mainly in the Government sector. The government has taken many initiatives in EWS and LIG sector and promoted the usage of precast.

Magicrete has won the prestigious Global Housing Technology Challenge! Organized by the Ministry of Housing and Urban Affairs, we have been awarded the opportunity to build 1000 houses within a year with our pre-fabricated sustainable housing model, MagicPod, in Ranchi. In consonance with our honourable Prime Minister, Shri Narendra Modi's directive, we are honoured to be a part of the dream to help transform Ranchi, Jharkhand, into a smart city.

Currently, MagicPod PBU's (Prefabricated Bathroom Units) and PKUs (Prefabricated Kitchen Units) find an ever-increasing demand among real estate developers. These are 3D modular pods that are cast & finished in the factory, shipped to the site, and installed.

The rapid growth and development of urban centres today call for shorter timelines and reduced costs in the construction sector, proven technologies ensuring the highest standards, and uniformity in quality. These are the need of the hour that is now effectively met by Magicrete, one of the leaders in the sector and implemented many successful projects. Our 3D Modular Precast Technology has recently won ET Ris's "India's Top Innovative MSMEs, 2021".

A STUDY ON BENEFITS OF CONSTRUCTION WITH MAGICRETE AAC WALL PANELS

Siddharth Sharma, President, Magicrete Building Solution Pvt. Ltd.

ABSTRACT

This paper reports the production of Autoclaved Aerated Concrete (AAC) Wall Panels (Magicrete AAC Wall Panels) made of Cement, Lime, Fine Silica Sand, Aeration agent, and steel reinforcement. Magicrete AAC Wall Panels are resistant to water, fire, termites, and rodents, making them withstand adverse weather conditions. Also, they exhibit excellent thermal and acoustic insulation properties. Panels are strong, durable, lightweight, and easy to transport. Magicrete AAC Wall Panels' design and application method make it suitable for seismic-prone zones. Panels do not require wet plastering and curing, leading to fast construction. The panels have broad applications such as Internal partition walls, External Walls, Boundary walls, Fire Separation Walls, and Prefabricated Walls.

KEYWORDS

Autoclaved Aerated Concrete (AAC) Wall Panels; Eco-friendly panels; Drywall; Fast construction; Building products.

INTRODUCTION

Magicrete Building Solutions Private Limited is India's frontline producer of **AAC Blocks & AAC Wall Panels, Construction Chemicals & Precast Construction Solutions,** has turned over a new leaf in the construction industry. It was found in 2008 by a young and dynamic team comprising alumni of IIT Kharagpur, IIT Delhi & IIM Lucknow. A pioneer in green building materials, its vision is to help people build their homes **Better Cheaper & Faster** by using innovative construction technologies. Magicrete has been a flag-bearer of modern construction technology over the last decade and has touched the lives of more than a million people by being used in more than 5,00,000 homes.

Magicrete has many awards to its credit **"Great Place to Work Certification"** by Great Place to Work Institute, India -2022. **'India's Top Innovative MSME's 2021'** by 'ET Rise'. **"Most Promising Brand Award 2019** (building material)" by Global Real Estate Congress, **"Most Preferred Brand 2018"** (blocks/bricks) by ET Now, and many more.

As part of the company's product diversification, innovative building materials such as Autoclaved Aerated Concrete (AAC) Wall Panels are manufactured by Magicrete as a growing segment of building environmentally conscious product consumers is growing. So, Magicrete has taken up this challenge and is confident that as a pioneer, they will be able to set standards and serve the customer to their satisfaction. The masonry brick wall is heavy, and its construction is time-consuming. Other products like plywood, Gypsum Board, Cement bonded particle board, Resin bonded particle Boards, etc., have one or more deficiencies such as not being resistant to water, fire, or termites, or being non-load bearing, etc. Therefore, an initiative was taken by the company to develop a product called **Magicrete AAC**

Wall Panels. These panels were created using a unique process called 'Aeration,' which avoids these deficiencies and allows use in structural applications.

Magicrete AAC Wall Panels are Eco-friendly owing to the following reasons:

Environmentally friendly Can be substituted for wood and metal

Protection of precious fertile lands

Substitution of conventional clay bricks with Magicrete AAC Wall Panels avoids using clay from fertile land and soil for making clay bricks.

Conservation of forests

Since the product can replace plywood and Cement bonded particle boards etc., in which wood is used, deforestation can be avoided.

Pollution-free process (Zero waste disposal)

The process utilized for making panels does not generate any by-products, and the waste material generated is reused, thus preventing the pollution of the environment.

THE PRODUCT

Magicrete AAC Wall Panels is an interlocking panel with a tongue and groove jointing system, as shown in the figure.

It comprises Cement, Lime, Fine Silica Sand, Aeration Agent, and steel reinforcement.

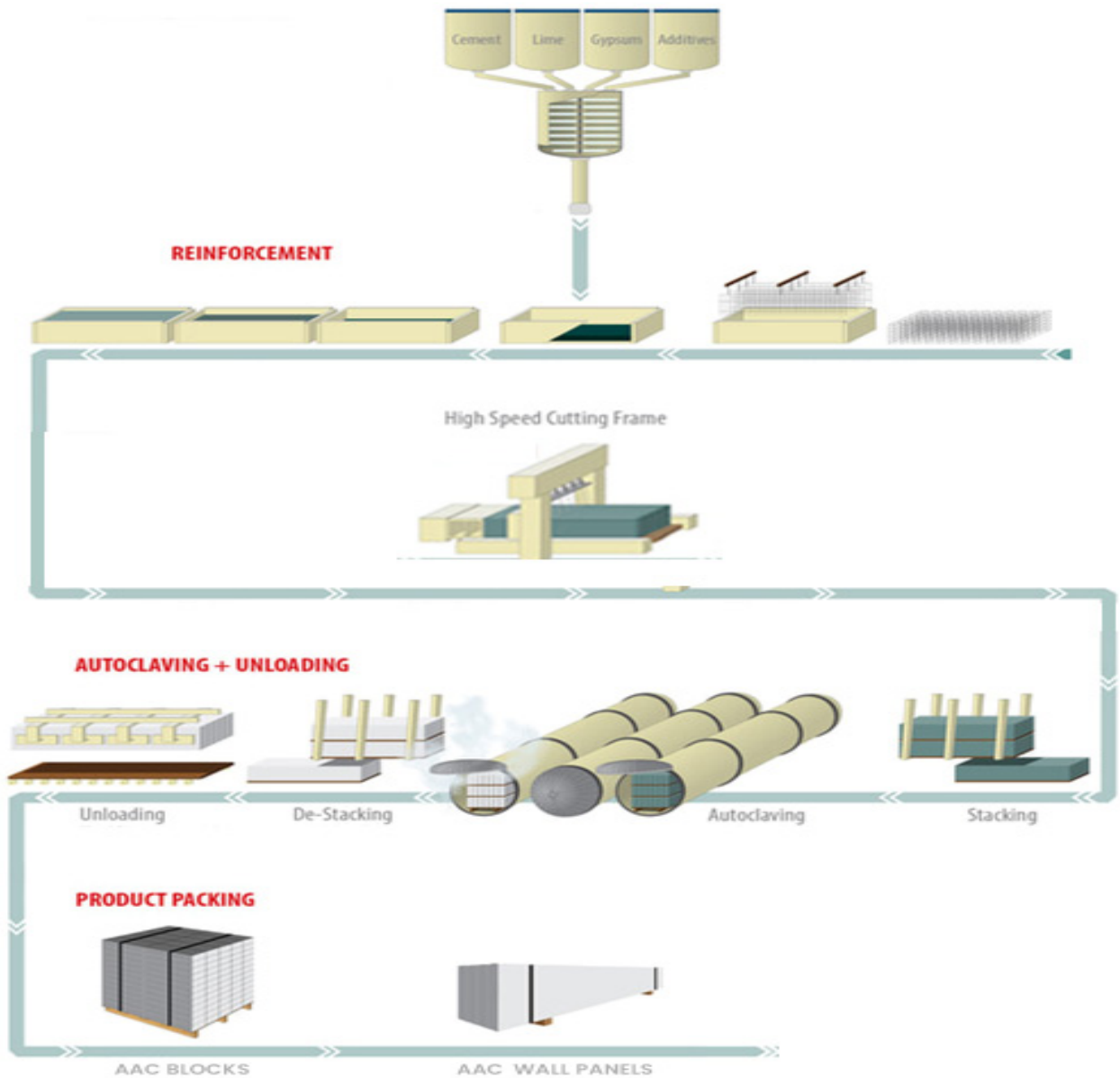
Figure 1

PRODUCTION OF MAGICRETE AAC WALL PANELS

Under controlled conditions, Fine Silica sand, aluminum powder, cement, and water are mixed. When AAC is mixed and cast in forms, several chemical reactions take place, giving AAC its lightweight property and thermal properties. First, aluminum powder reacts with calcium hydroxide and water to form hydrogen. The hydrogen gas foams and doubles the volume of the raw mix. At the end of the foaming process, the hydrogen escapes into the atmosphere and is replaced by air.

When side forms are removed from the material, it is solid but still soft. It is then cut into panels and placed in an autoclave chamber. During this steam pressure hardening process, when the temperature reaches 190° Celsius and the pressure reaches 8 to 12 bars, sand reacts with calcium hydroxide to form calcium silica hydrate, which accounts for AAC's high strength and other unique properties. After the autoclaving process, the material is ready for use on construction sites.

MAGICRETE AAC WALL PANELS PROCESS FLOWCHART



TECHNICAL SPECIFICATION AND PROPERTIES OF MAGICRETE AAC WALL PANELS

Technical specifications of the panels are given in table 1, and their characteristics in table 2

PHYSICAL DIMENSIONS

Thickness (mm)	Weight (Kg/m²)	Width (mm)	Length (mm)	Tolerance (mm) (T, W & L)
75	55	600	2000 - 3000	+/- 1
100	70	600	2000 - 4000	+/- 1
150	100	600	2000 - 4000	+/- 1
200	140	600	2000 - 4000	+/- 1

Figure 2

MATERIAL PROPERTIES

Parameters	Magicrete AAC Wall Panels
Basic Raw Material	Cement, Lime, Fine Silica Sand & Aeration Agent
Dry Density	550 – 650 kg/ m3
Compressive Strength	4 N / mm2
Fire Resistance	4 Hours (100 mm Wall)
Thermal Conductivity	<0.16 W/k-m
Modulus of Elasticity	2190 MPa
Sound Reduction Index	> 40 dB
Resistance to Water Penetration Test	No Sign of Water Penetration & Surface Alteration after 3 days

TECHNOLOGY COMPARISON

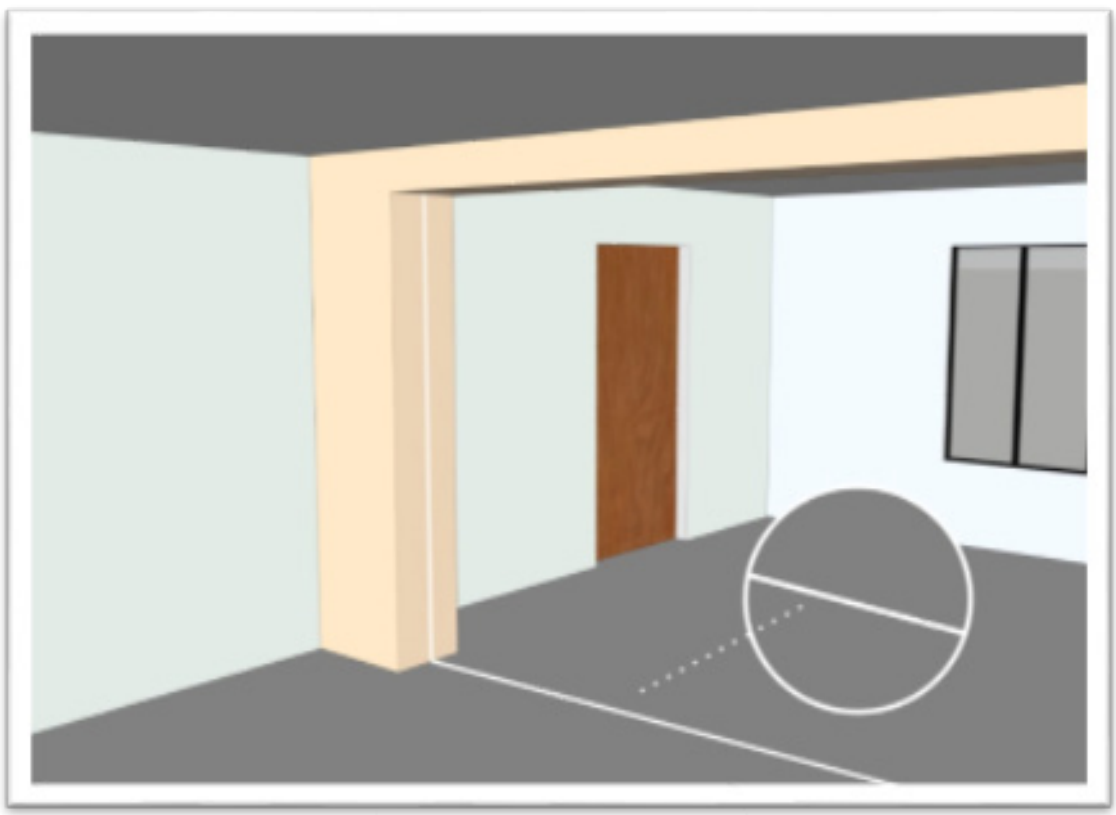
Parameters	Burnt Clay Bricks	AAC Blocks	Hollow Core Wall Panel	Dry Wall	Sandwich Wall	AAC WALL PANEL
Weight	185 kg/m² (115 mm)	70 kg/m² (100 mm)	110 kg/m² (100 mm)	20 kg/m²	54 kg/m² (75 mm)	**55 kg/m² (75 mm) 70 kg/m² (100 mm)**
Dry Density	1950 kg/m³	550-650 kg/m³	1550 kg/m³	600-800 kg/m³	1000 Kg/m³	**550-650 kg/m³**
Speed of Installation (1 Mason + 2 Helpers)	10 m²/day	20 m²/day	40 m²/day	40-50 m²/day	20-30 m²/day	**40-50 m²/ day**
Fire Resistance	2 Hours (200 mm)	4 Hours (100 mm)	2 Hours (100 mm)	1 Hours (100 mm)	2 Hours (75 mm)	**4 Hours (100 mm)**
Thermal Conductivity (W/K-m)	0.81	0.16	0.4	0.25	0.21	**0.16**
Sound Reduction Index (dB)	50 dB (230 mm)	44 dB (200 mm)	44 dB (100 mm)	40 dB (100 mm)	35 dB (100 mm)	**44 dB (100 mm)**
MEP Installation difficulty level	Medium	Very Low	High	High	High	**Very Low**

SIGNIFICANT PRODUCT ATTRIBUTES

1. Eco-friendly
2. Faster construction, No wet plastering, and on-site curing
3. Lightweight
4. High thermal insulation
5. Fire resistant
6. Excellent sound reduction properties
7. Water, termite, and weather resistant
8. Suitable for Seismic prone zones
9. Thin walls (space saving)
10. Smooth finish
11. Construction of houses/shelters is possible where sand, water, and cement are unavailable, like in high mountain regions.
12. Minimum foundation or ground preparation required.
13. Easy workability

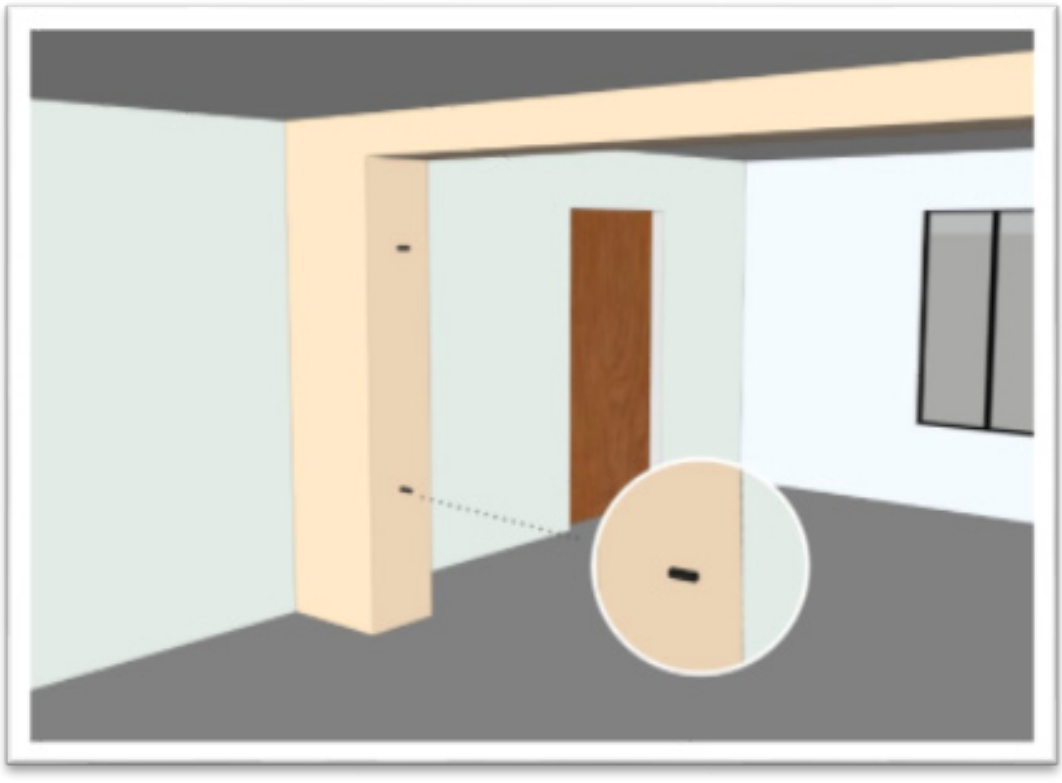
INSTALLATION INSTRUCTION OF MAGICRETE AAC WALL PANELS

Step-1



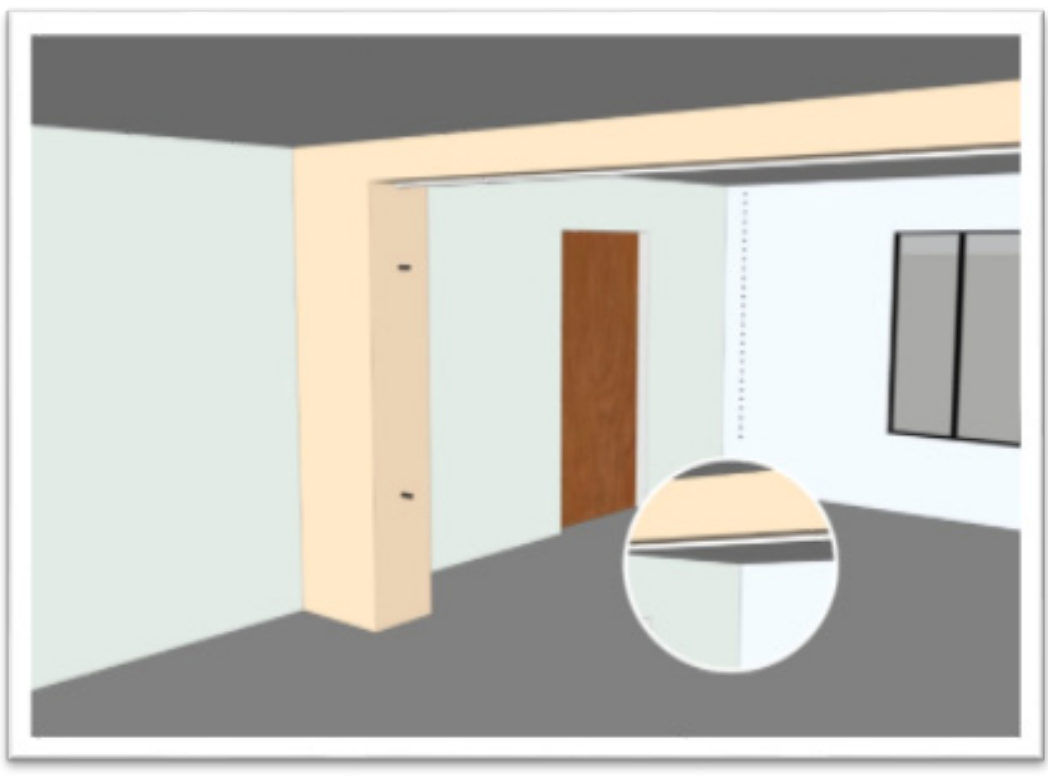
Ensure the floor and ceiling are free of dust before making the line by chalk.

Step-2



Drill 2 holes of 40 mm depth 8 mm dia at the marked in the column and Insert dowel bars (8 mm dia x 80mm Width) into holes.

Step-3

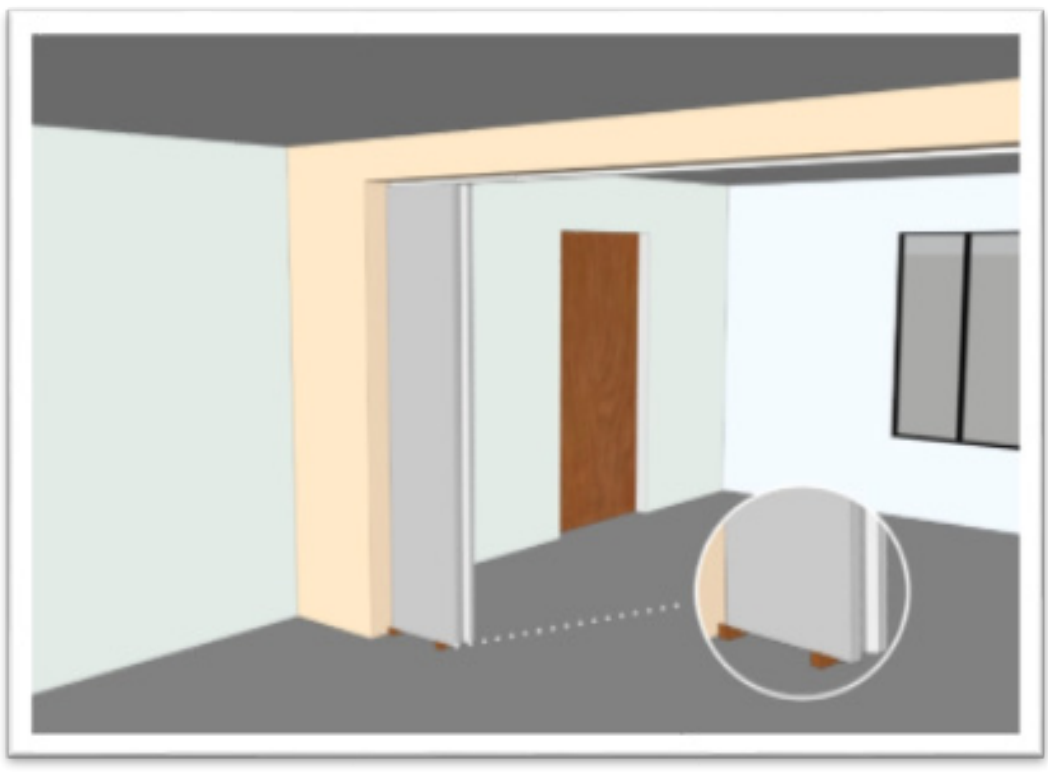


Paste Styrofoam (50 mm x 15 mm) across the length of the wall to beam bottom/slab bottom.

Step-4

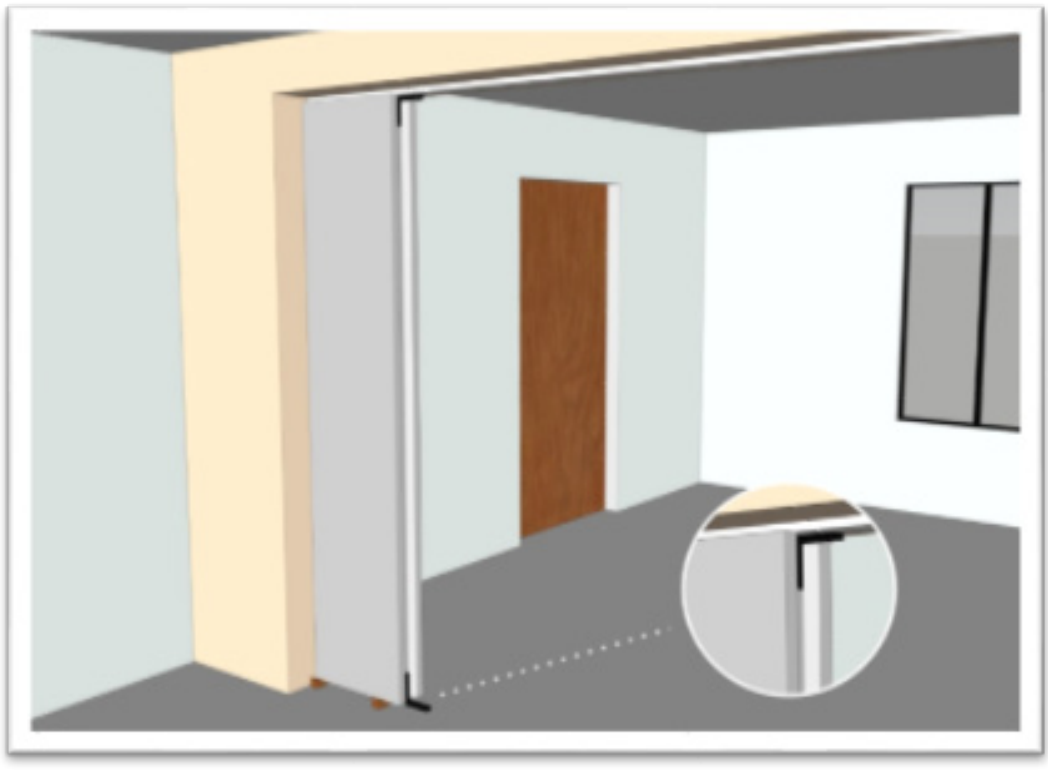
Lift the wall panel & push it to attach with the column.

Step-5



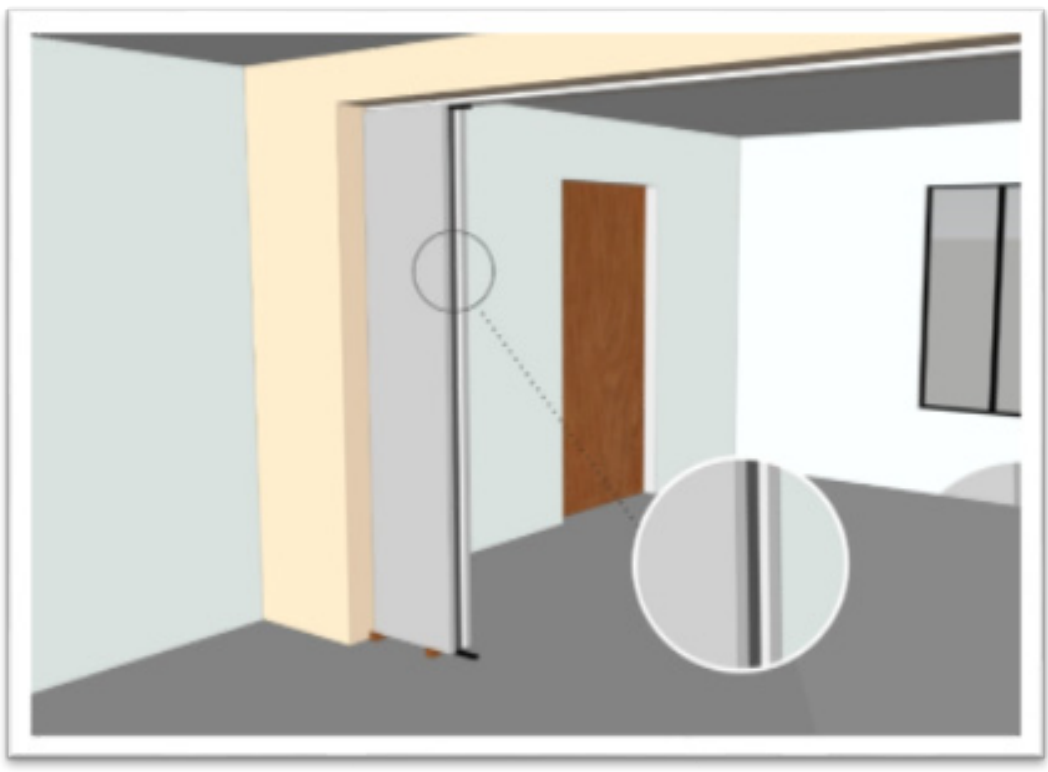
Attach the Magicrete AAC wall panel with column and insert wooden wedge under the panel.

Step-6



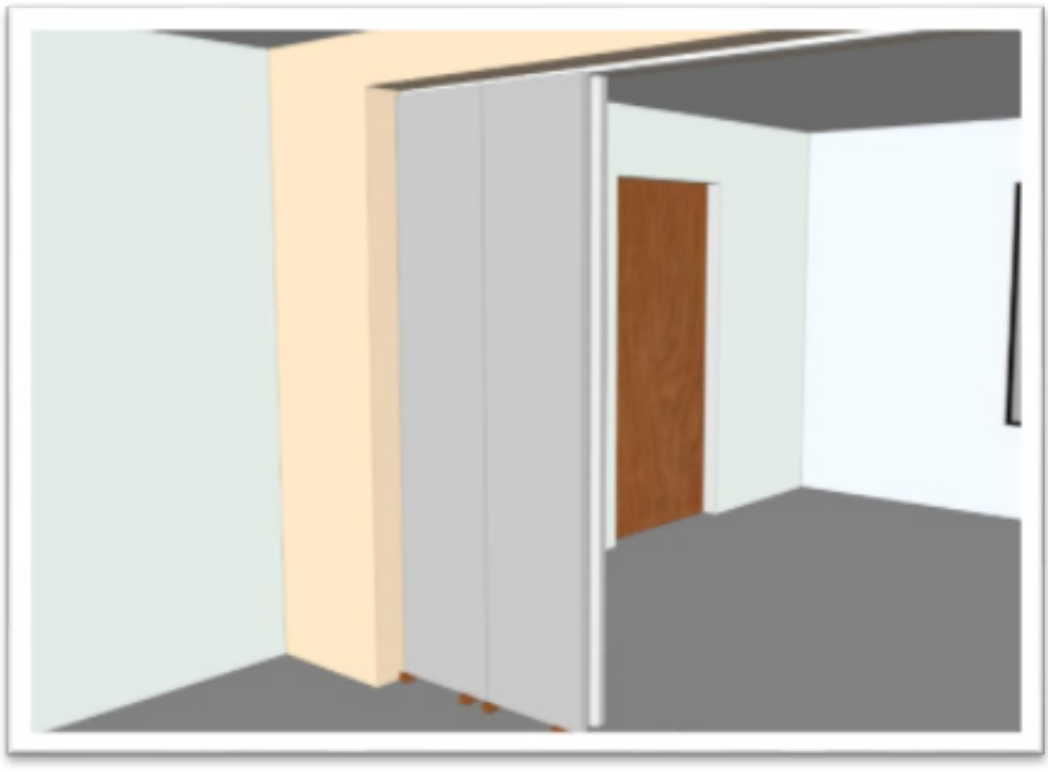
Use GI L-clamp to fix the panel with the floor and the roof with the help of fasteners.

Step-7



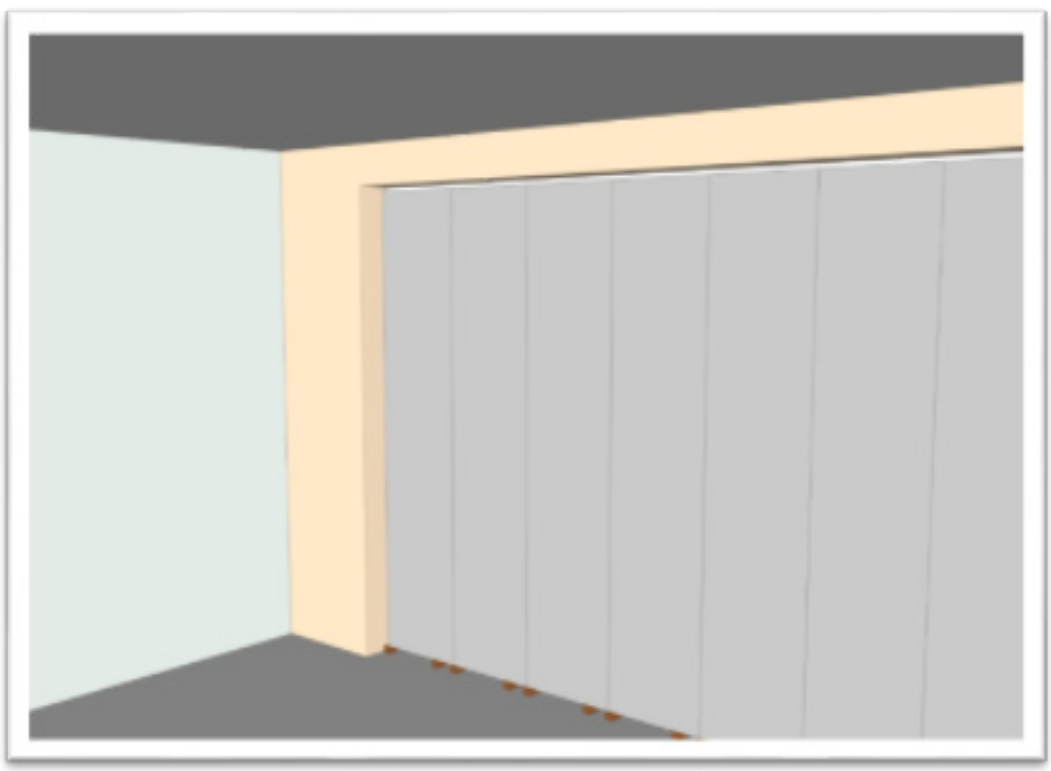
Apply thin-bed mortar on side of the first panel

Step-8



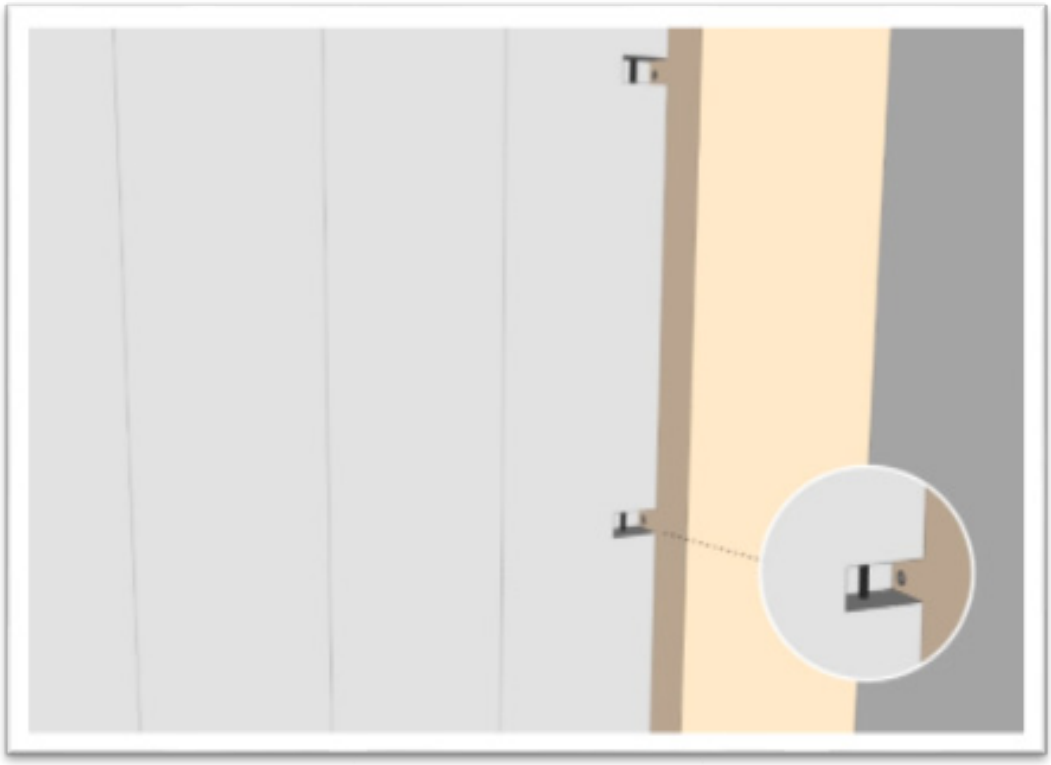
Lift the next wall panel to attach and repeat steps 6- 8.

Step-9



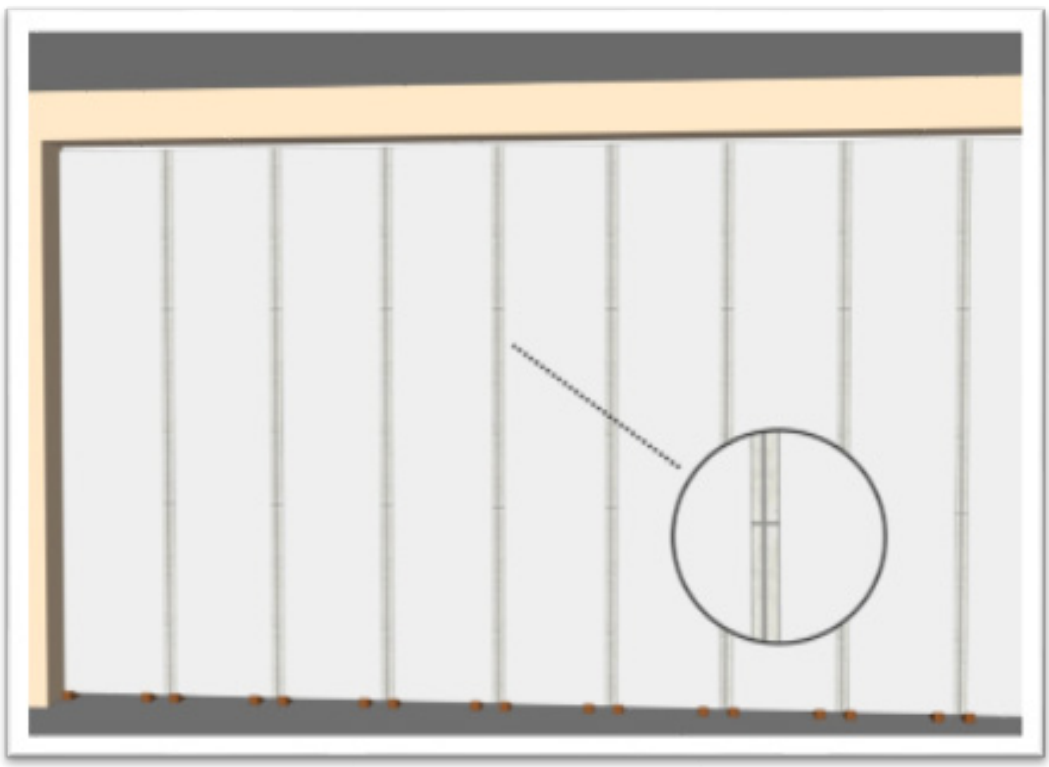
Continue to install wall panels until the gap can be closed by last panel.

Step-10



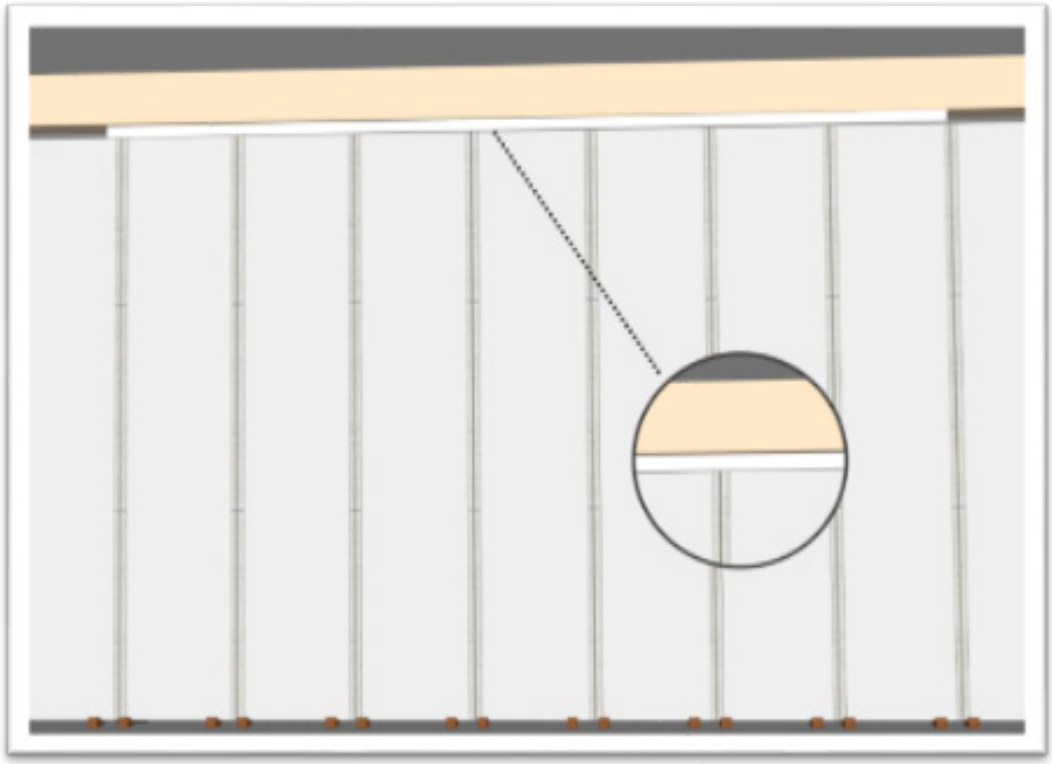
Carve 2 slots in the panel for dowel connection with the end column.

Step-11



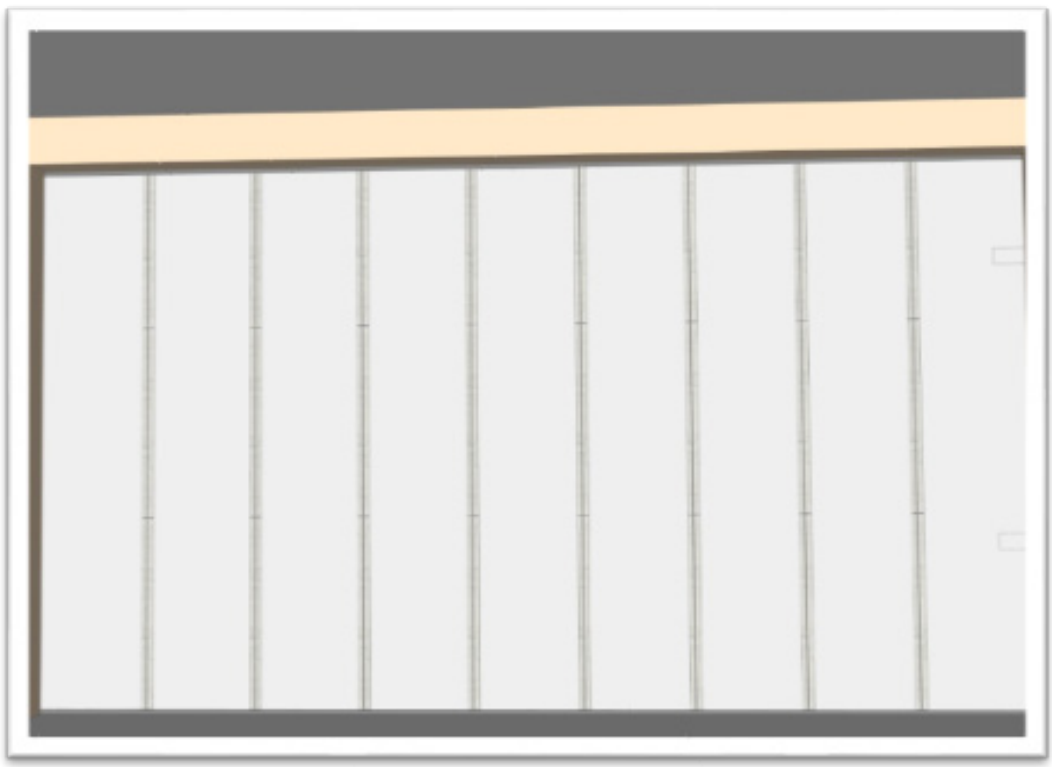
Apply glass fibre tape on the joints between panels and cover it with polymer based putty.

Step-12



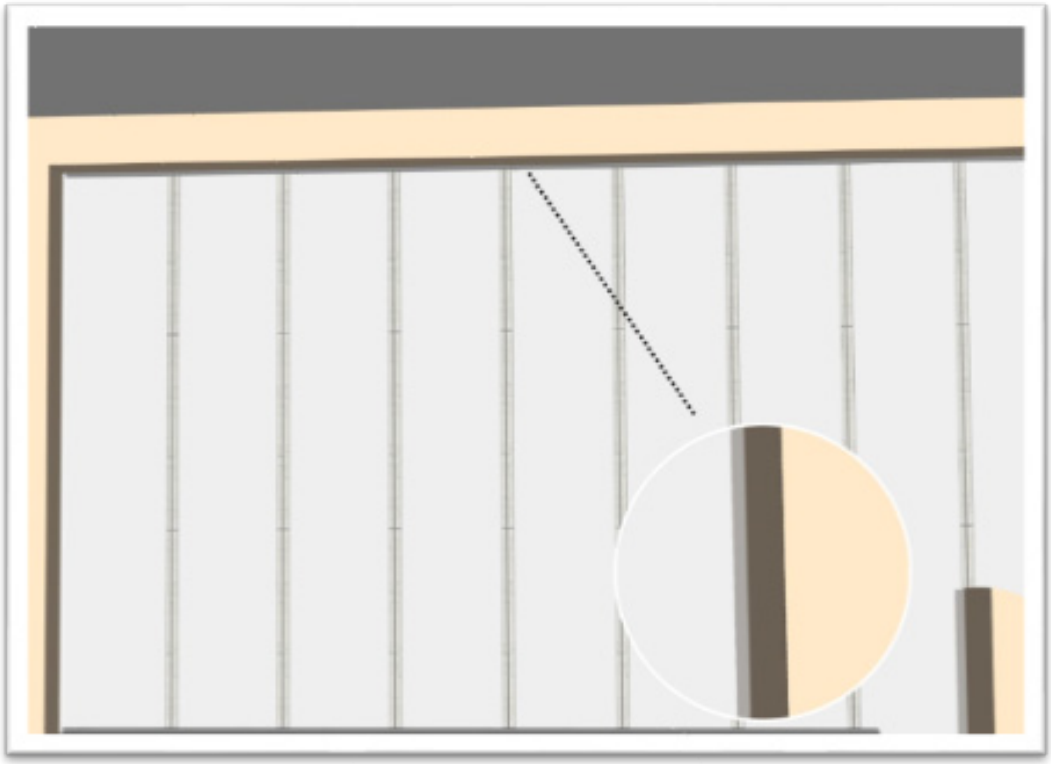
Fill the gap if any between beam/slab top and wall panel by PU Foam and remove excess of it.

Step-13



Fill the gap between floor and panels with a 1: 4 sand-cement mortar & allow it to dry.

Step-14



Fill PU sealant in vertical control joints & end gaps.

APPLICATIONS OF MAGICRETE AAC WALL PANELS

Euro School, Bangalore

Avior Merlin Pvt Ltd, Pune

Avior Merlin Pvt Ltd, Pune

CBRE Group, Pune

Euro School, Bangalore

CBRE Group, Pune

CONCLUSION

Magicrete AAC Wall Panels have high thermal and acoustic insulation properties and are resistant to fire, water, and termites. As a result, they have wide applications in the construction of Pre-Fab houses, High rise buildings, shelters, Boundary walls, etc.

Compared to conventional building products, they take much less construction time, are dry construction (not requiring water, thus Eco-friendly), and can be easily relocated. As a result, this product has become the favored option for building in rugged terrains where other materials are unsuitable. Furthermore, the product's design makes it suitable for application in seismic and cyclone-prone zones.

RISING HYBRID PRECAST PANELS BUILDING SYSTEM

Ratan Singh

" LET US FULFIL THE DREAM OF EVERY FAMILY, TO HAVE A HOME OF THEIR OWN! "

HON'BLE PRIME MINISTER OF INDIA, SHRI. NARENDRA MODI
Signing the foundation stone of Rising Hybrid Precast Panels Building System plant in India

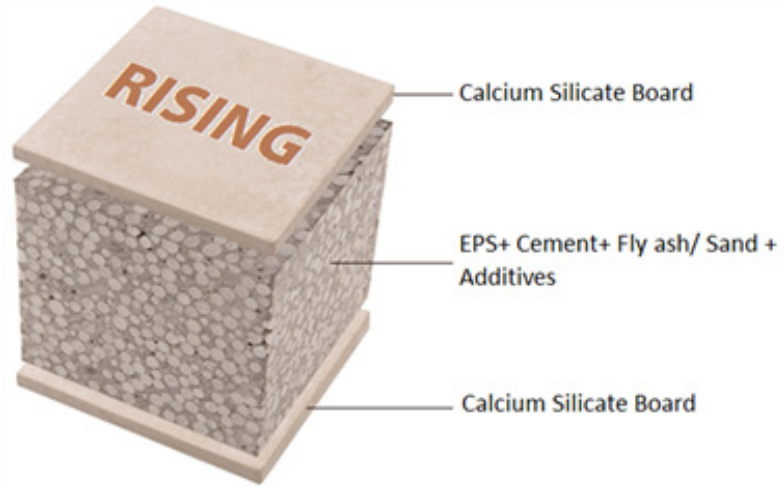
A RISING JAPAN INFRA PRIVATE LIMITED
NEW TECHNOLOGY PROJECT UNDER "MAKE-IN-INDIA"

RISING JAPAN INFRA

Rising Japan Infra Private Limited, in collaboration with Rising Hongfa group is responsible for developing new construction technologies, which are suitable for India conditions. The company started its operation in 2016, and has been working in close association with the Ministry of Housing and Urban Affairs, CPWD, BMTPC, NBCC, State Governments; and with leading private construction groups in India.

We started in India, the latest building technology products by producing Rising Precast Hybrid Building System, which is a wonderful combination of Rising EPS Cement Sandwich Panels as walling material for different applications and Rising Prestressed Hollow Core Precast Slabs, for roofing and flooring and with faster and more durable construction.

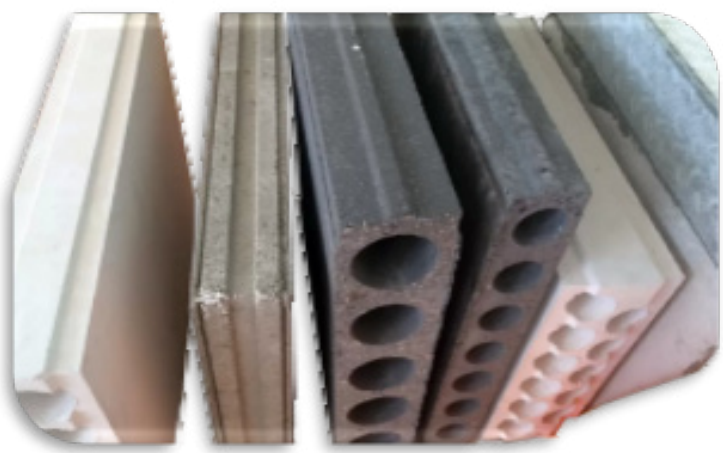
RISING EPS CEMENT PANELS



Rising EPS Cement sandwich panels are revolutionary new type of high-grade lightweight molded panels made with foamed EPS particle mixed with cement fly ash, Sand, slag and additives as core material and Calcium silicate boards as surface material. The two surfaces of this new type composite sandwich panels are composed of high strength water resistant calcium silicate board with good waterproof properties and thermal insulation. The product is of structural function, waterproof and thermal insulation performance, mainly used as building wall partition.

When comparing the solid strength, lightweight, thin body, high strength, impact resistance, strong hanging force, heat insulation, sound insulation, fire prevention, waterproof, easy cutting, can be arbitrary slot, without rendering coat, dry construction and environmental protection. EPS Cement panels wins hands down.

This takes construction industry into production industrialization with technical equipment, intensive production and legal application compliance at the same time it also reduces the wall occupying space increasing usable residential space, reduce structure load, promote building aseismic ability and safety performance, reduce the comprehensive cost.



VARIOUS TYPES OF RISING EPS CEMENT PANELS USING DIFFERENT SPECIFICATIONS AND DESIGNS ACCORDING TO REQUIREMENT

ADVANTAGES OF RISING EPS CEMENT PANELS

With advanced features, Rising EPS Cement Panels save money, time, energy, water, labor and give the construction industry a tremendous advantage over the traditional wet type construction methods.

The panels reduce the wall occupying space and increase the usable floor area, reduce the structure load, promote building seismic stability and earthquake resistance and overall safety performance, while reducing the comprehensive cost.

They are widely used in all kinds of high-rise, multi story buildings as non-load bearing walls with sound insulation and fire protection properties.

SOME OF THE ADVANTAGES OF RISING EPS CEMENT PANELS ARE:

1. Carbon-Negative (utilizing fly-ash)
2. Save valuable earth used in brick production
3. Environment-friendly and Non-toxic
4. Significantly reduce Air and Noise pollution
5. Reduce construction waste
6. Saving water due to dry-construction
7. Increase in carpet area up to 15% which saves money
8. Lighter Building Structure and Foundation, thus saving money
9. Labor Saving
10. Time saving (easy and faster Construction)
11. Cost Effective
12. High Banging Strength
13. Very high single point hanging strength
14. Earthquake resistant
15. Fire Resistant
16. Electrical Insulator
17. Water Proof and Dampness Resistant
18. Termite Resistant
19. High Sound Insulation
20. High Absorption Capacity
21. Low Shrinkage
22. Permeability Resistance
23. Temperature resistance
24. Smooth and Flat Surface, thus no plastering needed
25. Total Quality Control & Anti-Manipulation construction.


Acoustic Insulation


Strong & Durable


Extra Floor Space Index


Termite Proof


Fire Retardant


Eco-Friendly Dry Construction


Water Resistant


Recyclable


Light Weight


Energy Saving by Thermal Resistance

USES OF RISING EPS CEMENT PANELS

Rising EPS Cement panels are today the best solution for the construction industry. Our panels are the most suitable alternative to the outdated brick wall technology.


Village Housing


Pillar-less Villas


Pillar-less Affordable Houses


Hotels & Resorts


High Rise Complexes


Hospitals

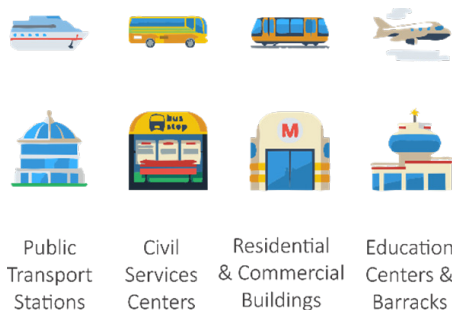

Shopping Malls


Highways & Bridges


Border Security Walls

SOME APPLICATIONS WHERE RISING EPS CEMENT PANELS ARE USED:

1. Multi-story construction as walling, floors and roof panels
2. Commercial and Residential projects
3. Low cost Housing
4. Urban slums Housing
5. Rural Housing
6. Earthquake sensitive zones
7. Remote areas housing and construction
8. Extreme temperatures housing
9. Disaster management quick construction housing
10. Holiday resorts
11. Hospitals & Universities
12. Water body housing
13. Up to two floor houses without pillar support.
14. Highways and Bridges side walls railings
15. Railways and Metro stations
16. Rail lines boundary walls
17. High-tech Bomb resistant boundary walls (with steel pipes and laser inserts)
18. Walkways in public places
19. Pavements along the roads
20. ***Any open area needing fast and economical coverage & non load bearing application if without structure.***




Places with Extreme Weather Conditions

TECHNICAL DATASHEETS (BMTPC: PAC-1032-S/2017)

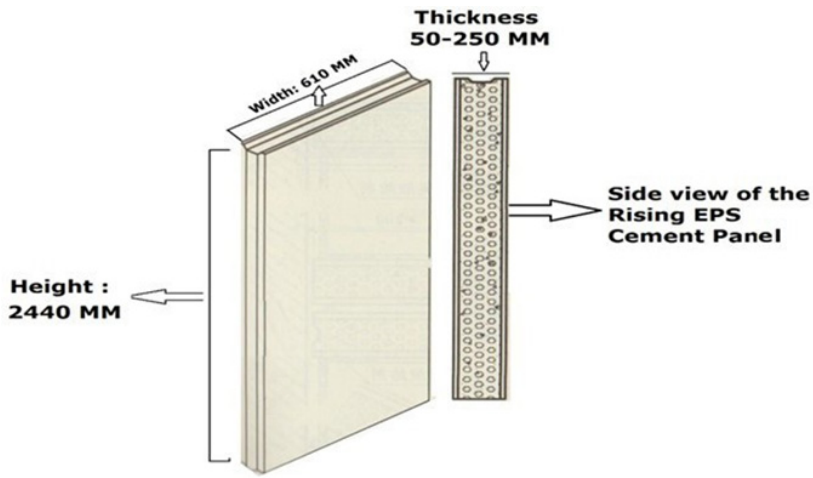
A. ABOUT THE TECHNOLOGY

These are lightweight composite wall, floor and roof sandwich panels made of thin fiber cement/calcium silicate board as face-covered boards and the core material is EPS granule balls, adhesive, cement, sand, flyash and other bonding materials in mortar form.

The core material in slurry state is pushed under pressure into preset molds. Once set, it shall be moved for curing and ready for use with RCC or steel support structure beams and columns. These panels are primarily used as walling material, but can also be used as floor and roof panels. These are non-load bearing panels to be used with structural support frame only. However, if used in G+1 structure, these can be used as load bearing panels.

B. SIZE AND TYPE OF PANELS

PRODUCT SPECIFICATIONS (LENGTH 2440-3000; WIDTH 610; THICKNESS 50-250) DIMENSIONS ARE SHOWN




Very high water resistance


Very high Fire proof rating


Very high bending resistance


Very high hanging strength

C. RAW MATERIALS

(i) OPC 43/53 grade cement shall conform to IS 8112:2013/12269:2013.

(ii) Fly ash shall conform to IS 3812 (Part 2):2003.

(iii) EPS beads shall conform to IS 4671:1984 and shall have density not less than 15 kg/m3.

(iv) Fiber cement board shall conform to IS 14862:2000.

(v) Calcium silicate board shall conform to EN 14306:2009

(vi) Fine (sand) & coarse aggregate shall conform to IS 383:2016.

(vii) Water shall conform to IS 456:2000.

(viii) Adhesive like HPMC and RD Powder shall be used for core and sheet

D. PERFORMANCE CRITERIA

Rising EPS panels shall meet the following performance criteria when tested in accordance with the relevant Standards:

Sl.No.	Performance Characteristics	Criteria	Test Method
1.	Flammability of EPS	≥ 600kgs/M³	IS ASTM D 7309:2013
2.	Axial compression	≥ 3.5MPa	IS 2095 (Part1):2011
3.	Resistance to continuous heating	≥ 70°C	ASTM F 1939:2015
4.	Flexural Strength	≥ 1N/mm²	IS 516:1959
5.	Acoustic Performance	≥ 35dB	IS 9901:1981
6.	Thermal conductivity	≥ 0.1W/M² k	IS 3346:1980
7.	Thermal Resistance	≥ 0.40M² k/W	IS 3346:1980
8.	Water penetration	There should be no damage or leakage	EN1609:2013
9.	Fire rating of the panels	Should be Grade 1/3 Hrs	BS 476 (Part 20 & 22)
10.	Resistance to structural damage from a large light body	There should be no collapse or dislocation	BS 5234 (Part 2):1992, Annex E
11.	Anti-bending damage load	≥ 1.5 times of its weight	BS 5234(Part 2):1992
12.	Non-combustibility	Should be 'A' level	GB 8624:2012
13.	Water tightness behind panels after 24 Hrs at 250mm water head	No droplets should be observed	ASTM C1185:2016
14.	Drying Shrinkage value	≤ 0.1%	IS 2185 (Part 1):2005
15.	Single point hanging strength	≥ 1000N	BS 5234 (Part 2):1992

E. INSTALLATION OF EPS CEMENT PANEL, APPLICATIONS & JOINTING PROCEDURE

- With RCC frame structure: If RCC frame structure is used in the construction, then the panels should be directly fixed on the walls, pillars, beams and floor with the help of cement glue and later iron locking rods should be inserted into the panels and the pillars, beams and floors at 45° so that they are firmly locked with each other and become one single unit.
- The manufacturer shall inform the specialized chemical "cement glue", if available in India/ manufactured by reputed chemical/ water proofing companies to the customers.
- With Steel frame structure: If steel structure frame is used in the construction, then the panels can be fixed with steel clips to hold the panels with the structure. In this case additional clips should be welded with the frame pillars or beams to hold the clips firmly with the pillars / beams and floor. There after PU glue should be applied to hold the panels firmly.
- After installation of the panels in both the above systems, all gaps should be checked and filled with additives, PU and cement mixers and later thin putty should be applied to give uniform smooth surface ready for paint.

2. INSTALLATION OF PANELS

- **Receipt and inspection of Panels**

Once the panels are received, it should be checked if the edges are safe and also there are no cracks or damages on the surface of the panels which can happen during transportation and handing.

- **Laying of panels as per drawings**

Once panels received are as per the drawings, then it should be separated and laid down as per the drawings for easy installation and to avoid extra handling.

- **Marking and sizing the panels**

Once panels are placed at the proper place, marking should be down as per drawing and proper sizing should be cut of the required panels as per the drawings.

ACTUAL INSTALLATION AS WALL

The panels are lifted and placed as per the drawings. For installation of the panels, following points should be considered:

2.1 Joining of panels with each other

- The panels shall be placed at the marked space and adjusted together. Dust should be cleaned on the tongue and groove of the panel to be installed. Cement mortar shall be applied and glue filled in the gaps on the panel joining parts and force them together to form one panel. Levels of both panels shall be checked.
- The panels shall be fixed with steel bar between each other or between the panels and the floor to lock them together.

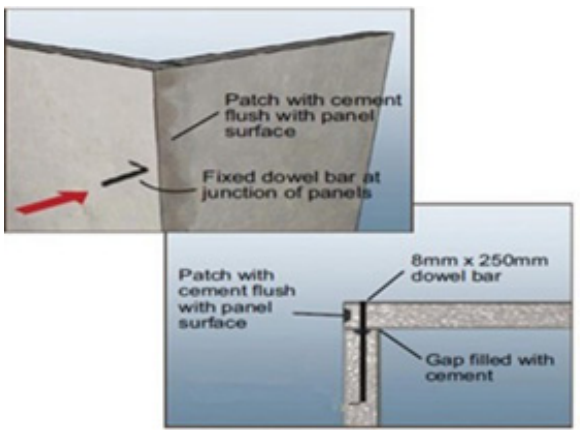
2.2 Typical Joint between two panels side by

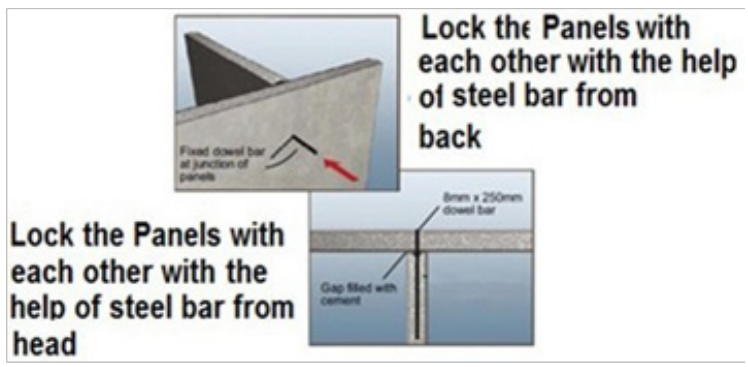
- The panels shall be fixed with dowel bars and the bars inserted in one panel at 45° and hammer it down to lock both the panels.

2.3 Typical joint with

- The panels shall be placed on floor, cement and glue applied between panels and floor and L type steel bars inserted through the panels edge at 45° in the floor. The panel will then be locked to the floor.

2.4 Typical L and T joint with





2.5 Joining of upper and lower panels together:

- The panels shall be placed one over the other vertical/ horizontal after applying cement and glue. The steel rod shall be inserted from the sides of the panels into each other to join them together and locked.
- A wall of these panels shall be inter-connected with steel bars inserted at 45° and fixed with cement and glue in between panels.

2.6 Connecting panels with RCC pillar/RCC Walls/RCC

- For connecting these panels with RCC pillars, the panels shall be placed with the pillar after applying cement and glue on the side of the panels and pushed to make the perfect position.

Following are three types of connections depending on the situation:

- Steel rods/screw or bolt shall be inserted in the pillar and the panels locked with the help of the above. Thus the panel will be fixed and becomes part of wall connected with pillars.

2.7 Wall head

- Dowel bar of 250mm length and 8mm dia shall be fixed into pre-drilled hole of the panels and lock the panel to the overhead beams or RCC roof slab.

2.8 Fixing panels to the Steel frame (Pillars & Connection of wall panel to RHS column)

- Steel L-angle/C Channel/Z channel shall be welded to the side of RHS column and the panel inserted inside the angle/channel and locked. The thickness of the panels shall determine the size of angle/ channel.

2.9 Cutting of space for doors and windows

- The space on the drawing where doors and windows are required to be placed shall be marked and then while making walls keep that space. There is another way also where the space is cut later on once the walls are set fully.

2.10 Door Opening

- The panels shall be placed horizontally to keep space for doors.

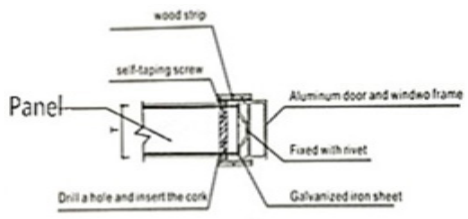
2.11 WINDOW OPENING

- The panels shall be placed horizontally to keep space for windows.

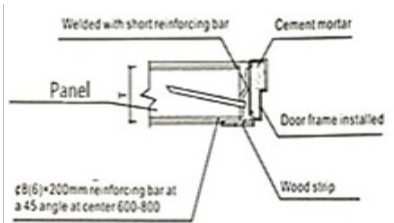
2.12 Cutting space for doors and windows after the panels are fixed.

- The position of steel inserts shall be marked to protect the wall from any movement while cutting of panels. All the steel bars shall be inserted at 45° angle to lock the panels with each other to stop further movement.

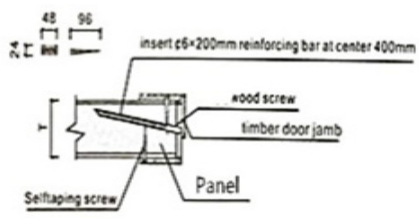
2.13 FRAME FIXING



Door and window frames fixed on the panel



Door frame fixed on the panel



Door jamb fixed on the panel

3. Laying of electrical

- The wire shall be embedded from the ceiling into the trench.

4. Hanging

- Expandable metal bolt shall be used and hooked on the wall panel.
- Tile adhesive shall be used for fixing heavy granite tiles.

5. Fixing the Panels as

- Steel frame shall be fixed if this is to be a raised platform otherwise the panels can be used directly as floor after making the ground level properly.
- Floor tiles can be fixed on these panel, if required.

6. Fixing the Panels as Roofing

- These panels can be used in the roofing as long as it is non-load bearing application.

LIMITATIONS ON THE BASIS OF PERFORMANCE, SAFETY, GEO-CLIMATIC CONDITIONS

These are non–load bearing panels and should be used as walling, floor and roofing with additional structural support, steel or RCC depending on the design. However, these may be used as single floor construction or stairs case slabs, kitchen/bathroom slabs etc. without support structure. These panels are non-load bearing only if they are used without any pillar and beam support. However, they may be used as walling material with RCC or steel frame structure. The panels, if used for floors/roofs, shall require screeding concrete of 35mm thick with nominal reinforcement/ GI wire mesh for shrinkage monolithic action to avoid leakage through the panel joints.

PMAY (PRADHAN MANTRI AWAS YOJNA)

Hon'ble Prime Minster of India: Shri Narendra Modi, Minster for Housing & Urban Affairs and Civil Aviation: Mr. Hardeep Singh Puri, and Chief Minister of Madhya Pradesh: Mr. Shivraj Singh Chouhan; Inaugurated and laid the foundation stone of the LHP project using Rising Technology for the construction of 1,024 EWS houses under the PMAY's "Light House Projects" scheme of the Ministry of Housing & Urban Affairs, Government of India at Indore on 1st Jan 2021

GOVERNMENT APPROVALS - INDIA

आत्मनिर्भर भारत

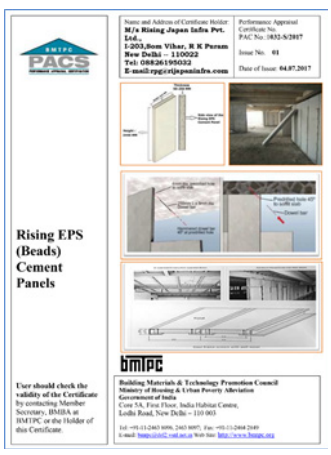
प्रधान मंत्री आवास योजना-शहरी
Pradhan Mantri Awas Yojana-Urban

सत्यमेव जयते
Ministry of Housing and Urban Affairs
Government of India

RISING

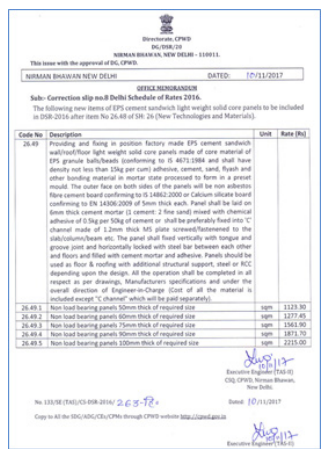
स्वच्छ भारत
एक कदम स्वच्छता की ओर

PACS APPROVAL – BMTPC



MANDATORY USE – MOHUA

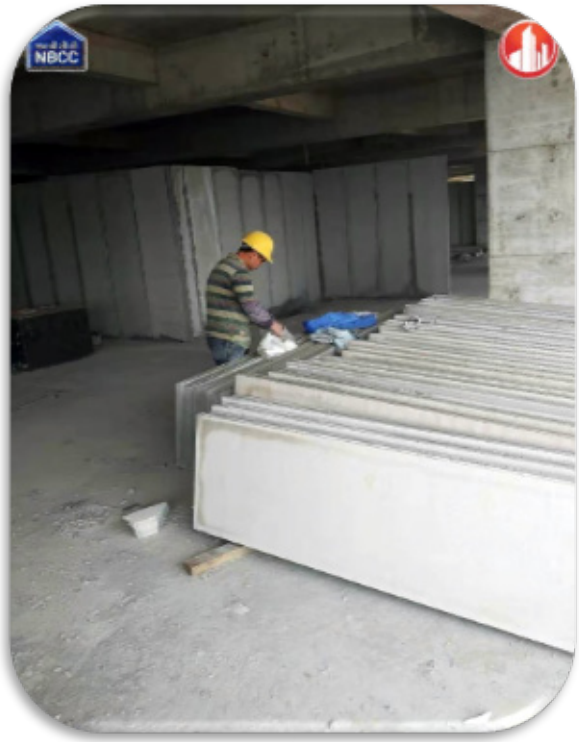
SCHEDULE OF RATES - CPWD



MANDATORY USE – NBCC

SOME OTHER PROJECTS USING RISING HYBRID PRECAST PANELS

- **NBCC: New Delhi – Kidwai Nagar Redevelopment Project**

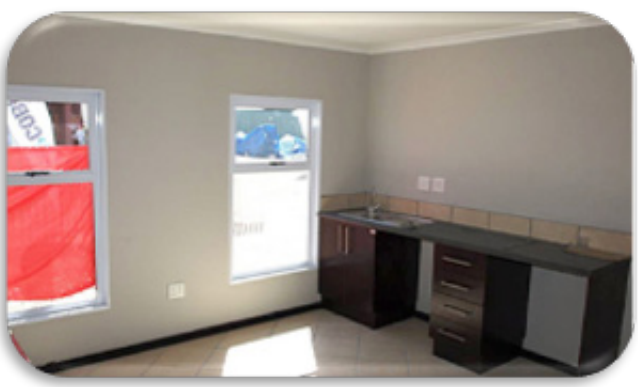


- **G+1 – 530 Flats**
  Zambia: Social Housing Project
  PILLAR-LESS CONSTRUCTION



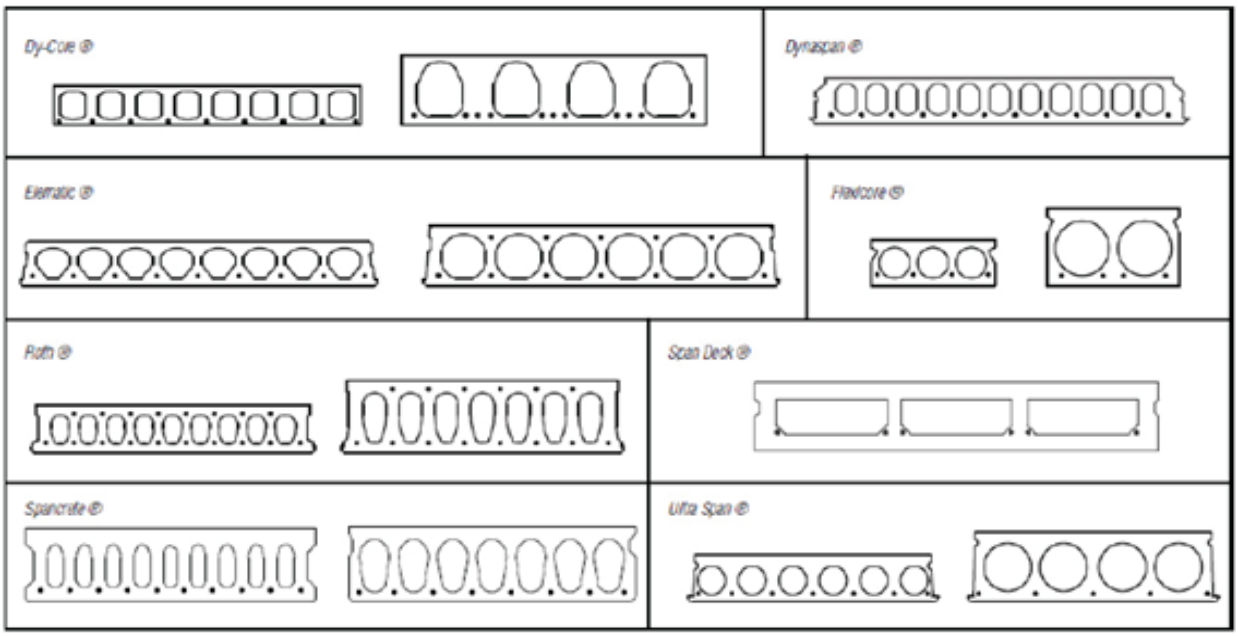







Rising Pre-Stressed hollow-core and solid slabs are used in various buildings such as housing, school, hotels, health-care centers, offices, manufacturing structures, etc. Pre-stressed slabs can be made as thin and thick based up on the requirement and objective of the structure.

Product Models



ADVANTAGES OF RISING PRECAST HOLLOW-CORE SLABS

1. The long hollow cores (voids) can be used to run mechanical and electrical equipment.
2. The long span capabilities in hollow-core slab provides long and clear spans, opening interior spaces in projects and allows designers to maximize functional layouts.
3. The Pre-Stressed high-strength hollow-core slabs can provide floors and roofing which can support heavy loads.
4. Buildings (especially tall buildings) that use hollow-core slabs have less vibrations than conventional buildings, along with a strong acoustical performance.
5. Hollow-core slabs are most helpful in meeting the requirement of separating parking and other functional areas of the mixed-usage facility.
6. Cantilever hollow-core slabs can provide monolithic balconies that are secure and quick to construct.
7. Hollow-core slabs act as a ceiling and flooring unit and reduces the building height while saving the cost.
8. The ducts in the Hollow-core slabs can save material and time by eliminating ductwork.
9. The Hollow-core slab can also be used as vertical or horizontal wall panels.

PRECAST SLABS PLANT LAYOUT

BENEFITS OF SYSTEM FORMWORKS IN CONCRETE IN-SITU CONSTRUCTION FOR HOUSING AND INFRASTRUCTURE PROJECTS

Samir Bapat, Outinord Formworks Pvt. Ltd.

Founded in 1955 and based in France, Outinord is the world leader in the design & manufacture of steel formwork for cast in situ concrete construction. Outinord pioneered 'Tunnelform' construction technology - an cast in situ RCC system, based on the use of high-precision, re-usable, room-sized, steel forms or moulds.

We have now started our Manufacturing project in India and fully operational from 01st July 2018.

We have different types of system formworks which cater to various segments of cast in situ construction.

We work on industrialization of construction. We offer Building technology that can enable you to cast on a daily basis and thereby reducing the project schedule on a project considerably.

Types of System formworks offered by Outinord :

1. Tunnel formwork
2. Wallform
3. Table form
4. Column form
5. Circular form
6. Safety platform
7. Other customized solutions for Dams, Nuclear Power Plants, Infrastructures etc.

TUNNEL FORMS

Outinord's tunnelforms, consist of inverted L-shaped half-tunnels (one vertical panel and one horizontal panel) joined together to create a tunnel.

Articulated struts brace the horizontal and vertical panels. These struts enable the adjustment of the horizontal level of the slab and simplify the stripping of the formwork; The vertical panel is equipped with adjustable jacking devices and a triangulation stability system. Both devices are on wheels.

A range of spans is possible by altering the additional horizontal infill panel's dimensions. Due to the distribution of the horizontal beams on the vertical panel, the formwork can also cast staggers and offsets in the layout of the walls, as well as differing wall thicknesses.

The half-tunnels can be equipped with back panels to cast perpendicular shear walls or corridor walls

WALL FORMS

The equipment used each day is productive and is reused in subsequent phases by the same team, achieving 30 linear metres of concrete wall, depending on the complexity of the structure. The four daily operations which outline the daily production cycle for wallform equipment are identical to those for tunnelform equipment, with the exception that it is solely used for casting concrete walls. The slabs are cast as a secondary phase. The existing equipment can be adapted on a day-to-day basis by the addition of standard elements and corner-wall formwork to take into account different wall configurations on site. All safety and stability devices are fully integrated into the standard version of wallform equipment.

Approx. 30 R Mt wall of about 3 M Ht can be cast on a Daily basis using only 8 labor and 1 Hydra.

Time saved during Installation & removal, adjustment, transfers & superimposition.

Cost saving due to

No Plaster required

Less Labor required

Less Time required

COLUMN FORMS

SINGLE COLUMN P2M Easy–to-install, easily adaptable forms speed up the construction of support and architectural columns of rectangular or square shape. Specific beam sections that can be integrated into column heads may be specified. The design of the P2M negates the requirement for spacers between the formwork panels. If necessary, a rubber joint may be simply installed in the vertical profiles in order to improve the seal between panel joins. To maintain a consistent column with true right angles, even at height, the panels are rigid and remain level due to a set of wind-bracing elements consisting of diagonal strips and horizontal struts. Outinord produces four standard models, which together, can produce 630 dimensional combinations in square or rectangular configurations. TYPE P1, P2, P3, P4. Great height columns The panels are stable up to a height of 10 m. Any vertical stacking can be achieved by differing combinations of panels and lower or upper extension panels. Lugs in the upper profiles of the panels are sufficient to obtain plumbness of the column.

TABLE FORMS

Table with Lyre Shaped Feet

The novel concept of this table make sit an economical tool,

Perfect for the construction of floors for :

- Collective or individual housing projects
- University, administrative or hospital projects.

This table is simple to use

- Very adjustable in height
- Quickly assembled (30/100^2 h/m2) excluding the plywood
- Light – weight requiring only a low-capacity crane : a 6 x 4m.
- Table weighs less than 1.5 T. including plywood.
- Non-bulky for transport from one building site to another.
- It is a reliable and rapidly redeemed tool.

CIRCULAR FORMS

CCRV 8000 Variable radius circular formwork Outinord CCRV is a multi-purpose tool used in many construction tasks, both for architectural projects, where the surface quality must be flawless, and for civil works, such as water treatment plants. A variable radius circular formwork system that uses turnbuckles affixed to the vertical stiffeners to increase or decrease the curvature.

Overlay pouring CCRV 8000 enables 10 linear metres height concrete walls to be cast on a daily basis, with minimum personnel. The CCRV 8000 is equipped with connection and components to plumb and superimpose panels, enabling the use of upper and lower extensions

SAFTEY PLATFORMS

Your work force is safe at all times during the Outinord construction process. Supports, platforms and stabilizing equipment are either integrated into or designed to move with the Outinord formwork systems.

STRIPPING PLATFORMS These platforms are essentially designed to facilitate removal of tunnel forms during the stripping process. They also serve as large working areas with clear access. A narrower platform may be substituted in restricted areas.

GABLE END SUPPORTS Gable end supports are designed to service gable end forms, facades or prefabricated units. They also provide easy access and a safe working area. An automatic locking system guarantees stability.

SAFETY PLATFORMS Slab box outs (for stairwells, elevators and service ducts) may be filled with various types of safety platforms

BENEFITS OF SYSTEM FORMWORKS.

TUNNELFORMS

- Economical : 500 repetition, minimal labour, no plastering,
- Speed: One day cycle.
- Quality: Fair Faced finish - F5 finish quality.
- Accuracy : High dimensional accuracy.
- Flexibility & Safety : Safety integrated in the process.

Benefits for Developers

- Reduction in cost
- Up to 50% saving in time.
- Quick return on investment from earlier occupancy.
- Reduced maintenance cost.
- Predictable construction rates and completion times.
- Resulting structures are seismically resistant.
- Elimination of columns will increase net usable area.
- Reduction of required material volumes.

Structural benefits.

- Monolithic solid structure.
- Efficient load distribution for foundation savings.
- Improved seismic properties and wind force resistance.
- Acoustic insulation due to density of walls and slab materials.
- Reduction in rebar densities due to load distributions.
- Elimination of columns will increase net usable area.

Benefits for construction team.

- Reduction in construction costs.
- Predictable and reduced labour force utilisation.
- Predictable scheduling and logistic control.
- Daily production cycle of repetitive task.
- High quality surfaces reduces the need for plastering.
- Highly Engineering construction systems results in structures with high dimensional accuracy.
- All safety systems are incorporated with the equipment.

Architectural benefits:

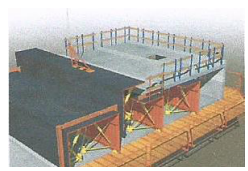
The system flexibility, combined with the concrete benefits, encourage architectural innovation and excellence.

THE 24 HOUR CYCLE

07:00

Engineer completes a concrete test to ensure that the previous day's pour has achieved the required strength.

07:30



With the engineer's permission the Tunnelform is struck, cleaned, oiled and repositioned.

11:00

Once all of the packages are in position slab reinforcement and insertion of conduits can begin.

COMPOSITE BUILDING CONSTRUCTION USING JINDAL SPEED FLOOR SLAB SYSTEM

Sanjay Nandanwar, VP & HOD-Product Application (S&M),
Jindal Steel & Power Limited

With the rise in the population along with rapid urbanization, the most affordable, efficient and fast construction methodology is required. Comparing cost optimization with time value of money, Composite construction is the best choice.

In composite construction, the bare steel sections support the initial construction loads and self-weight of the structure. Also the weight of the structure is less than the traditional RCC structure leading to economical foundations.

The composite sections refer to structures having:

1. Composite Columns
2. Steel Beams with Speed floor slab

1. COMPOSITE COLUMNS

Composite columns are the compression members comprising of hot-rolled or built-up steel sections encased in concrete or a concrete filled steel sections shown in Fig. 1. The additional reinforcing steel is for fire resistance and in encased sections is to prevent excess spalling of concrete.

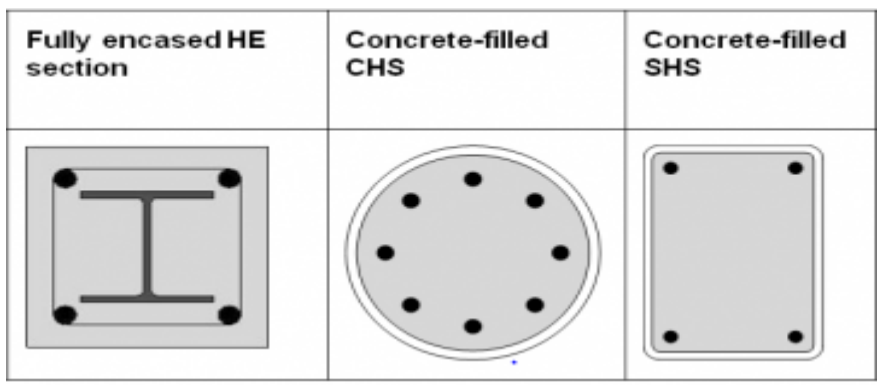


Figure 1: Types of Composite Columns

The steel and concrete give a composite behavior by resisting the loads by both friction and bonds. Additional shear studs are installed in encased steel sections for transferring the longitudinal shear due to external loads such that both materials are utilized effectively.

The steel sections are transported to the site and erected. Subsequently concrete is cast in-situ enabling the whole section to limit sway and adding strength. The buckling is effectively restrained in the encased columns eliminating one of the biggest weakness of the steel sections. Moreover, fire resistance is increased exponentially saving the exorbitant cost spent for fire protection of bare steel sections.

The design of composite sections has to be according to AISC 360-10 or Eurocode 4 as the Indian code has yet issued only the draft copy of the code. The analysis of the buildings should preferably done by the Indian codes using all the Indian load factors, combinations and material strength factors as they are more conservative than the foreign codes and are more relevant to Indian construction methods.

The concrete grade can be used as high as M 70 and structural steel of yield strength 550. The materials should conform to IS 456-2000 and IS 2062-1992. The reinforcing steel should conform to IS 432-1982 (Part 1) and/or IS 1786:1985.

2. COMPOSITE BEAMS

In the construction of buildings and bridges, steel beams often support concrete slabs. If there is no provision of shear transfer between the two, each component will act independently with relative moment or slip occurring at the interface. In composite construction, the concrete slab and the steel beam act together as a single unit and the longitudinal shear is transferred by the means of shear connectors. This results in increase in strength and stiffness and the whole beam can be termed as composite beam.

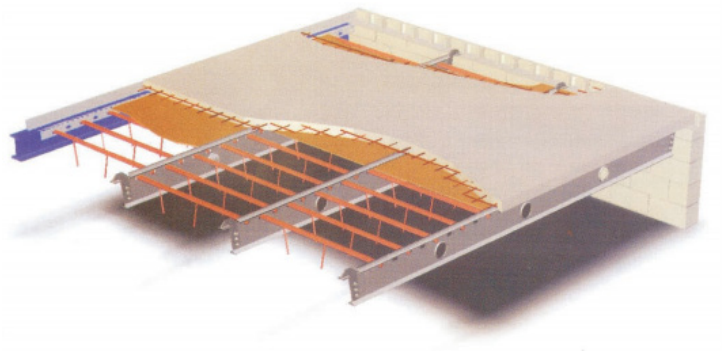


Figure 2: Jindal Speedfloor (right)

Jindal speed floor are placed over the top of rolled/built up I sections and for the speed floor both on-site and shop installation of shear stud/channels can be done. The Speed floor can typically span up to 4.3 m un-propped which is important for fast-track construction. A light reinforcement mesh is added in slab to control cracking, spread the load and provide continuity.

The design of composite sections should be according to Eurocode 4 due to advancement of this code in design of composite beams. The analysis of the buildings should be done by the Indian codes using all the Indian load factors, combinations and material strength factors as they are more conservative than the foreign codes and are more relevant to Indian construction methods. The materials should conform to IS 456-2000 and IS 2062-1992. The reinforcing steel should conform to IS 432-1982 (Part 1) and/or IS 1786:1985.

Composite Construction

With the use of composite columns along with Speed floor slab system it is possible to erect high rise structures in an extremely efficient manner. There is quite

a vertical spread of construction activity carried out simultaneously at any one time, with

numerous trades working simultaneously. For example

- One group of workers will be erecting the steel beams and columns for one or two storeys at the top of frame.

- Two or three storeys below, another group of workers will be fixing the
- Speedfloor slab system for the floors.
- As we go down the building, another group will be tying the column reinforcing bars
- in cages.
- Yet another group below them will be fixing the formwork, placing the concrete into
- the column moulds etc. and another group will be concreting the floors.

Brief write up of Speed floor Slab System

Speed floor 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. The Speed floor system essentially is 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 Speed floor composite floor system is suitable for use in all types of construction. The Speed floor joists are custom manufactured to suit particular job conditions.

There are various advantages of Composite construction using Speed floor Slab system:

a) Fast construction leads to early return of investment. 7-8 days slab cycle can be achieved

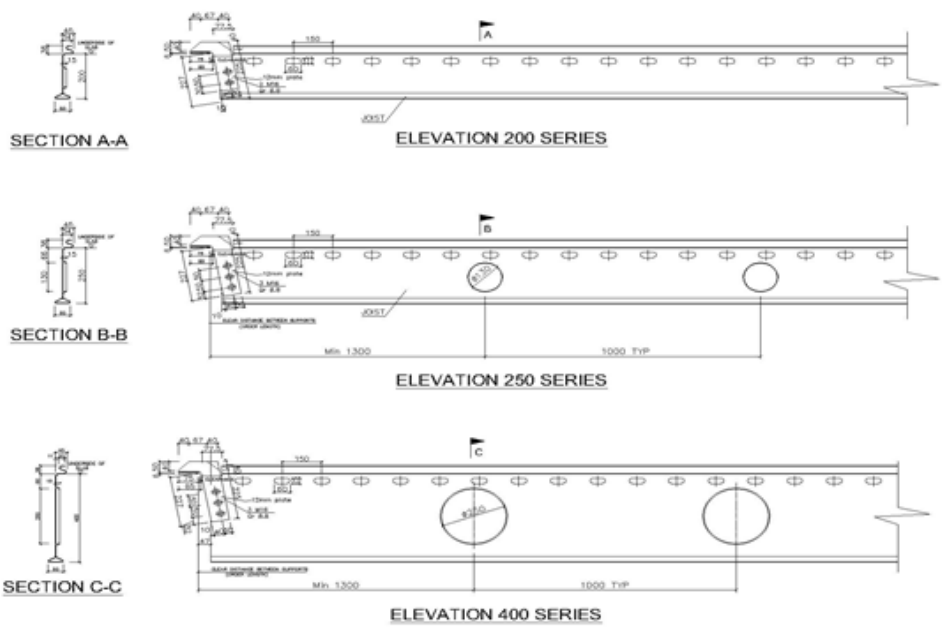
b) Steel is factory made quality product which has higher strength to weight ratio result lighter structure

c) As the strength is higher the member sizes in steel building are less as compared to concrete buildings result in better spaces.

d) Due to light weight it leads to economy of foundation and reduce earthquake forces also.

e) It also reduces human labour component and hence reduce error to greater extent.

The Joist- Few series



COMPARISON BETWEEN CONVENTIONAL SLAB & SPEEDFLOOR SLAB FOR 4M SPAN				
S.No	**PARAMETERS**	**CONVENTIONAL SLAB**	**JSPL SPEEDFLOOR SLAB**	**% SAVINGS**
1	Thickness of Slab for 4 M span	150 MM THICK	125 MM THICK	17
2	Casting cycle	Minimum 10 days	3 Days	70
3	Reinforcement required	8dia@200c/c (Top & Bottom)	8dia@200 c/c (one layer)	25
4	Reinforcement cover blocks for slabs	Required	Not required. JSPL SPEEDFLOOR has inbuilt cover.	100
5	SERVICES (Fire fighting pipes, cables, flexible ducts etc)	Need extra head room	Pre-punched holes in JSPL SPEEDFLOOR, accommodates services, without extra head room	-

Speed floor Seismic design

a) The general arrangement of the joist and the shoe end together create a number of very real advantages for the Speed floor system in seismic regions. Seismic design promotes relatively rigid interconnection of elements under normal conditions and flexible connection when subjected to seismic disturbance. It is absolutely imperative that the floor/beam connection does not induce moments into other elements of the structural system that would compromise the integrity of the structure.

b) The use of a 'pin-jointed' or 'simply-supported' connection between the concrete floor and the support structure (joist with shoes) allows the Speed floor to flex without shearing. The shoe will remain as a fail-safe mechanism on top of the support medium. Reinforcement bars connected to the structure prevent horizontal displacement of the concrete floor.

c) The Speed floor system generally uses much less concrete than pre-cast or in-situ concrete alternatives and hence has less mass and less inertial force.

d) As a ductile suspended concrete floor incorporating a relatively high percentage of steel, Speed floor is ideally placed to help dissipate the dynamic shock involved in seismic loading.

e) Speed floor has the ability to act as a diaphragm and transfer the lateral forces.

JINDAL PANTHER CRS TMT Rebars

Jindal Panther TMT Rebars are produced only by Jindal Steel and Power, a part of the Shri Naveen Jindal Group. Jindal Panther TMT Rebars are manufactured only at our state of the art Primary and Integrated Steel Plants located in Raigarh, Patratu & Angul.

Jindal Steel & Power, recently developed higher diameter 45 & 50mm TMT Rebars and accredited with BIS license first time in India. Higher diameter TMT Rebars can be applied for Heavy Foundations, Columns and Pillars

Jindal Panther CRS TMT Rebars is having improved strength, ductility, longer durability, life to structures because of improved corrosion resistant properties.

INNOVATIVE TECHNOLOGY USED IN CONSTRUCTION INDUSTRIES

Light Gauge Steel Structural System & Pre-engineered Steel Structural System

Er. (Dr.) Abhay Gupta, Director, Skeleton Consultants Pvt. Ltd.

INTRODUCTION

Times are changing in construction with the evolution of newer technology. Rapid construction and the huge demand for energy efficient construction materials are on the rise. One such technology is LGSF, which requires a shorter construction period compared to that for a conventional building system. Due to various economic, structural and ecological benefits, this construction technology is getting high acceptance. The need to lower the production costs involved in the construction of buildings is also estimated to be one of the key factors responsible for LGSF market growth. The use of LGSF technology provides ease of installation along with a reduction in the cumulative project completion period owing to prefabricated steel structures.

With traditional methods of construction struggling to keep up with the international standards for better, more efficient, affordable buildings and issues pertaining to sustainability, many leading players in the construction industry are turning to alternative methods to solve these problems – one of the technology that is leading the way is – Cold Form Steel construction (CFS), also known as Light Gauge Steel (or LGS)

LGSF is a leading technology that will fast track the construction process by 200% helping the ministry and related bodies construct more houses with minimum cost and environment footprint.

In addition to offering strength to the overall structure, it also allows greater design flexibility at lesser costs.

Benefits of Light Gauge Steel Frame Structures in Metal Building Construction.

Light gauge steel frames are considered great choices for low- and mid-rise (upto G+3) metal buildings. However, with HR sections, it can be used for highrise buildings also.

There are a lot of benefits of using these frame structures, which include:

1. **Strength & Durability**

   Even if we talk about normal steel, we know that they have extremely long lifespans and do not require much maintenance. Unlike other materials like timber, steel cannot be affected by weather conditions and pests. Steel is also resilient to rust and rot.

2. **Lightweight**

   Specialized light gauge steel frames are quite light; however, this does not compromise its high strength factor. The lightweight factor is important because it results in a lighter weight, which means lesser damage probabilities from natural disasters like earthquakes.

3. Quality

As mentioned previously, manufacturers make these steel frames out of high-quality industrial-grade materials. This means that these frames will have consistent straightness, which will aid in structural alignment. Additionally, the frames will not split and warp under any conditions.

4. Recyclable

Steel is 100% recyclable. While it may take roughly 40-50 trees to frame an average-sized home, you would require steel from only six scrapped cars for the same. Additionally, steel produces less waste on the construction site and prevents air leaks and cracks.

5. Expansion & relocation

Light gauge steel frames are great choices if you want to expand or relocate existing steel structures. You can also add additional floors with it. The flexibility factor is perfect for relocation and expansion in the future.

6. Unequaled design flexibility

Since these frames have a great deal of strength, these frames can span longer lengths. In turn, they have increased design flexibility and offer larger open spaces without any additional load-bearing walls or intermediate columns.

7. Lower construction costs

While you may have to spend a good sum of money upfront for light steel frames, it will lower the project's overall cost. This also means that the jobs are completed faster, depending on the size of the project.

8. Easy transportation & handling

Since these steel frames are quite lightweight, transportation should not be a problem. Additionally, you can handle them with ease.

9. Quick & easy construction

Steel frames are made based on the prefab models of the buildings. Hence, it does not require a skilled labor force for the construction job. In addition, most steel framing features service and electrical holes pre-punched, thereby reducing the time on-site for electricians and plumbers.

Limitations:

- Light framed structures allow the passage of sound more readily than the more solid masonry construction.
- Light gauge steel frame load-bearing is made with a non-combustible material. Despite this, it does need to be protected from fire with properly fire-rated boarding, as it will lose its strength in a fire.
- Usage of plastic based elements (like covering, insulation elements, gypsum board etc.) may result in biological living like termites settling in and damaging the system.
- Pre planning of MEP concealed line must be done before completion of cladding work.
- Light gauge metal frame installation can be a bit costly. Usage of specific construction tools and skilled labour can increase the expenses for installation.

However the advantages far outweigh these disadvantages and it is therefore no surprise that LGSF will become the preferred construction system in the years ahead.

Components of Light Gauge Steel Frame Structures

1. Wall Panels (Load-bearing walls and non-load bearing walls)

The wall panels are considered the load-bearing structures of the house; this is because it carries lateral loads created by the win and the vertical loads from the construction above. Typically, these loads can be used in combination or separately. The internal and external walls can also be load-bearing. Some other types of walls include partitions, wall cladding, and non-load-bearing walls.

2. Wall Connections

In most cases, you can fasten steel framing metal building components to the floor structure once all the panels have been aligned and plumbed correctly via the bottom plate. You can utilize welding to assemble the prefabricated panels from the factory. You can also use them on the building site where strong connections are required.

3. Wall Openings

There are two types of wall openings – window frames and external doors. You can use the same frames used in timber-framed construction in steel-framed construction. You can use self-drilling screws to drive through the frame and pack into the steel framing, and you can use the same screws to fasten the window frames (aluminum) to the steel frame openings.

4. Wall Claddings

You may attach reflective foil sarking to the outside flange of the steel studs via self-drilling screws if you need it in the external walls. On the other hand, you may also make use of wafer head screws for this purpose. Finally, you can paint the exterior cladding with a layer of weather-proof base coat, fiberglass mesh, and polystyrene.

5. Flooring Systems

The flooring can consist of C-section joists that you connect with bearers. Depending on the loading parameters, manufacturers can design the floor joists with a variety of C-section sizes. However, a lattice beam flooring is a good choice because it will have a stiffer base and provide better sound insulation between the floors.

6. Roof Systems

In most cases, the steel truss system is the most commonly used via tiles and metal sheets. This roof framing system is screwed directly to the wall frame, and you can use them for all types of roofs like steel, Dutch, tile, gable, and even hip roofing sheets.

References

- IS 801:1975 Code of Practice for use of Cold-Formed Light Gauge Steel structural Members in general building construction
- AS/NZS 4600:2005 - Design of Cold Formed Steel Structures
- AISI S100-2007 LRFD North American Specifications for the design of Cold Formed Steel Structures.
- ASTM A 568 – Standard specifications for thickness tolerances of cold rolled steel sheets & coils

Technical Comparison of LGSF with conventional structure.

Characteristics	LGSF with PEB structure	Conventional Structure
Carpet Area	We get 8-10% more carpet area than conventional area.	Less carpet area due to bulky walls
Thermal (Dry Wall)	FCB board and glass wools have lower thermal conductivity will give superior Thermal insulation and will reduce the Air-conditioning bills by average 30%	If the walls are more than 14' thickness in that case only give better efficiency in reducing Air conditioning bills.
Acoustic (Dry Wall)	FCB boards and glass wools have higher insulation property and hence will give superior Acoustic insulation and will reduce the noise level by average 30%	If the walls are more than 14' thickness in that case only give better efficiency in reducing noise level.
Super Structure Load Calculation	Dead load of LGS is 8-12 KN/M3 which is around 40% of the conventional brick wall dead load which in turns saves cost of construction in foundation.	Dead load of brick masonry is 16-22 KN/M3
Fast Track	Majority of components are pre fabricated and hence reduce the time of execution at site by more than 20-25%	time consuming in execution at site as well as need extended time for curing of the executed work
Life Cycle Cost	Higher scrap value as at the end of life span give better value of scrap than the conventional structures	Scrap value is negligible or negative as walling material required cost to remove from the site.
Natural Resources	No use of cement and natural resources like sand, water, aggregates for dry wall construction with LGSF technology	Masive use of natural resources like Soil (for brick manufacturing), sand, aggregates, water, cement etc.
Carbon Footprint	Very less natural resources used and hence reduce the carbon emission	High carbon emission as more natural resources used for the walling material
Cleanliness	As all the materials used in walling is pre designed and manufactured at factory, only assembling is required at site and hence zero wastage and no debris at site	All the process for raw material to execution done at site and hence more debris generated at site. It increase the cost of removal from site and also generate health issues.

Figure-1 : *LGSF Structure in Construction phase*

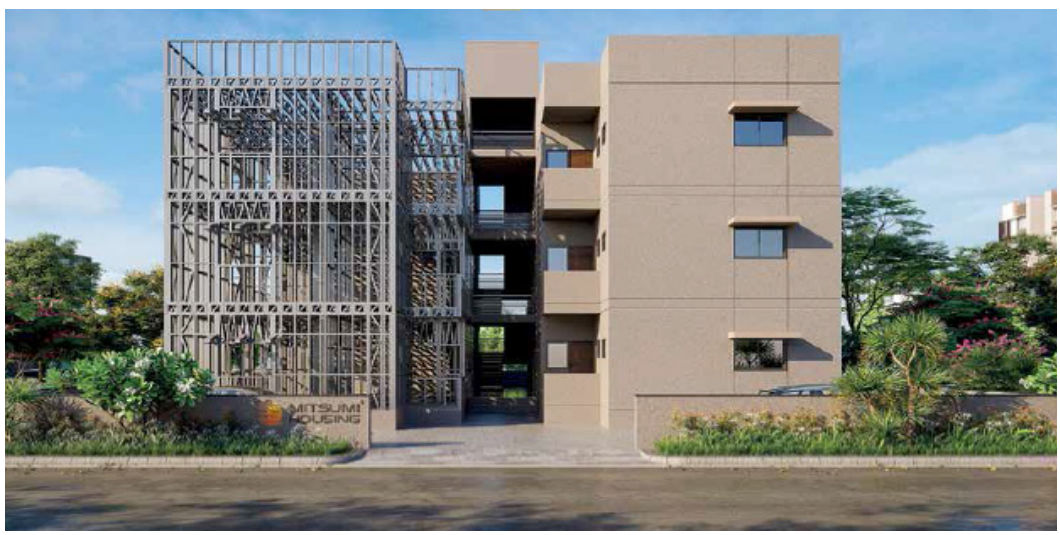


Figure-2 : *LGSF Structure after completion*

Figure-3 : *Light Gauge Frame Structure*

NEW TECHNOLOGIES (E&M) AT NEW PARLIAMENT BUILDING (NPB)

Vikas Gupta, CE (Elect), CPWD & Rahul Kamble, SE (Elect), CPWD

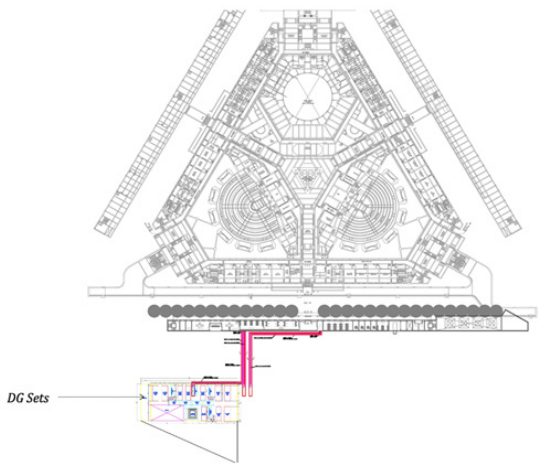
E&M services of New Parliament building have been designed keeping in mind the efficiency (Star rating), green parameters and state of art technologies available in market.

Major services are considered here for elaborating special features such as :

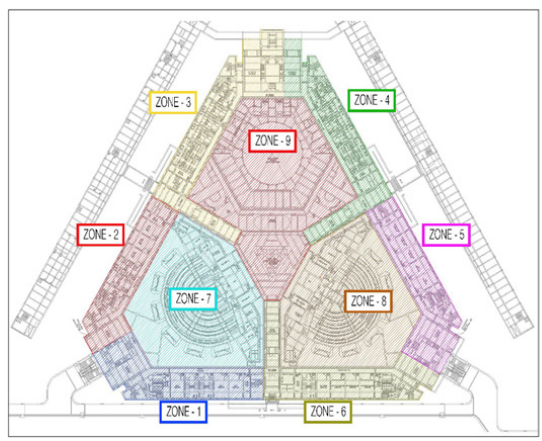
1. Electrical systems : (EI, fans, substation equipment, DG set, UPS etc)
2. Major electromechanical systems : (HVAC, FPS, FF, STP, WWS, hydro pneumatic system etc)
3. Low voltage systems : (CCTV, IBMS, AV systems including multimedia conferencing systems for Lok Sabha and Rajya Sabha chambers).

A. Electrical systems

3. Key Electrical Locations – DG Sets



Key Electrical Locations – Zones of Building for Electrical distribution



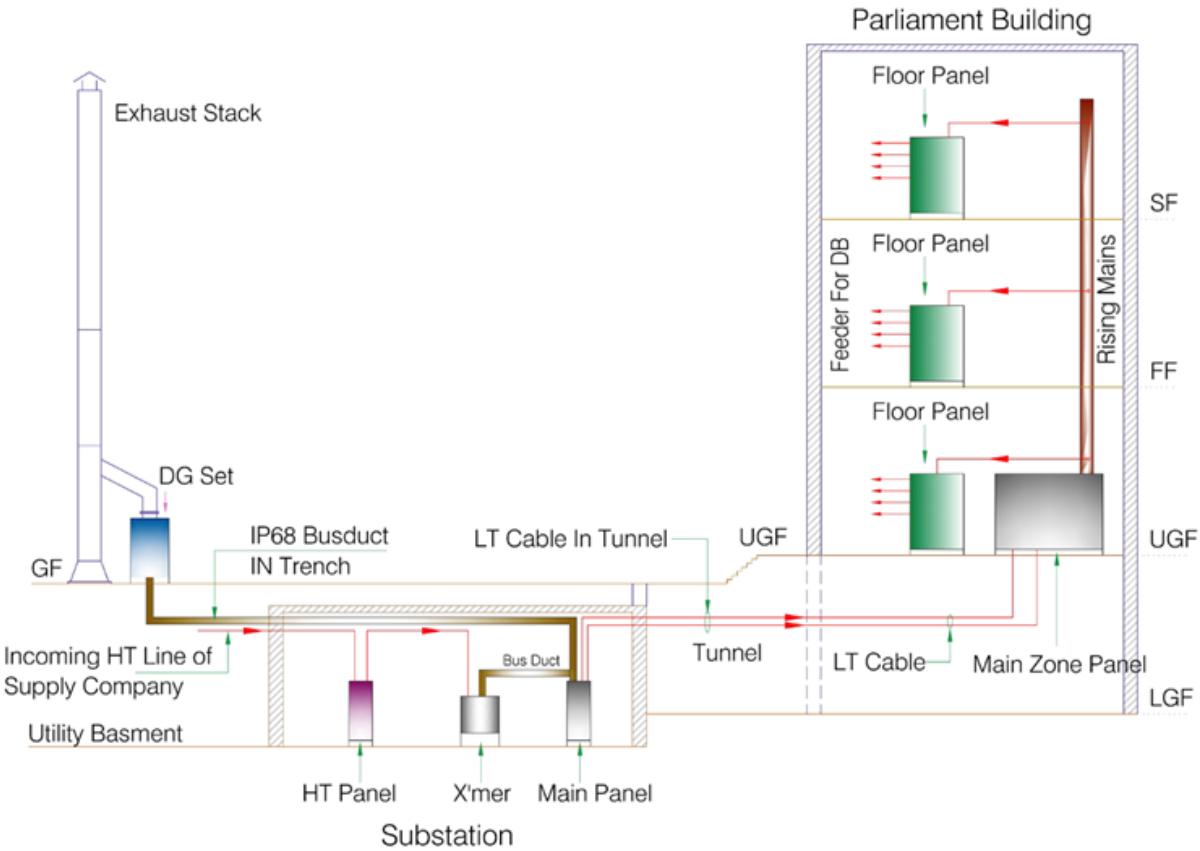
a) Internal Electrical installation and fans:

Nos. of light points considered as per lux level requirement as specified in IS codes and also as per lighting design proposed by lighting consultant. Circuit/sub main wiring considered with MS steel conduit for various lighting switch boards and plug points. Internal wiring considered with MS steel conduits, Modular type switches and copper FRLSH wires for light point, plug point, etc. LS and RS chamber point wiring are considered on running meter basis. Four pole Aluminium Rising mains considered in each zone. Chemical type, GI Pipe type and GI Plate type earthing station considered for various application i.e. lifts, UPS, LT panels, Servers, ELV system etc. Conventional type structural Lightning protection system considered. Readymade double door type MCB Distribution boards considered with per phase isolation with required nos. of poles. RCCB and Over voltage protection provided with each MCB distribution boards. Under floor metal race ways

with junction boxes are provided mainly for data, telephone and power circuits for computer/ telephone points. BLDC type ceiling fans provided mainly for all utility areas. Occupancy sensors have been considered in MP offices, toilets and corridors. Switch board to sensor considered as a primary point and from sensor to all light fixtures considered as secondary points.

b) Substation (Two no.s [one for HVAC and other for power supply to various services])

4. Distribution Scheme – Schematic Primary Distribution



Separate substations equipment are considered for OPB (Old Parliament Building) and NPB (New Parliament Building) near to NPB block.2 Nos. 11KV vacuum HT panel considered with 9 nos. HT breaker each. N+1 arrangement considered for transformers. For NPB, 4 nos. of 2500KVA and for OPB, 2 nos. of 2500KVA and 2 nos. of 2000KVA.11/0.415 KVA Dry type transformer with OLTC (+5 to - 15% in step of 2.5%) and RTCC considered. Vacuum type OLTC considered. Sandwich type Four Pole Al bus trunking provided from Transformer to the Main LT panels .In substation all Main LT panels and APFC panels considered Fully Type Tested Assembly (TTA) with Tube type Auto gas suppression system (Inert Gas). All other panels considered PTTA/Conventional type without gas suppression system. For critical application, Fire Survival (FS) cable considered for smoke exhaust fan, fire- fighting panel, etc. From Substation to OPB and DG yard to substation, two runs of IP 68 underground Al bus duct considered. All substation Equipment, major incoming/ outgoing feeders of main panels and selected multifunction/KWH Meters are considered with IBMS compatibility. For power factor correction, contactor based APFCR panel considered with filters at substation with each transformer considering power factor correction for 0.99. 2 nos. HT tie breakers considered at each HT panel. Entire building is divided into different zones and accordingly zone wise main LT panel considered which is located at respective zone, LT panel room with dual incoming feeder from substation and different transformer.

Rising mains considered in each zone with 200% capacity (to cater the 100% load of nearest zone in case of emergency and maintenance). All sub LT panel considered with manual change over with two incomers from two different zones rising mains. For LS/RS, additional redundancy panel and redundant rising mains considered through different feeders from substation to avoid black out in case of any fault in primary networks and also during maintenance work.

From DG to substation and from substation to OPB, bus duct (IP 68) considered with N+1configuration.

c) DG Set & UPS :

For NPB, 100% DG backup considered with 4 nos. of 1500 KVA DG set with acoustic enclosure and with engine mounted radiator. Total approx. 8 hours fuel storage tank considered with provision of day tank and bulk storage tank with auto refilling system. A stand-alone DG stack provided as per CPCB norms for exhaust piping. DG set is considered with IBMS compatibility.

All these DG sets are located on separate plot at ground level (open to sky) near to substation.

For all common areas (other than LS/RS), a centralized 600 KVA modular UPS considered with 15 minutes SMF type battery back up at substation for partial lighting, computers and ELV(Security System, Fire Alarm, Wi-Fi, PA, AV system for meeting room etc.) load considered with UPS backup.(600KVA UPS). For Lok Sabha and Rajya Sabha AV load, a dedicated 400 KVA modular UPS considered with 15 minutes SMF type battery back up near LS/RS at service area (one for LS and one for RS). For Lok Sabha and Rajya Sabha lighting load, a dedicated 90 KVA monolithic UPS considered with 15 minutes SMF type battery back up near LS/RS at service area (one for LS and one RS). Each UPS considered with isolation transformer. Efficiency of the UPS is considered more than 96%. THD less than 3% at 100% load, UPS considered with IBMS compatibility.

B. Major Electromechanical services

a) Wet riser, Firefighting , Sprinkler system and Gas Suppression System:

System description :

1. Hydrant System -Internal Fire Hydrant System has been envisaged throughout the building to control and extinguish fires in incipient or advanced stages. Internal hydrant valves with hoses, hose reels, nozzle and branch are placed in fire shaft with fire shaft door. Fire water piping with MS 'C' Class pipe with necessary valves.
2. Pumps Comprising –
    a) one motor driven pump of capacity 2850 lpm & 88 mwc head, two standby diesel engine driven pump of capacity 2850 lpm & 88 mwc head (common for both hydrant and sprinkler system) and a line pressurization jockey pump of capacity 180 lpm & 88 mwc head 3 nos. of booster pump of 900 lpm capacity & 35 mwc head is envisaged to ensure adequate pressure at outlet of hydrant valves situated on the top floors.
    b) Internal hydrant main pipe connected to ring main routed at basement ceiling level for wet riser pipe tapping.
    c) Fire brigade inlet connection shall be provided to enable fire brigade vehicles to pump in water into the hydrant system/fire underground tank.
    d) Draw out connection shall be provided to enable the fire brigade teams to draw water from the fire water storage tanks in case of any eventuality.

3. **Automatic Wet Sprinkler system** has been envisaged for detection of fires and automatic actuation in the region of fire, thus preventing its spread.
4. Underground and above ground fire water piping of MS 'C' Class pipe with necessary components (i.e. isolation valve, test and drain connection, flow switch etc).
5. The sprinkler quartzoid bulb rating for all sprinkler areas of buildings shall be 68 deg C for internal and air conditioned areas, 79 deg C for basement areas & 93 deg C for kitchen areas.
6. Concealed sprinklers have been used in all spaces except Utility & Service areas.
7. Recessed type side wall sprinklers have been used in chambers of Assembly halls.
8. Sprinkler drain riser pipe shall be connected to catch basin located in the basement.
9. A flow switch will be installed on downstream of alarm valve to relay annunciation in FDAS panel of each building, if any of the sprinklers is activated.

Clean Agent based Fire Suppression System:

Clean Agent system has been envisaged as per NFPA 2001:2018 to cater to critical rooms i.e. server room.

- Clean agent based fire suppression system for server room has been envisaged & designed as per NFPA 2001-2018 Edition requirement.
- 100% online stand-by cylinders of clean agent has been considered for restoring the area protection after discharge of main bank of cylinders.
- Clean agent system will be UL Listed / FM / VDS approved.

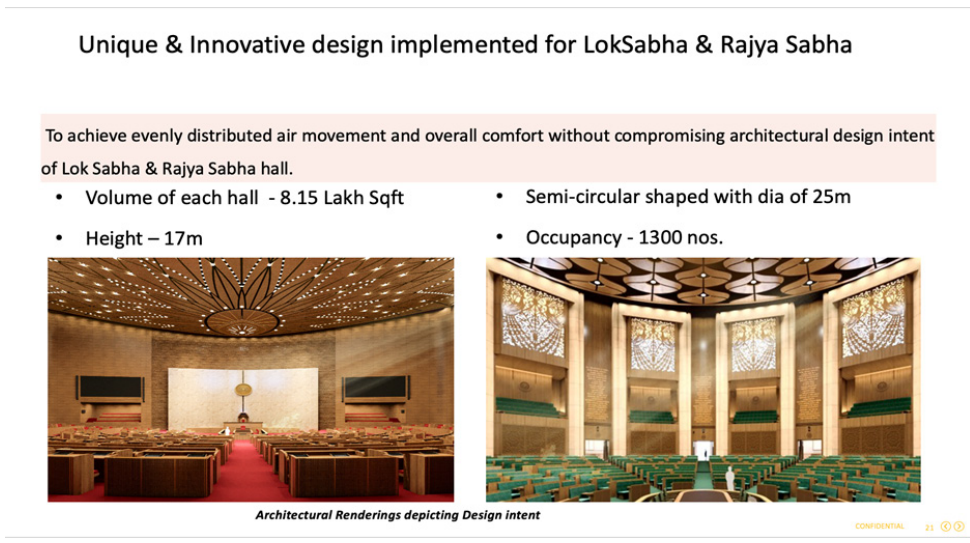
Fire Extinguishers System:

Fire Extinguishers shall be located in the facilities / buildings & these shall be used for extinguishing small fires. Portable fire extinguishers have been envisaged as per IS: 2190 (2010) guidelines to put-off small fires and shall be used in the incipient stage of fire thus avoiding major losses. Foam Type for only Class B fires, these have been located at D.G. Rooms, Fire pump house etc.

ABC Extinguisher Type : for Class A, B & C fire

CO2 type : for Class B & C fires.

b) Heating , Ventilation and Air-conditioning System (HVAC):



It is proposed to have a separate Plant room for New Parliament building in the basement of the Utility Building. This plant room is consists of following major chilled water equipment:

There are 4 numbers of 700TR (3 working + 1 stand by) water cooled centrifugal chillers installed within plant room. There are 4 numbers of primary pumps (3 working + 1 stand by) of capacity 1680gpm @ 15m head installed within plant room. There are 4 numbers (3 working + 1 stand by) of secondary variable pumping having capacity 1980gpm @ 40m head installed within the plant room. These pumps shall be provided with dedicated VSD panels along with sensors and controls. There are 4 numbers of condenser water pumps (3 working + 1 stand by) of capacity 2800gpm @ 25m head installed within plant room. There are 4 numbers of hot water circulation pumps (3 working + 1 stand by) of capacity 230gpm @ 45m head installed within plant room. There will be one 1000 Litre capacity and 500 Litre capacity closed expansion tanks for chilled water system and hot water system respectively are installed within plant room along with Air Separator. There are 4 numbers of cooling towers of (3 working + 1 stand by) to suit 700TR chiller capacity are provided on ground floor open to atmosphere. There are 3 numbers of air cooled heat pumps of (3 working + 0 stand by) of 300kW capacity to generate hot water are provided on ground floor open to atmosphere. Electrical panels with power cabling will be provided within plant room to feed electrical power to all equipment mentioned above. Makeup water tanks will be located on the Ground level. The makeup for the Cooling Towers will be supplied from WWTP water and the blow down from the cooling towers will be disposed back in the WWTP.

Proposed HVAC system compliance GRIHA ratings, all equipment are selected with considering GRIHA points.

1. Water Distribution

Chilled water & Hot water piping will be routed from Plant room to the building through accessible trenches. Chilled water system shall be provided with primary constant and secondary variable pumping system. Chilled water piping with insulation will be provided with air vent and drain valve at the highest and lowest level respectively. Isolation valves will be provided in the chilled water pipes catering to individual buildings for ease of isolation and water balancing. 2 way Modulating

Pressure Independent balancing & control valves (PIBCV). PIBCV valves will be provided on the individual AHU chilled water return lines to sense the actual room loads and vary the secondary pump flow accordingly. Hot water system shall be provided with primary constant speed pumps. Insulated hot water piping shall be same as that of chilled water piping only the difference is hot water piping will be connected to hot water coil and 3 – way valve along with automatic balancing valve will be provided in the return line of individual AHU. Each AHU will be provided with insulated condensate drain piping up to nearest floor drain.

2. Air Distribution

Dedicated AHU Rooms will be provided based on the zoning and application requirement. AHU Rooms will be acoustically insulated to reduce noise transfer from the AHU to connected spaces. There are 57 numbers of AHUs having capacity from minimum 3100 cfm to maximum 30000 cfm. These AHUs will be further ducted to supply and distribute the cool air. Initial duct of supply air duct (almost 3 mtr.) will be acoustically lined to reduce air borne noise.

All supply air and return air ducts of assembly hall and balcony area will be connected to supply air fans and along with motorized dampers. In case of fire these fans will be operated providing requisite fresh air @ 12 ACPH to provide fresh air at lower level. However, smoke will be evacuated @ 12 ACPH directly through smoke spills fans kept on terrace trough fire rated ducts.

All Office areas along with adjacent corridors will be air conditioned with separate AHUs kept either one level above or below as per the space available. All supply air ducts will be connected to fresh air fans with motorized dampers and all return air ducts will be connected to smoke spills fans with motorized dampers. All return air ducts will be painted with fire rated paint to withstand for 2 hrs in fire. All fresh air make up fans and smoke spills fans will be kept on terrace. These fans will be operated after receiving signal from fire panel in case of fire.

Centralized Treated Fresh Air Units which includes Pre-filter (MERV 8), Electronic filter, Chemical filter, Cooling Coil, EC fan, etc. It will be provided and located on the terrace level and Capacity will be based on grouping of AHUs/ FCUs at respective floors. There are total 14 numbers of TFAs are used for this project. All TFAs will be kept on the terrace.

All recirculated AHUs will be provided with Pre-filter (MERV 8), Electronic filter for better air quality, chilled water and hot water coil, humidifier, UV lamp for cleaning of cooling coils, EC fans for energy saving & in-built redundancy, etc. In addition to this supply air ducts of assembly hall AHUs will be provided with PCO filters to disinfect supply air.

Air cooled Heat Pump will be provided along with hot water circulation pumps and pipe work to meet the heating requirement during winter and to control room RH during monsoon season.

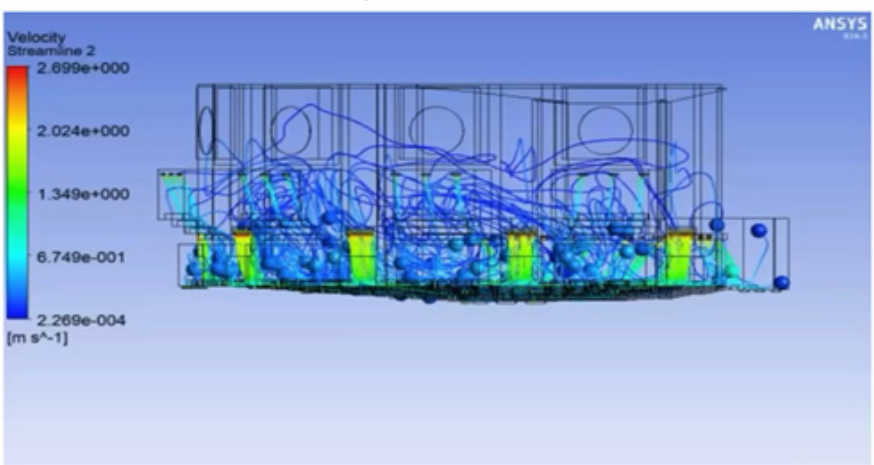
Areas like toilets, pantry, store room, STP, electrical room, Atrium etc will be ventilated as per NBC 2016.

Kitchen will be ventilated using supply air through air washer. Spot cooling for cooking chefs will be provided using dedicated treated fresh air unit.

Staircases lift wells will be pressurized as per NBC 2016. Pressurization fans shall be kept on the terrace and air shall be thrown inside lift well / stair well shafts. The basement area will be provided with fresh air & exhaust air duct to meet fire requirement at the rate of 12 ACPH.

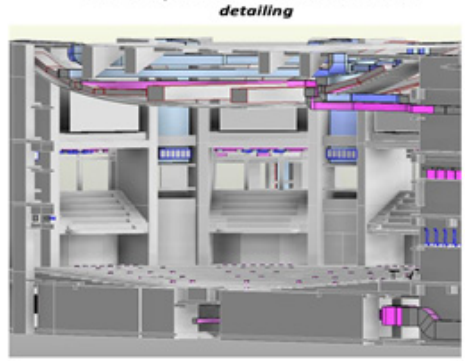
CFD ANALYSIS & BIM MODELLING

CFD Analysis video



REVIT model developed for issue of GFC

Assembly hall view detailed with HVAC detailing



3. Fire strategies

Building is divided into number of fire zones. AHUs are provided with supply and return air ducting. Each supply air ducts shall be connected to fresh air make up fans and each return air ducts shall be connected to smoke spill fans with motorized fire dampers.

In case of fire all AHUs in affected zone and zones connected to affected zones shall be OFF. All fresh air and smoke spills fans in the affected zones shall be ON. Fresh air shall be pumped in

affected zone through supply air ducts and smoke shall be evacuated through return air ducts. Return air ducts shall be fire rated to with stand for 250 deg C for 2 Hrs as per NBC 2016.

Lift well and Stair well pressurization fans in the affected zones shall be ON to provide the necessary pressurization effect. All pressurization , make up and smoke spill fans in affected zone shall be ON and all AHUs in affected zone shall be OFF after receiving signal from fire panel.

c) Sewage Treatment Plant and Solid Wastage Management System:

The Scope of work includes designing, planning, supplying, installation, testing & commissioning of the STP plant for the building and complex based on the norms of the local body, Delhi Jal Board, NBC- 2016. The plant has to be installed based on the same but with minimum capacity 125 + 125 KLD. All pumps shall be in 1W+1S combination.

Organic Waste De-composter of minimum 1000Kg per day will be installed. The capacity will be worked out to meet the requirement of waste generated in the building.

d) Pneumatic Based Water Supply System:

The work of Supply, Installation, testing & commissioning of Pneumatic Based Water Supply System as per the BOQ and Drawing and as per NBC 2016.

e) Kitchen Equipment:

The Scope of work is design, supply, installation, testing & commissioning of kitchen equipment including kitchen hood, air washer etc.

C. LOW VOLTAGE SYSTEM I/C A/V SYSTEM

a) Addressable Fire Alarm system:

The work consists of planning, designing, supplying, installation, testing & commissioning of Automatic Intelligent Addressable Fire alarm system and Public Address System. The system shall be as per CPWD specifications, NBC 2016 and local by-laws and as per clearance issued by Delhi Fire Service. Scope work also includes integration of Fire Alarm System with Smoke Extraction System, Fire Fighting System, AHU and Ventilation System etc. as per NBC 2016, requirements of the main control room, etc.

Criteria for selecting detectors and devices considering the various areas of the plant shall be as follows:

Type of detector/ device	Area/ Environmental conditions
Multi-criteria detector	True Ceiling, Below False Ceiling and Above False Ceiling
Heat Detector	Kitchen / Canteen / Pantry (Ceiling Height limitation is 7 meter)
Beam type smoke detectors	Area where ceiling height above 10 meter
Hydrogen gas detectors	Battery / UPS Room
Duct mounted smoke detector	Air Handling Units

Fire Alarm Control Panel (FACP) provided with loop supervision, alarm generation from detector/ device, functional alarm such as low battery, AC power failure, fault, connection to detectors/ devices through loop cable. Fire Alarm Repeater Panel (RP), active type with Alpha-numeric

display, controls like alarm silence, alarm reset and alarm acknowledge, and repeat alarm signals from all the FACPs that are connected in network. PC based GUI shall be provided with customizing software, seamless integrated graphical mimic with full alarm management and panel control capability, installation plans, device type, locations, zoom areas and zoom magnifications shall be able to import from AutoCAD as loaded in GUI. Software shall be able to generate audio-visual indications in case of emergency/input signals from detectors/devices/panels in the event of change of any logic, detector/zone sequence alteration, the operator can initiate this by alpha-numeric keys on the respective Fire Alarm Panel or through the GUI. Main FACP shall be located in Fire Command Centre located near Main Entrance. It is proposed to have 2 Nos. of Fire Alarm Repeater Panel at Main Security Gates of Two Utility Buildings. 1 No. GUI shall be located in Fire Command Centre to monitor various areas as per the location layouts loaded in the software. All the panels/repeater panels are connected in a ring topology maintaining redundancy in network over fibre/ copper cable. All detectors & devices considered in various areas will form an intelligent fault tolerant loop & connected to the FACPs. Each FACP will monitor individual detectors for checking the healthiness as well as to indicate the location of fire. Manual Call points (MCP) shall be addressable & loop powered. It shall be surface wall or pole mounted indoor and outdoor type for safe area. It shall be addressable & loop powered. Hooter shall sound automatically when any of the detectors in that zone detects fire condition.

Control module

It shall be provided the dry contact output for activating a variety of auxiliary devices as Firefighting equipment, AHUs, conventional devices as required. These are typically used where control or shutting of external equipment is required. Control relay modules shall be provided to integrate FDAS with third party system like Public Address System, Access Control System etc.

Early Smoke Detection and Alarm System

It shall be provided in the critical areas like server room for early detection of smoke/ fire hazard.

b) Audio Video System:

Scope of work consists of design, supply, installation, testing & commissioning of audio, visual system & video conferencing systems for auditorium, conference halls, meeting rooms etc and providing of LCD TV with DTH facility at different locations.

This system shall facilitate the day-today functioning of the Parliament during the sessions and non-session period. The Lok Sabha & Rajya Sabha Chambers shall be provided with Fully Digital Wired IP based system with integrated Multimedia Display for each Members, Audio conference, parliamentary voting with Additional Security Button for Both hand use, language interpretation and listening facility for all members and Visitor/reporter in galleries, automatic camera control, large Hall LED & LCD Video Display for Individual & Voting result, Camera Feed with member information & speak time, Speaker List/ general messages etc, Operator Control, Sound Reinforcement systems , Sound Recording, and sound Distribution System. Video conferencing facility with additional PTZ cameras etc.

c) Integrated Building Management System (IBMS) :

Integrated Building Management System (IBMS) includes seamless operation of Building Management System (BMS), Fire Alarm System (FAS), Access Control System (ACS), CCTV Surveillance System.

Building Management System is proposed to centralize monitoring, controlling operations and management of facilities within the building and to achieve more efficient building operations

at reduced energy and labor costs while providing a safe and quality working environment to the occupants. IT will control and monitor the building's mechanical and electrical equipment such as HVAC system, Electrical system, Plumbing system, Ventilation & Exhaust system and other required utility services. Building Management System shall be designed as per Energy Conservation Building Code – ECBC 2017 and National Building Code – NBC 2016. It will not only help in conserving energy by making it possible to plan and execute various energy conservation control schemes but also help in reducing scarce trained manpower requirement for operating and maintaining the building services without compromising on quality of services.

d) CCTV surveillance system:

Design, Supply, Installation, testing & commissioning of CCTV system to monitor & supervise the entire area (internal and external)for security purpose, as well as record and inform officials on unwanted, untoward incidents. It is also essential to have recorded images to be stored at least for min 30 days of all critical areas to facilitate investigations of a reported incidents. The cameras will cover entire boundary and external areas. The system will be designed to cover the entire building keeping in view the security requirement of Building. The hardware required for the system including Servers VMS & Recording, Workstations, Monitors, CAT-6 Patch Cable to connect the camera to nearest POE enabled LAN point, Cables, connectors, conduits, power supplies etc. is in the scope of work. The complete LAN networking, for the CCTV should be separate and exclusive for CCTV system only. The Video Management System is a client / server based for IP video provides seamless management of digital video across an IP network. The system will have network connectivity that shares all video, recording, playback and control data over the CCTV system over Wireless / Ethernet / (FO) network. The video management software will be provided with adequate number of camera license and client station licenses for controlling and monitoring. The system will be easily expandable for connecting cameras which will be provided in future. Video Management system will support Video Analytics features. Software for VMS will be of latest version available in the market. CCTV will be monitored simultaneously at Two Places – CCTV Surveillance Room at Upper Ground Floor and Information & Communication Centre (Outside parliament building – location yet to be finalised).

Network wiring :

The IP Networking for CCTV will be of Stand-alone IBMS network and independent of other network. It will be of 3-Tier architecture (Core layer, distribution layer & Edge/access layer) or 2-Tier architecture (Core layer & Edge/access layer) and will be further connected to Storage as well as monitors for CCTV monitoring. Horizontal cabling connecting the Cameras to the edge switches placed in the nearest rack within 90m, will be of CAT- 6A cables as per TIA/EIA 568 networking standards. Vertical or backbone cabling connecting all the floors in a building will be of Fiber optic cables (Single mode/Multi mode based on distance and bandwidth requirement) connecting all the edge switches (Layer-2 (L2) switch).All the edge switches in each floor will be connected in Ring topology using Fiber optic cables and will be further connected to the Distribution switch (Layer 2 (L2) switch).Distribution switch from various buildings will be connected in star topology to the Core switch (Layer 3 (L3) Switch) and further to the Server/Storage in the CCTV Monitoring room using fiber optic cables. Required patch panels, patch cords, LIUs, pig tails, connectors etc., will be considered as per the requirement for the above networking. PoE+ (High PoE) switches are used for PTZ camera.

e) Access Control System (ACS) :

Access control System is proposed to serve the objective of allowing entry and exit to and from the premises to authorized personnel only in the buildings in the following aspects. An access control system determines who is allowed to enter or exit, where they are allowed to exit or enter, and

when they are allowed to enter or exit. The electronic access control system grants access based on the credential (A credential is a physical/tangible object, a piece of knowledge, or a facet of a person's physical being) that enables an individual access to a given physical facility or computer-based information system. When access is granted, the door is unlocked for a predetermined time and the transaction is recorded. When access is refused, the door remains locked and the attempted access is recorded. The system will also monitor the door and alarm if the door is forced open or held open too long after being unlocked.

1. Smart Card readers:

   Readers will be directly connected to access control unit and will be of smart type allowing use of durable operating devices/cards. It will offer high reliability, consistent read range and low power consumption in an easy to install package.

2. Anti-pass back Operation:

   The anti-pass back feature is designed to prevent misuse of the access control system. The anti-pass back feature establishes a specific sequence in which access cards must be used in order for the system to grant access.

3. ACS software and features:

   Access Control System will be provided with software for programming of access cards and for access control database monitoring & management. The system will be capable to register/log all the time details whenever any person shows the card at the card reader at any time. The system will facilitate the time using access control hardware to gather the CLOCK IN and CLOCK OUT times of the user at designated readers. The ACS will provide configurable time schedules feature for programming automatic locking and unlocking of any access controlled door, as well as activating and de-activating of card holder settings for restricting any access groups from entering the Premises with the pre-programmed time model.

   It will be possible to monitor issued cards status time wise and area wise as used by the user.

   All door access activities will be logged into the central database in the Access Control System server.

4. Access control server & storage

   Access control system will be provided with server for database storage of access control system. Server contains records of all events round the clock throughout the year and can be used for generation of alarms and reports.

5. Card printer & personalization readers

6. Physical access / security control systems

   Physical Access control systems will consists of the following types of systems. These systems will be installed at the main entrance/exit where a large number of people (or) mass of people enter into the building to prevent Tailgating problem.

7. Anti-tail gate Operation: Hard Anti-tailgate:

8. For Human Physical access / Security Control:

   Flap Barriers

9. For RFID Based Vehicle Access Control:

a. Boom Barriers:

10. Tyre busters
11. Baggage scanner system
12. Time& attendance monitoring system: biometric readers based attendance monitoring.
13. Visitor management system:

f) LAN, IP Based EPABX:

Supply, installation, testing and commissioning of complete of IP based voice communication system of minimum 600 lines expandable to 2500 lines with 4 nos. PRI trunks lines (120 channels) with clip facility for IP users license for lifetime. The outlets are as described in Sub Head C-1. The scope of work also includes the provision of the IP based telephones as per requirement. The wiring shall be in the scope of the work of the firm and shall be IP based LAN networking, as described in the Internal EI subhead. LAN networking shall be covered in the LAN subhead. The complete system has to be supplied, installed, tested and commissioned in complete manner to have a fully functional system, as required. The Scope and purpose are to provide the voice communication with latest Pure IP at core with a 10G backbone. Server based Voice communication system in (1+1) High Availability mode shall be provided to all the users within the building including IP based operator console, In-skin Voice mail for all the users & access to call outside the campus through analog trunks or PRI trunks via local internet service provider (e.g MTNL/ BSNL/railtel etc.). The system shall have redundancy at the level of core switch as well for the backbone. Planning, designing, supplying, installation, testing & commissioning of LAN networking for minimum 2098 Nos nodes with 10G backbone with Wi-fi modem on all floors covering complete floor area. The system shall have redundancy at the level of core switch as well for the backbone.

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CPWD

Central Public Works Department

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