प्रधान मंत्री आवास योजना-शहरी

GLOBAL HOUSING TECHNOLOGY CHALLENGE INDIA

Ministry of Housing and Urban Affairs
Government of India

G20 भारत 2023 INDIA

Azadi Ka Amrit Mahotsav

Training cum Consultation Programme "Innovative Construction Technologies & Thermal Comfort for Affordable Housing"

Presentation on Light House Projects

Date: 21st Nov 2023
Venue: Hotel Vivanta, Bhubaneswar

bmtpc

Building Materials & Technology Promotion Council
Ministry of Housing & Urban Affairs
Government of India

GLOBAL HOUSING TECHNOLOGY CHALLENGE INDIA

A Novel initiative to Transplant Best Global Technologies for Indian Construction Sector

https://ghtc-india.gov.in/

Global Housing Technology Challenge - India (GHTC-I)

Categories	Technology	Tech. Providers
1	*Precast Concrete Construction System - 3D Precast volumetric*	4
2	*Precast Concrete Construction System – Precast components assembled at site*	8
3	*Light Gauge Steel Structural System & Pre-engineered Steel Structural System*	16
4	*Prefabricated Sandwich Panel System*	9
5	*Monolithic Concrete Construction*	9
6	*Stay In Place Formwork System*	8
	Total	**54**

GLOBAL HOUSING TECHNOLOGY CHALLENGE INDIA

Light House Projects under GHTC-India

Location	Technology	Houses
 Indore	Prefabricated Sandwich Panel System	1,024
 Rajkot	Monolithic Concrete Construction System	1,144
 Chennai	Precast Concrete Construction System-Precast Components Assembled at Site	1,152
 Ranchi	Precast Concrete Construction System-3D Pre-Cast Volumetric	1,008
 Agartala	Light Gauge Steel Structural System & Pre-Engineered Steel Structural System	1,000
 Lucknow	Stay in-place Formwork System	1,040

- GHTC-India was launched to identify and mainstream innovative proven construction technologies from across the globe which are Cost-effective, Climate & Disaster Resilient, Sustainable and Green.
- Shortlisted Technologies will showcase 6 Light House Projects (LHPs) in 6 States through challenge process as **Live Laboratories.**
- **3S** Mantra of Skill, Scale & Speed for quality of construction

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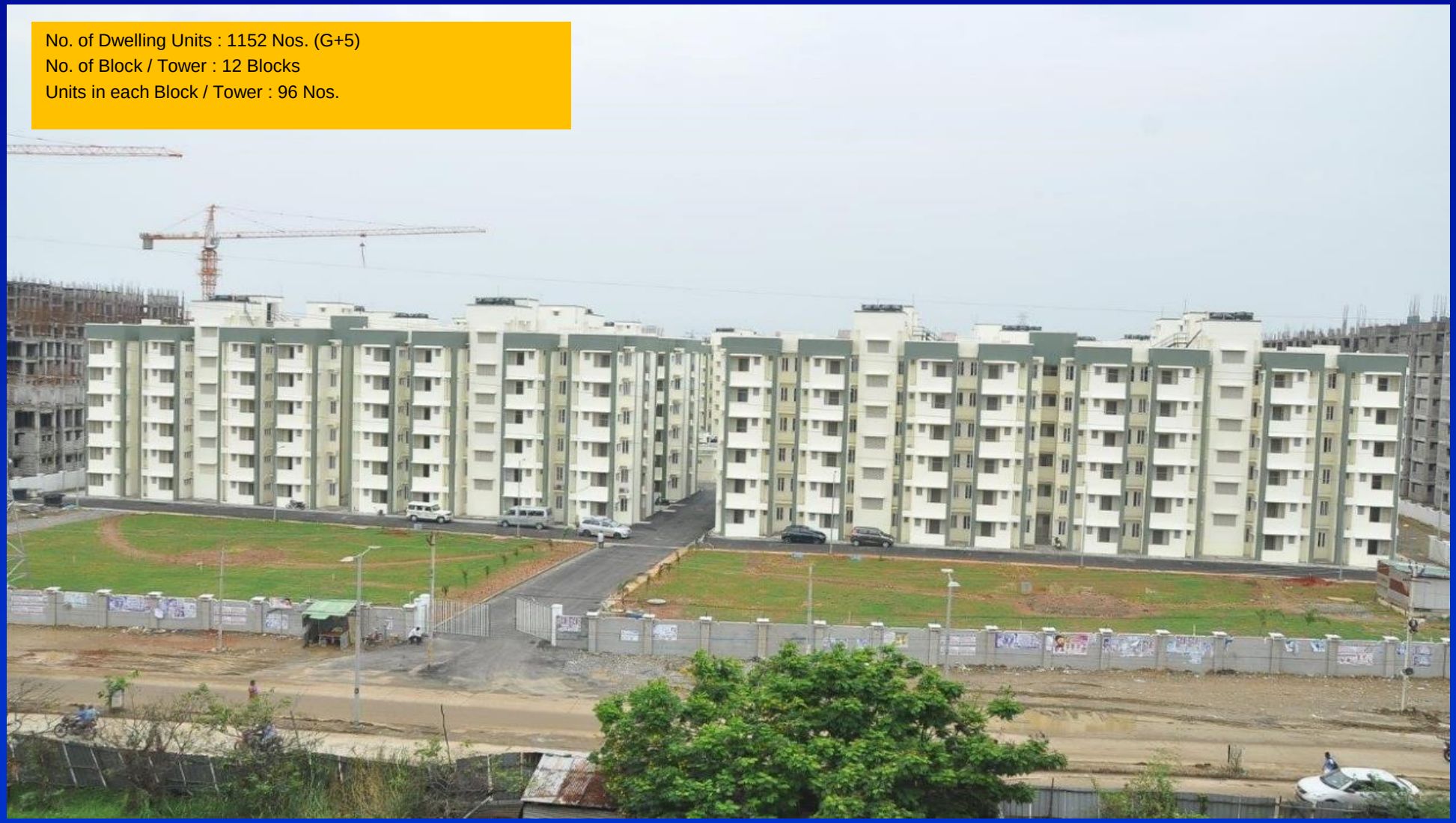
Summary of Six Light House Projects (LHPs)

LHP Location			Chennai (Tamil Nadu)	Rajkot (Gujarat)	Indore (Madhya Pradesh)	Ranchi (Jharkhand)	Agartala (Tripura)	Lucknow (Uttar Pradesh)
Sl. No	**Particulars**	**Units**						
1	Name of Technology	Name	Precast Concrete Construction System- Precast Components	Monolithic Concrete Construction using Tunnel Formwork	Prefabricated Sandwich Panel System	Precast Concrete Construction System – 3D Volumetric	Light Gauge Steel Frame System (LGSF) with Pre-Engineered Steel Structural System	Stay in Place Formwork System
2	No. of Houses	No.	1,152	1,144	1,024	1,008	1,000	1,040
3	No. of Floors	No.	G+5	S+13	S+8	G+8	G+6	S+13
4	Plot Area	Sqm	33,596	39,599	41,920	31,160	24,000	20,000
5	Per House Carpet Area	Sqm	26.58	39.77	29.04	29.85	30.00	34.50
6	Project Cost	INR (in Cr)	116.27	118.90	128.00	134.00	162.50	130.90
7	Per House cost (with infrastructure)	INR (in Lakh)	10.09	10.39	12.50	13.29	16.25	12.58

Light House Project (LHP) at Chennai, Tamil Nadu

(Technology: Precast Concrete Construction System-Precast Components)

No. of Dwelling Units : 1152 Nos. (G+5)
No. of Block / Tower : 12 Blocks
Units in each Block / Tower : 96 Nos.

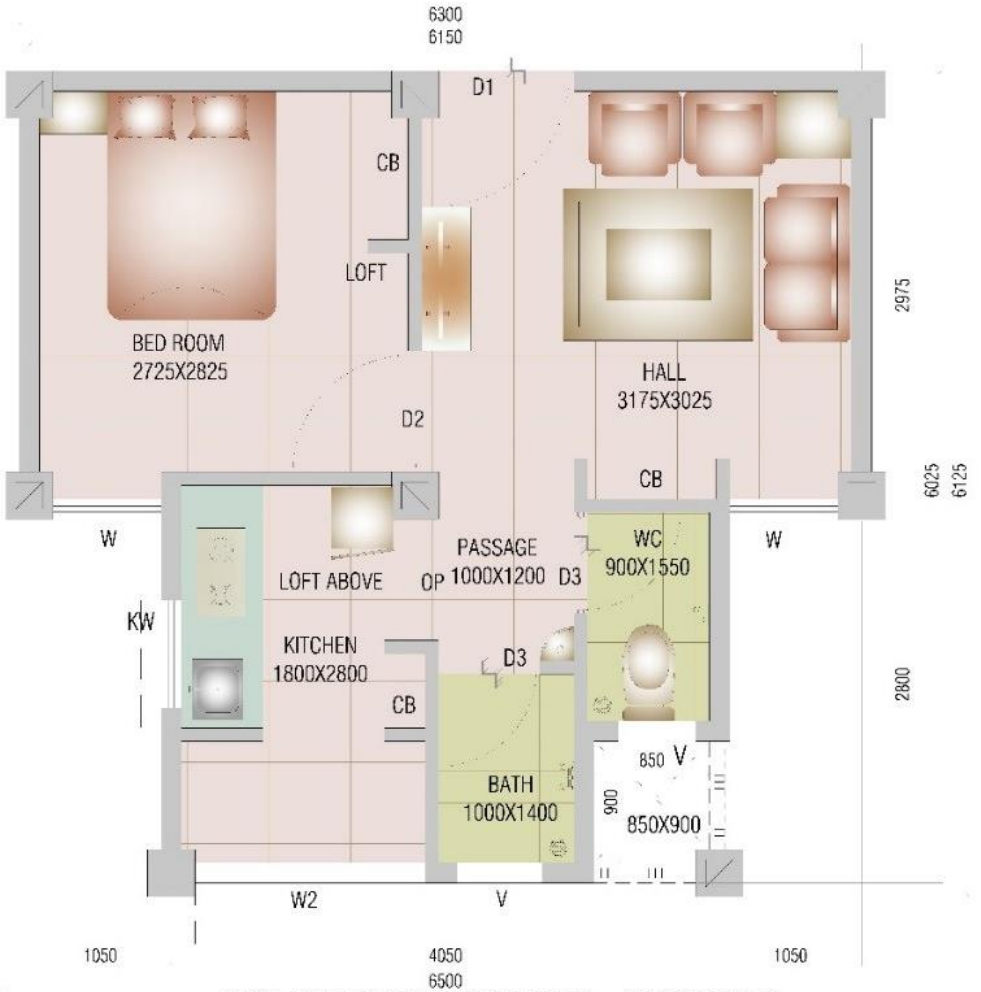


- Have a look at the project brief:
  - 1152 houses will be constructed in G+5 configuration.
  - The total plot area is around 30,000 Sqm and carpet area of each house is approximately 27 Sqm.
  - There are 12 residential blocks.
  - The project also includes social infrastructure such as Aganwadi, Shops, Milk Booth, Library and Ration Shop.

Typical floor plan

At each floor there are 16 dwelling units

Typical Dwelling Unit Plan



EWS-UNIT PLAN(CARPET AREA - 26.78 SQ.M.)

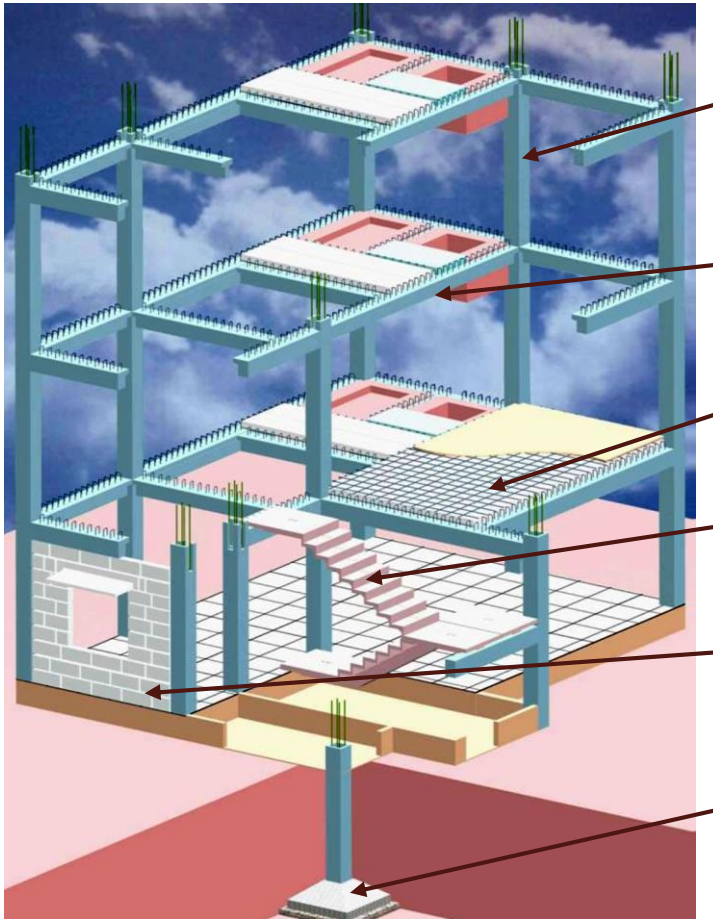
- Each dwelling unit comprises of one hall, one Bedroom, Kitchen, WC and Bath.
- The carpet area of each unit is 26.78 sq.mt. The sizes of individual rooms & service areas conform to NBC norms.
- **Other special features:**
  - Green rating as per GRIHA
  - Use of renewable resources:
    - Rain water harvesting
    - Solar lighting
  - Solid waste management
  - STP with recycling of waste water
  - Fire fighting services as per NBC norms

Prevalent Construction Systems → **Technology being Used**

Load bearing Structure

RCC Framed Structure

Precast Concrete Construction System-Precast Components Assembled at Site



Precast RCC Hollow Columns – core filled in-situ with self-compacting concrete.

Partially Precast RCC Beam – top part being cast with column and slab for monolithicity

Partially Precast slab with reinforced concrete screed

Precast staircase

Autoclaved Aerated Blocks (AAC) masonry for walls. This can also be replaced with precast RCC shear wall

Conventional RCC footing with precast stem column upto plinth level

CASTING OF PRECAST ELEMENTS

- Let's take you to a tour of typical casting yard which is setup at site for production of beam columns and slabs including other components like staircase, sunshades and lintels etc.

CASTING OF PRECAST ELEMENTS

- Casting of partially precast slabs

CASTING OF PRECAST ELEMENTS

Precast Beam

Precast slab

Precast Column

Precast Stairs

Foundation

- As per geo-technical investigations, bearing capacity, soil strata, water table, etc.
- Typical isolated footing along with some combined footings of varying sizes depending on the load.

Foundation

- Precast RCC Stem columns upto plinth level and connected with precast plinth beam.
- The stem columns have notches in which precast beams are placed.

Structural System

- Industrialized 3-S (Strength, Safety, Speed) prefab method of construction is based on mass produced precast structural components (columns, beams, shear walls, slabs, stairs etc.) onsite or offsite.
- The methodology of construction includes assembly of precast RCC hollow columns, beams and partially precast RCC solid slabs at site. The slabs shall have in-situ reinforced concrete laid on top after erection thereby making them monolithic.
- The filler walls are of AAC blocks.

STRUCTURAL SYSTEM

Erected Precast columns with notches and dowels over plinth beam

STRUCTURAL SYSTEM

- Placement of ground floor beam on columns.

STRUCTURAL SYSTEM

Wet jointing of stem column with plinth beam

Grouting of beam – column joint

Beam – column - slab wet jointing

- All the connections and jointing of various structural components are accomplished through in-situ **self-compacting concrete/micro concrete/non shrink grout** as per structural design and codal provisions.

STRUCTURAL SYSTEM

- A typical beam column joint showing monolithic action and continuity thus ensuring better seismic resistance

Before Jointing

After Jointing

FLOORS/ SLAB

- After erection of beams and column, partially precast slabs are placed with required bearing on the beams.

FLOORS/ SLAB

- Finally the screed concrete (55mm thickness) is poured over the partially precast slab to ensure monolithic continuous action and ductile behavior of the structure.

FLOORS/ SLAB

- Structural integrity and monolithic behavior is achieved in this technology through wet jointing using dowel bars/ continuity reinforcement placed at connection joints and filled with in-situ self-compacting concrete of higher strength in hollow cores of column.

Autoclaved Aerated Concrete (AAC) Blocks for Wall

- Autoclaved Aerated Concrete (AAC) blocks are lightweight, precast manufactured using foam concrete and suitable as masonry unit. These are non-load bearing infill walls.

AAC BLOCK MASONRY

Autoclaved Aerated Concrete (AAC) Blocks for Wall

- Autoclaved Aerated Concrete (AAC) is a lightweight, precast, foam concrete building material suitable for producing concrete masonry unit like blocks. Composed of sand, calcined gypsum, lime, cement, water and aluminum powder, AAC products are cured under heat and pressure in an autoclave.
- After construction of frame with precast beam column and slab, internal walls are constructed using Autoclaved aerated concrete (AAC) blocks having density 451-550 kg/m3 as per IS 2185 (Part-3).

Block size	600x200x150mm for outer walls 600x200x100mm for inner walls

Current Status

Current Status

Current Status

Hon'ble Prime Minister inaugurates Light House Project Chennai, dedicates 1,152 houses to beneficiaries

26th May, 2022, Chennai

Light House Project (LHP) at Rajkot, Gujarat

(Technology: Monolithic Concrete Construction System)

No. of Dwelling Units : 1144 Nos. (S+13)
No. of Block / Tower : 11 Blocks
Units in each Block / Tower : 104 Nos.

- Have a look at the project brief:
  - 1144 houses will be constructed in Stilt+13 configuration.
  - The total plot area is around 39,600 Sqm and carpet area of each house is approximately 39.77 Sqm.
  - There are 11 residential blocks.
  - The project also includes Community Centre and Health Centre.

Typical floor plan

Block Plan

At each floor there are 08 dwelling units

Project Layout Plan

Typical Dwelling Unit Plan

Unit Plan

- Each dwelling unit comprises of one living room, one Bedroom, one study room, Kitchen and two toilets.
- The carpet area of each unit is 39.77 sq.mt. The sizes of individual rooms & service areas conform to NBC norms.
- **Other special features:**
  - Green rating as per GRIHA
  - Use of renewable resources:
    - Rain water harvesting
    - Solar lighting
  - Solid waste management
  - STP with recycling of waste water

Unit 3D View

Prevalent Construction Systems → **Technology being Used**

Load bearing Structure

RCC Framed Structure

Monolithic Concrete Construction using Tunnel Formwork

Tunnel formwork
- Customized formwork

Assembly of Formwork

Concreting after Placing formwork

Structure after removal of formwork
- Shear Wall Construction

Foundation

- As per geo-technical investigations, bearing capacity, soil strata, water table, etc.
- Typical raft foundation of varying sizes depending on the load.

Foundation

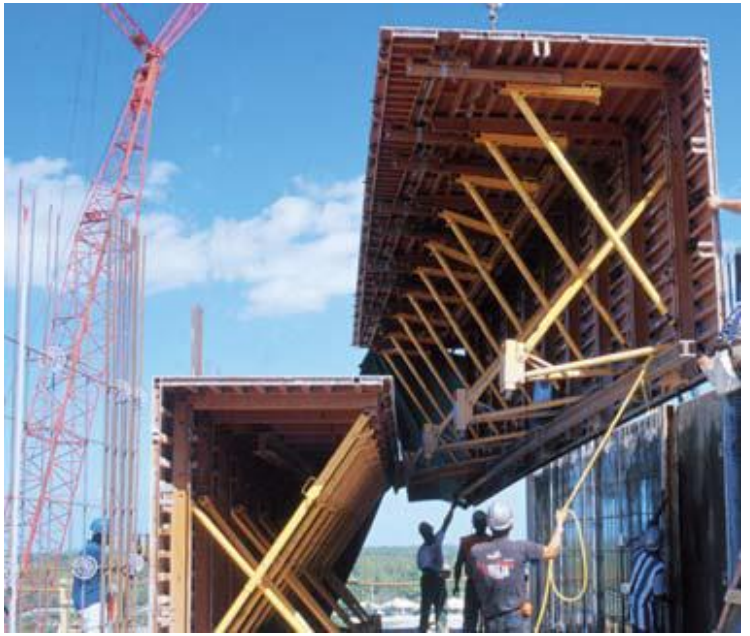
- Concreting of raft footing with M25 concrete as per Structural Drawing.
- Formwork for shear walls up to plinth beam.

Foundation

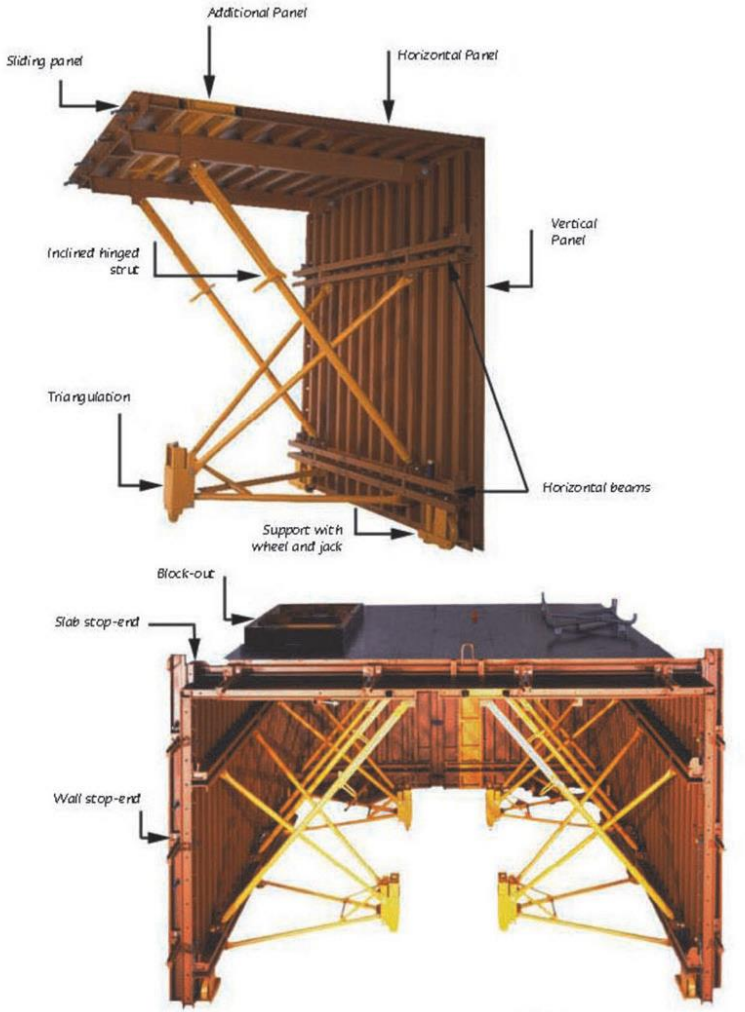
- Shear Wall up to Plinth level

Structural System

- Tunnel formwork is customized engineering formwork based on two half shells which are placed together to form a room or cell. Several cells make an apartment.
- The construction of structure is divided into phases. Each phase consists of a section of the structure that will be cast in one day. The phasing is determined by the programme and the amount of floor area that can be poured in one day.
- The infill walls are of Autoclaved Aerated Concrete (AAC) blocks and being used for partition walls.



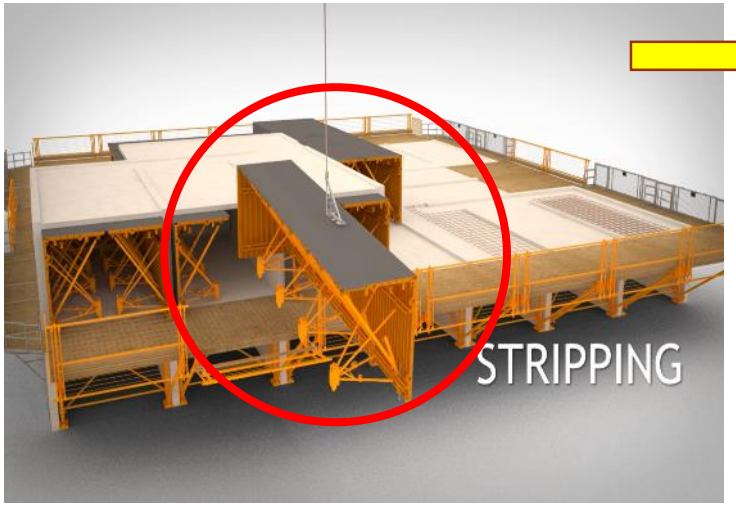
Assembly of Tunnel Formwork

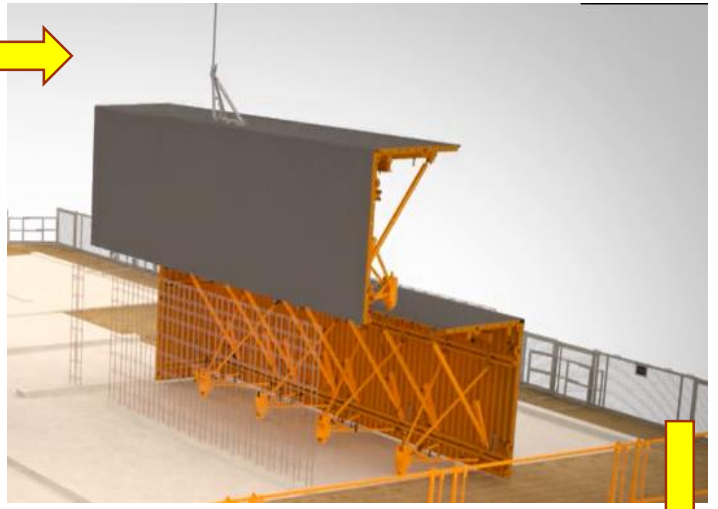


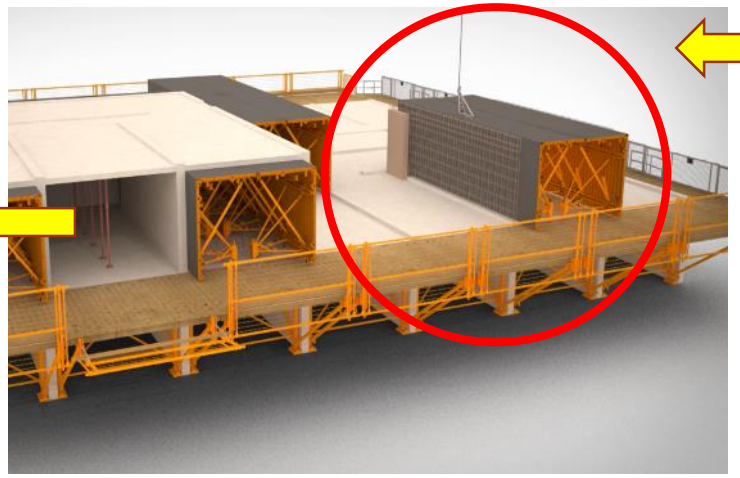
Work Cycle with Tunnel Formwork

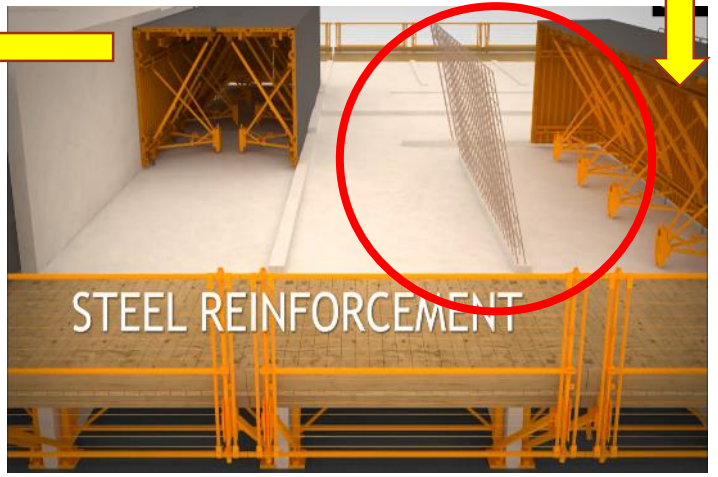
The on-site implementation of 24 hour cycle is divided into following operations.

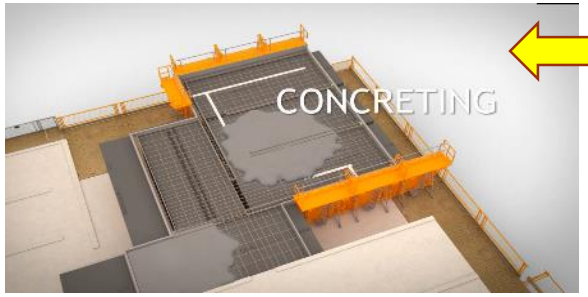
1. Stripping of the formwork from the previous day.
2. Positioning of the formwork for the current day's phase, with the installation of mechanical, electrical and plumbing services.
3. Installation of reinforcement in the walls and slabs.
4. Concreting.











Structural System

- Placement of tunnel formwork for slab and wall

- Concreting after placement of reinforcement on slab and wall.

Structural System

- After placement of reinforcement, the slab is cast monolithically with the walls.

Placement and leveling of concrete

Structural Elements

- Finished Monolithic structure with shear wall and slab

STRUCTURAL SYSTEM

Typical Reinforcement at Slab level

STRUCTURAL SYSTEM

Concreting of Slab

STRUCTURAL SYSTEM

Shear Wall after removal of Tunnelform

STRUCTURAL SYSTEM

Shear Wall and Slab after removal of Tunnelform

AAC BLOCK MASONRY

Autoclaved Aerated Concrete (AAC) Blocks for Wall

- Autoclaved Aerated Concrete (AAC) is a lightweight, precast, foam concrete building material suitable for producing concrete masonry unit like blocks. Composed of sand, calcined gypsum, lime, cement, water and aluminum powder, AAC products are cured under heat and pressure in an autoclave.
- After construction of frame with precast beam column and slab, internal walls are constructed using Autoclaved aerated concrete (AAC) blocks having density 451-550 kg/m^3 as per IS 2185 (Part-3).

MEP

In Shear walls, the plumbing and electrical services are incorporated before casting.

In AAC Block walls, the plumbing and electrical services are incorporated as done in conventional method of construction i.e. chasing and filling

PHOTOGRAPHS AFTER COMPLETION

PHOTOGRAPHS AFTER COMPLETION

HOUSES OCCUPIED BY BENEFICIARIES – RECENT PHOTOGRAPHS

HOUSES OCCUPIED BY BENEFICIARIES – RECENT PHOTOGRAPHS

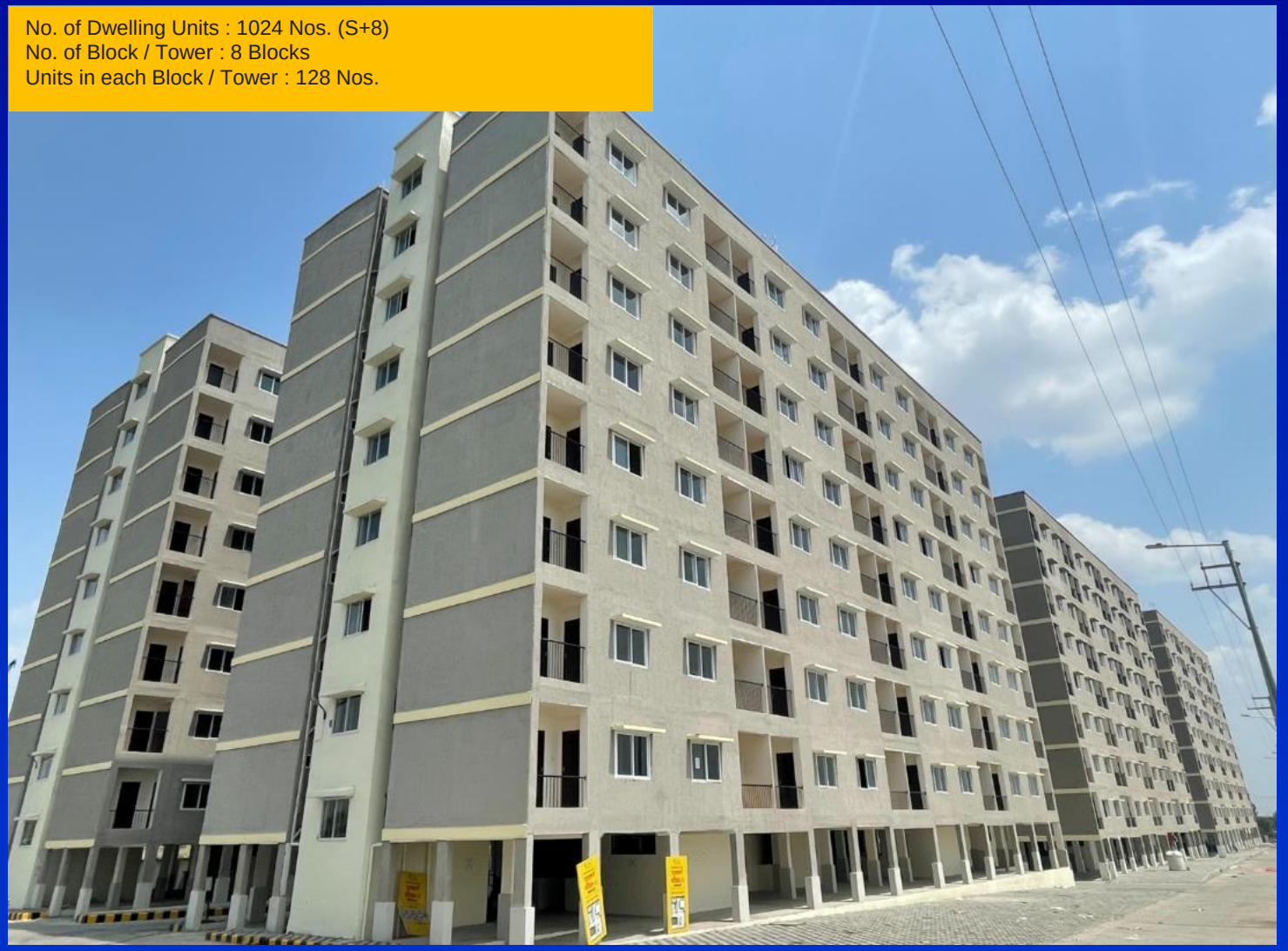
Hon’ble Prime Minister inaugurates Light House Project Rajkot, Dedicates 1,144 houses to beneficiaries

19th October, 2022, Rajkot

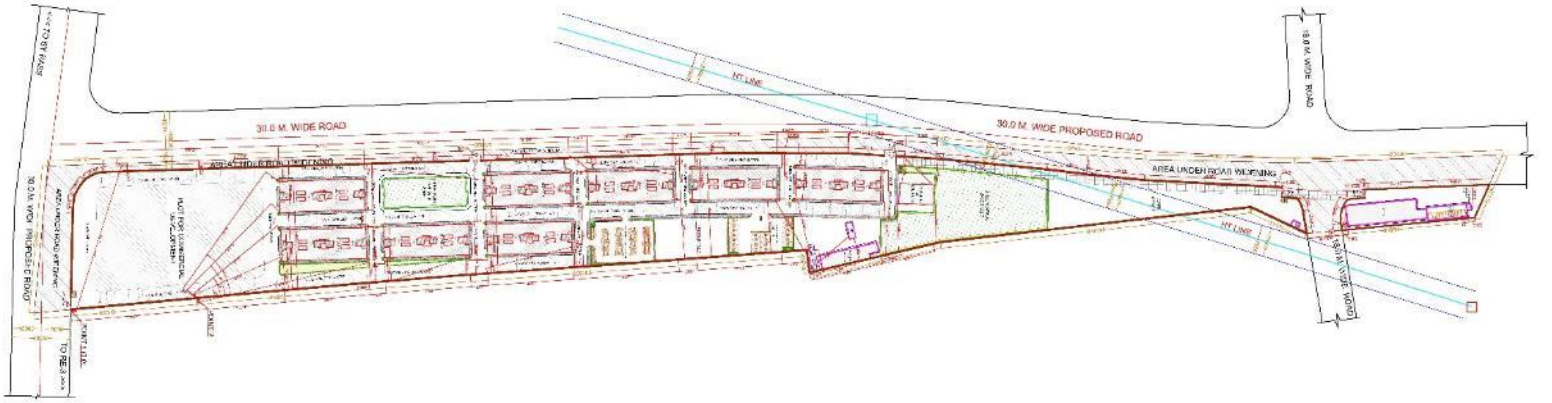
Light House Project (LHP) at Indore, M.P.

(Technology: Prefabricated Sandwich Panel System & Pre-Engineered Steel Structural System)

No. of Dwelling Units : 1024 Nos. (S+8)
No. of Block / Tower : 8 Blocks
Units in each Block / Tower : 128 Nos.

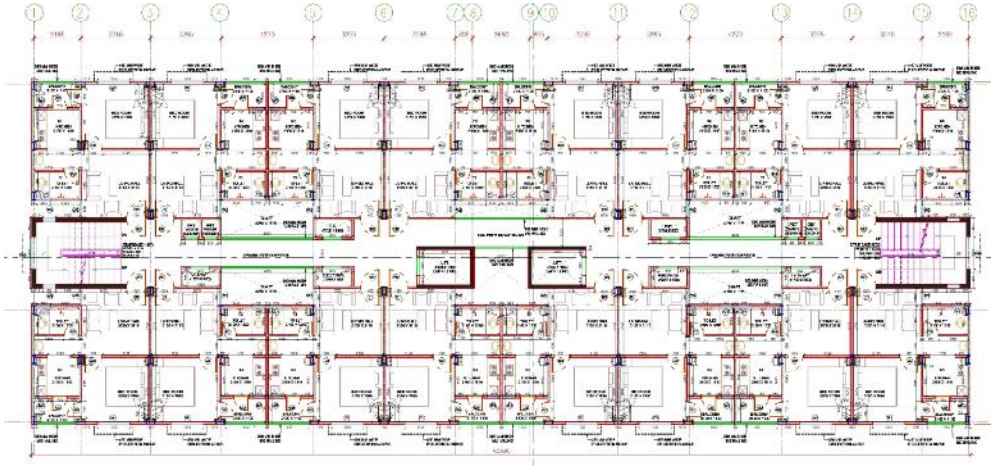


- Total Plot area is 41920 Sqm.
- Ground coverage of the project is15% and FAR achieved is 1.3.
- Proposed organized green space is 10.05%.
- The project also includes a community hall of 169.52 Sqm.



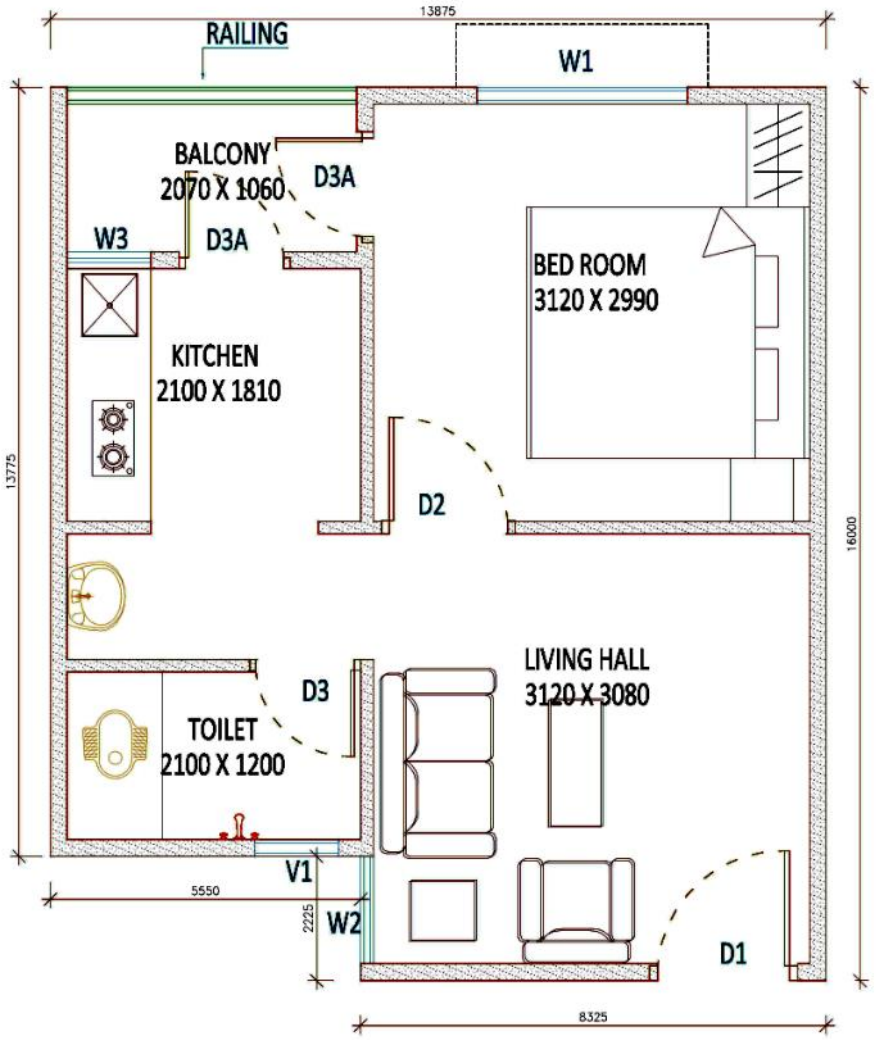
- There are 8 blocks in Stilt + 8 configuration with 1024 houses along with basic and social infrastructure.

Typical floor plan



- 16 dwelling units at each floor of building block with provision of lifts and staircases.

- Typical Dwelling Unit plan



Each dwelling unit consists of one living, one bed room, a kitchen, a toilet and a balcony. The carpet area of each unit is 29.04 Sq.mt. The sizes of individual rooms & service areas conform to NBC norms.

Other special features:

- Green rating as per GRIHA
- Use of renewable resources:
  - Rain water harvesting
  - Solar lighting
- Solid waste management
- STP with recycling of waste water
- Fire fighting services as per NBC norms

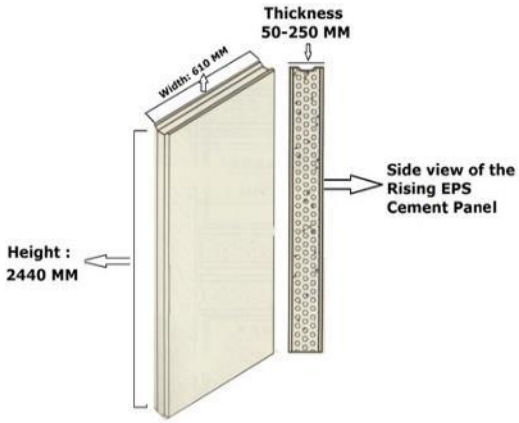
Prevalent Construction Systems → **Technology being Used**

Load bearing Structure

RCC Framed Structure

Steel Frame Structure

Prefabricated Sandwich System



The Sandwich Panel System are factory made wall panels replacing conventional brick/block & mortar walling construction and can be used as non-load bearing as well as load bearing applications.

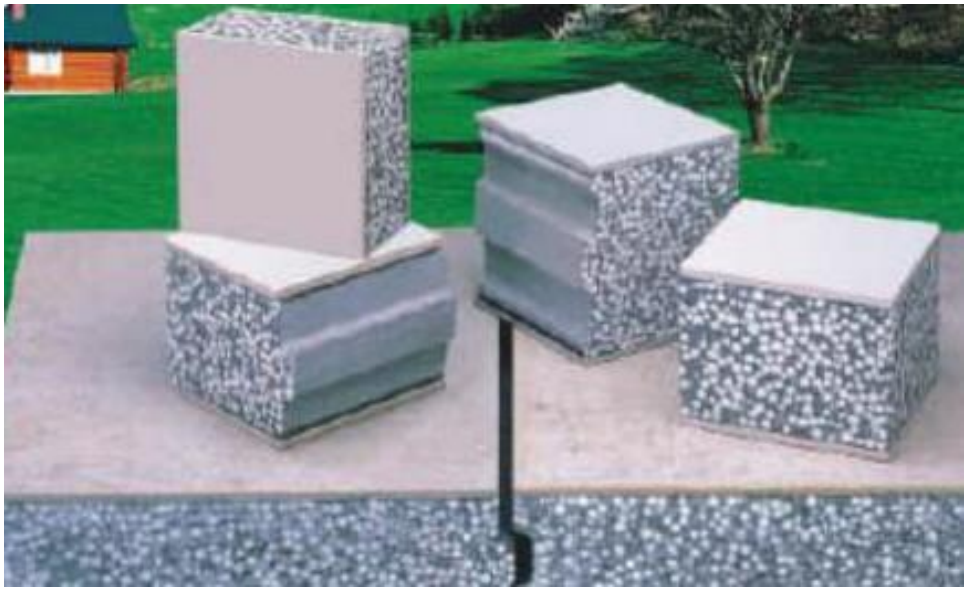
In order to meet structural requirements, Hybrid system comprising of **Prefabricated Sandwich System with Pre-Engineered Steel Structural System** has been adopted in the present project.

Floor/ Roof Slab

- The floor/ roof is deck slab which comprises of deck sheet, reinforcement with concrete screed

Wall Panels – Prefabricated Sandwich Panel System

- The panels are made of fibre cement / calcium silicate boards on both sides with infill core of light weight concrete made of EPS granule balls, cement, sand, flyash, adhesive and other bonding material.
- The core material in slurry state is pushed under pressure into the preset moulds.
- Once set, the panels are moved for curing and transported to the site.



Prefabricated Sandwich Panel System

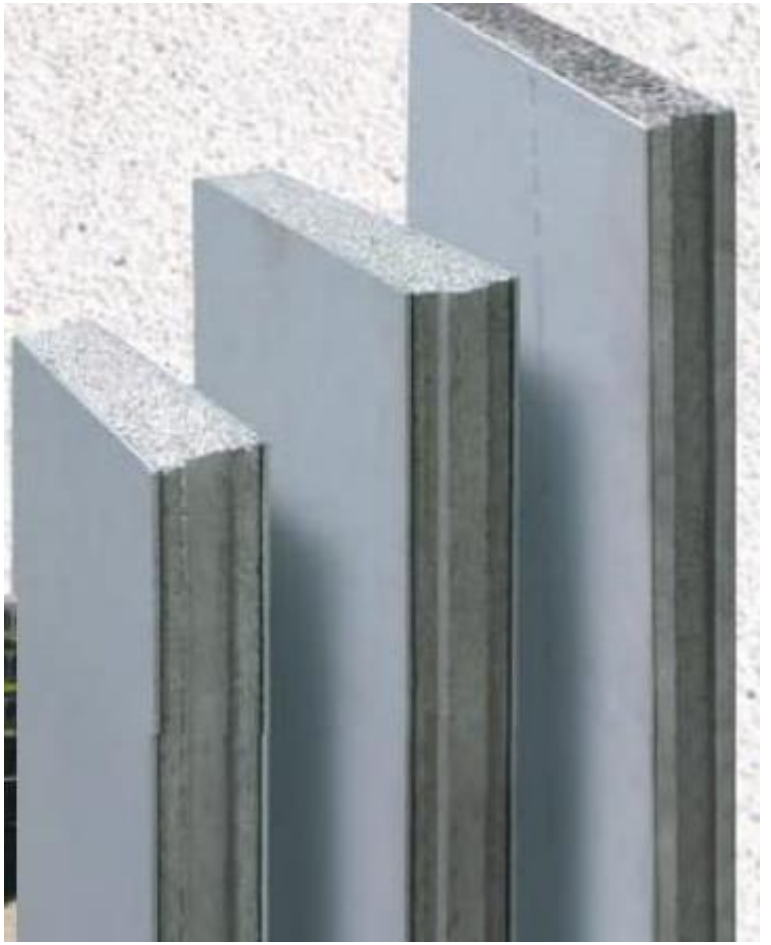
- Photos of manufacturing plant

Prefabricated Sandwich Panel System

- **Typical Wall Panel Dimensions**

Length	2440 mm (may be increased upto 3000 mm)
Width	610 mm (may be altered as per requirement but should not be too wide since handling of the panels become difficult)
Thickness	50-250 mm. Dimensions

- In LHP at Indore, the height of panel is 3.0 mtr., width is 610 mm.
- The thickness of panels being used is 120 mm for external walls and 90 mm internal walls.
- The additional cladding at L and T joints are required with 60 mm thick panels to encase the steel structure.



Wall Panels

- Typical view of Prefabricated sandwich panels and steel frame construction

Foundation

- Conventional as per geo-technical investigations, bearing capacity, soil strata, water table, etc.
- Combined and Isolated RCC footing with RCC column up to plinth height.
- RCC shear walls for staircase and lift wells on RCC Raft foundation and water proofing with kota stone.
- Base plate and Anchor bolts of varying sizes and diameter as per structural design for erecting Pre-Engineered Steel structure.
- RCC plinth beam and grade slab at plinth level.

Foundation

- All building blocks has isolated & combined footings as per the structural design with M25 Concrete. The raft foundation with thickness of 500 mm has been constructed around staircase and lift well. All lift and staircase wells are provided with kota stone for water proofing

Foundation

- Columns of M25 Grade Concrete are being cast upto plinth height over already laid cured footing

Foundation

- Back filling with soil and water in layers of 200 mm with proper compaction.

Foundation

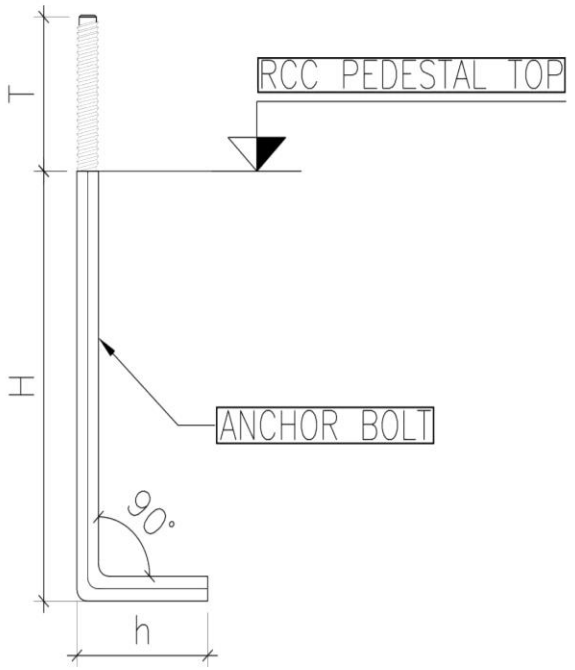
- Fixing of anchor bolts with templates over which factory made built up columns with base plate will be erected.

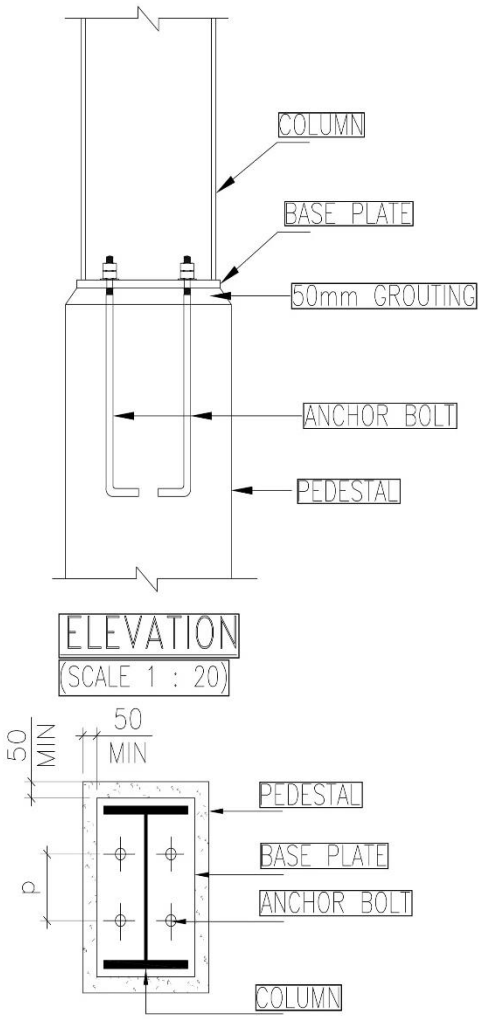
Structural System

- Pre-Engineered Building (PEB) system comprising of built-up fabricated I sections for beams and columns

STRUCTURAL SYSTEM

- **Connection details of built up steel column at plinth level (Stilt) with foundation (plinth beam)**





Dia (mm)	H (mm)	h (mm)	T (mm)
16	400	100	100
30	900	100	150

Anchor bolt schedule

a) Typical anchor bolt detail

Anchor bolt is inserted below plinth level upto height H and projected above plinth up to

b) Typical base plate detail

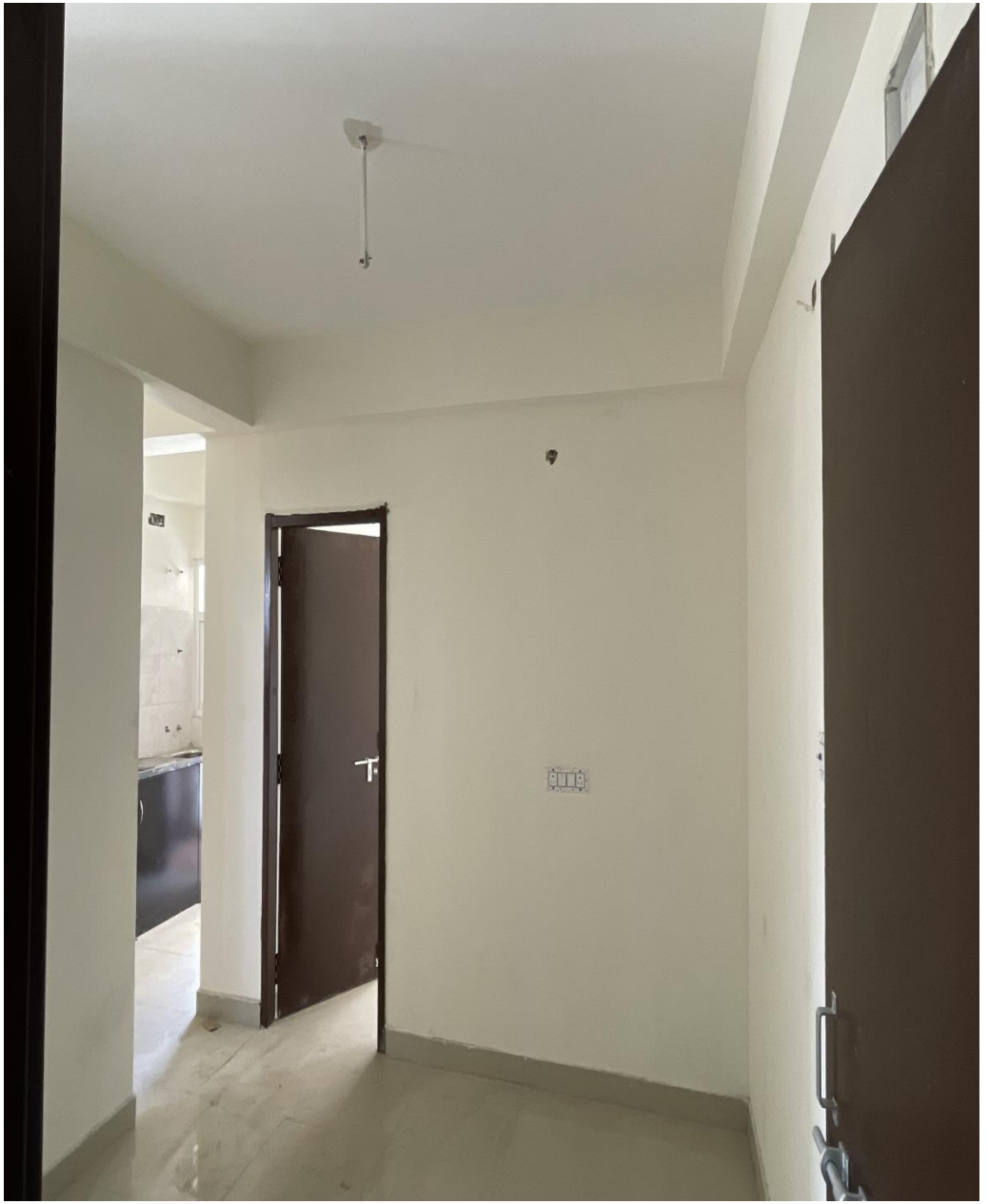
The built up steel I column is being fixed with anchor bolts and base plate

STRUCTURAL SYSTEM

STRUCTURAL SYSTEM

CONSTRUCTION STAGES

CONSTRUCTION STAGES



MEP

- The plumbing and electrical services are incorporated as done in conventional method of construction i.e. chasing and filling

Current status

Current status

Current status

Current status

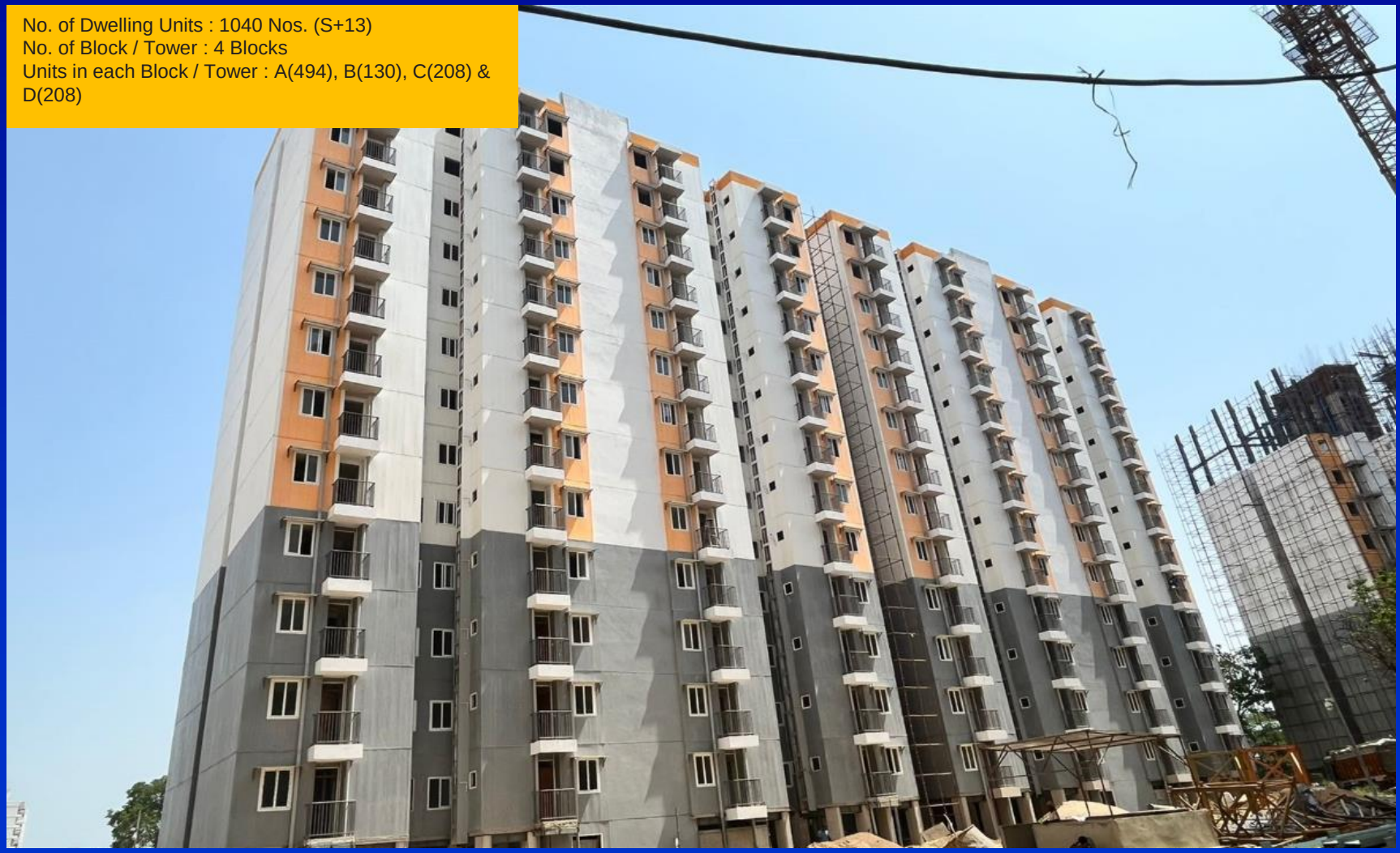
Current status

Current status

Light House Project (LHP) at Lucknow, U.P.

(Technology: Stay in-place Formwork System & Pre-Engineered Steel Structural System)

No. of Dwelling Units : 1040 Nos. (S+13)
No. of Block / Tower : 4 Blocks
Units in each Block / Tower : A(494), B(130), C(208) & D(208)

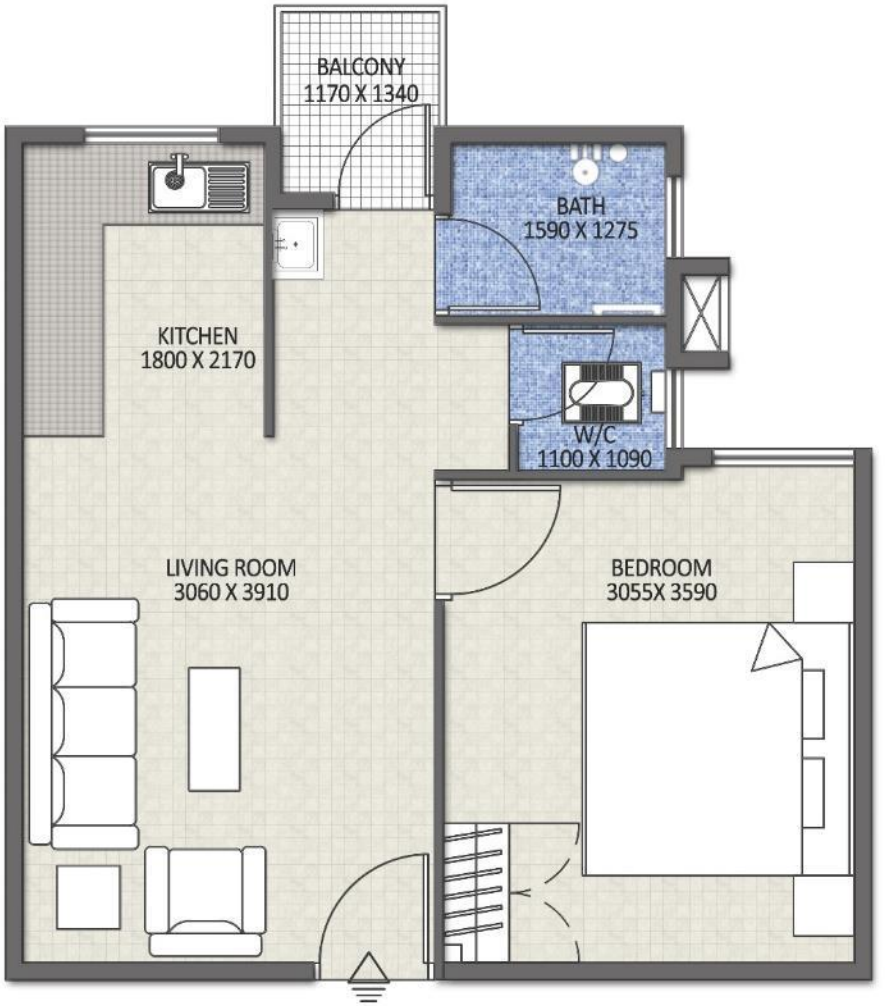


- Ground coverage of the project is 23% and FAR achieved is 2.41.
- Proposed organized green space is 13%.

Typical floor plan (Block C & D)

- 16 dwelling units at each floor of building block C &D with provision of lifts and staircases.

- Typical Dwelling Unit plan



Each dwelling unit consists of one living, one bed room, a kitchen, a toilet and a balcony. The carpet area of each unit is 34.51 Sq.mt. The sizes of individual rooms & service areas conform to NBC norms.

Other special features:

- Green rating as per GRIHA
- Use of renewable resources:
  - Rain water harvesting
  - Solar lighting
- Solid waste management
- STP with recycling of waste water
- Fire fighting services as per NBC norms

Prevalent Construction Systems → **Technology being Used**

Load bearing Structure

RCC Framed Structure

Steel Frame Structure

Stay In Place PVC Formwork System

The stay in place form work system is unlike the temporary shuttering adopted in conventional systems, as it stays permanently as an integral part of the structure.

In order to meet structural requirements, Hybrid system comprising of **Stay In Place PVC Formwork System with Pre-Engineered Steel Structural System** has been adopted in the present project.

Foundation

- Conventional as per geo-technical investigations, bearing capacity, soil strata, water table, etc.
- Raft foundation with RCC column upto plinth height.
- RCC plinth beam and grade slab at plinth level.

Foundation

- Reinforcement and shuttering for raft foundation

Foundation

- All building blocks have Raft foundation with 500 mm thick M-25 Concrete. **An additional thickness of 400 mm has been constructed around staircase and lift well.**

Foundation

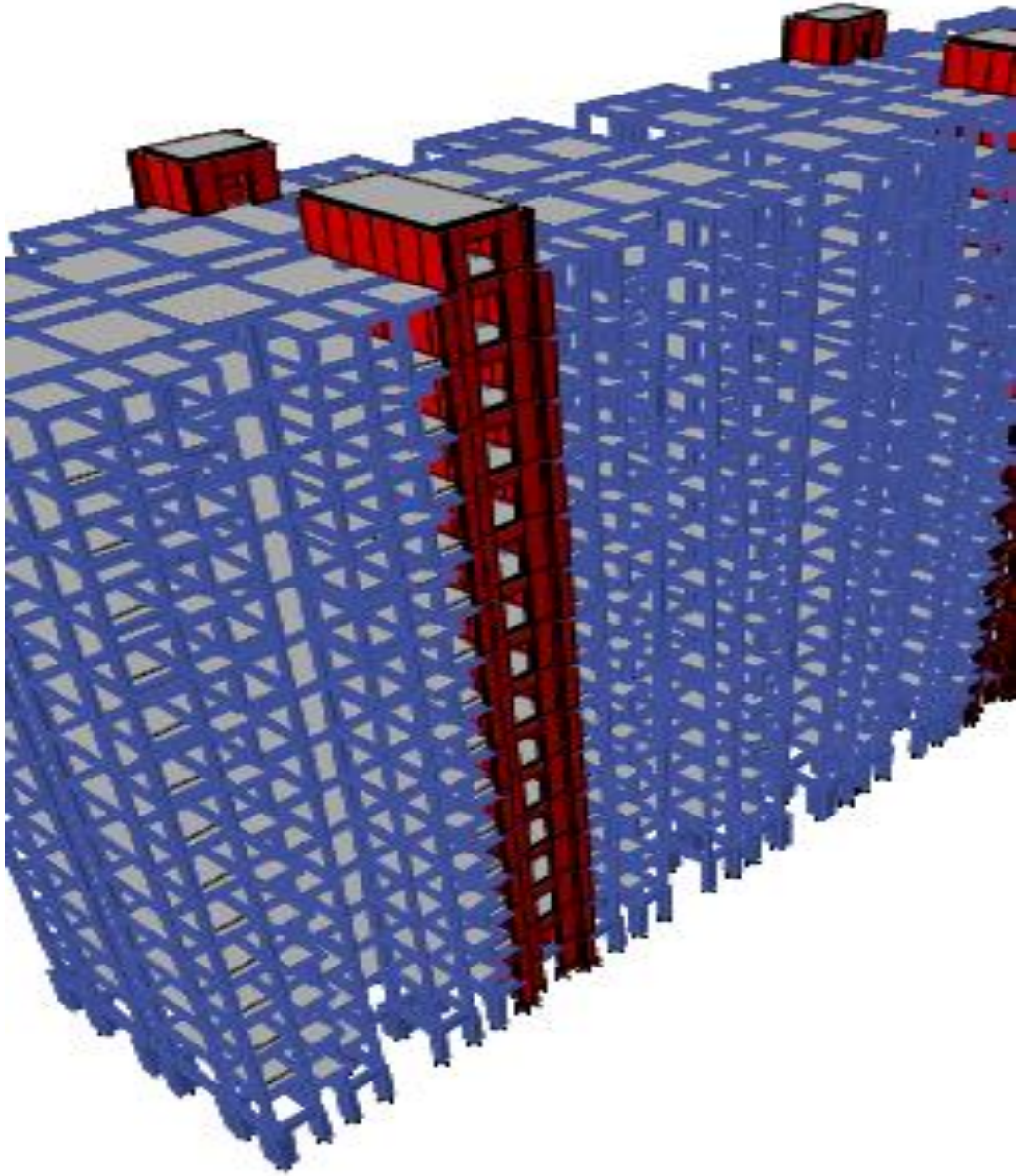
- Columns of M25 Grade Concrete are being cast upto plinth height over already laid cured raft.

Foundation

- Anchor bolts have been cast with concrete at plinth level over which factory made built up columns with base plate will be erected.
- The reinforcement laying & shuttering work is in progress for shear wall construction of lift & staircase portion.

Structural system

- Pre-Engineered Building system comprising of built-up fabricated I sections for beams and columns

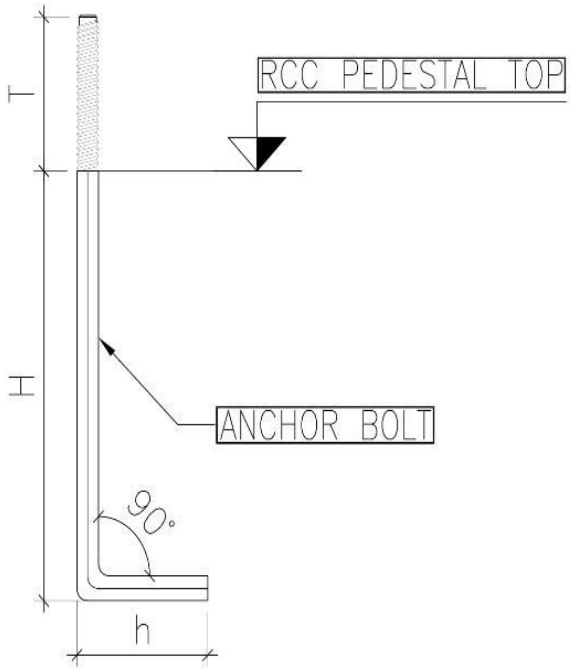


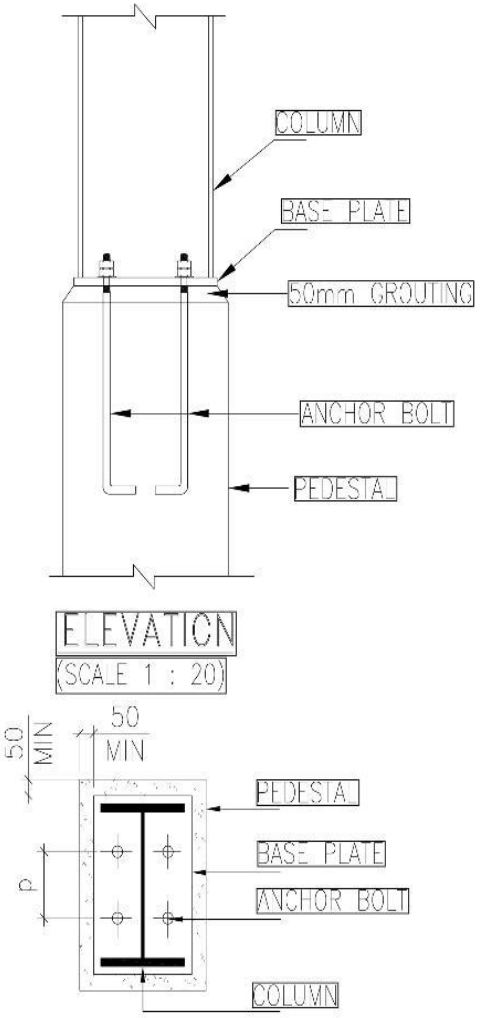
STRUCTURAL SYSTEM

In the present lecture, the structural system and other details are being explained through drawings, sketches and text.

STRUCTURAL SYSTEM

- Connection details of built up steel column at plinth level (Stilt) with foundation (plinth beam)





Dia (mm)	H (mm)	h (mm)	T (mm)
16	400	100	100
20	500	100	100
24	600	100	150
27	700	100	150
30	800	100	150

Anchor bolt schedule

a) Typical anchor bolt detail

Anchor bolt is inserted below plinth level upto height H and projected above plinth up to

b) Typical base plate detail

The built up steel I column is being fixed with anchor bolts and base plate

Erection of steel columns

Erection of steel columns &

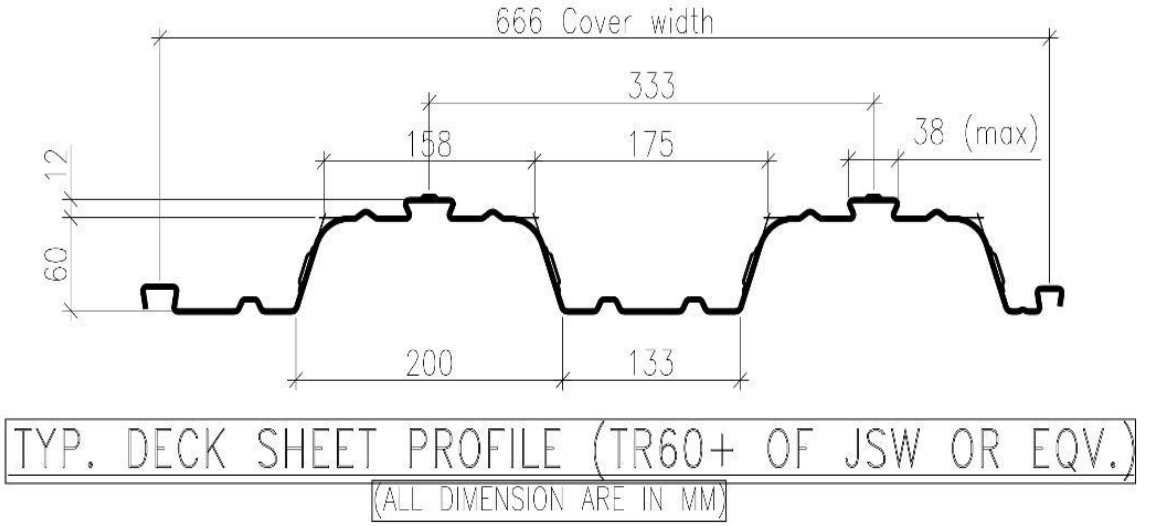
Floor/ Roof Slab

- The floor/ roof is deck slab which comprises of deck sheet, reinforcement with concrete screed

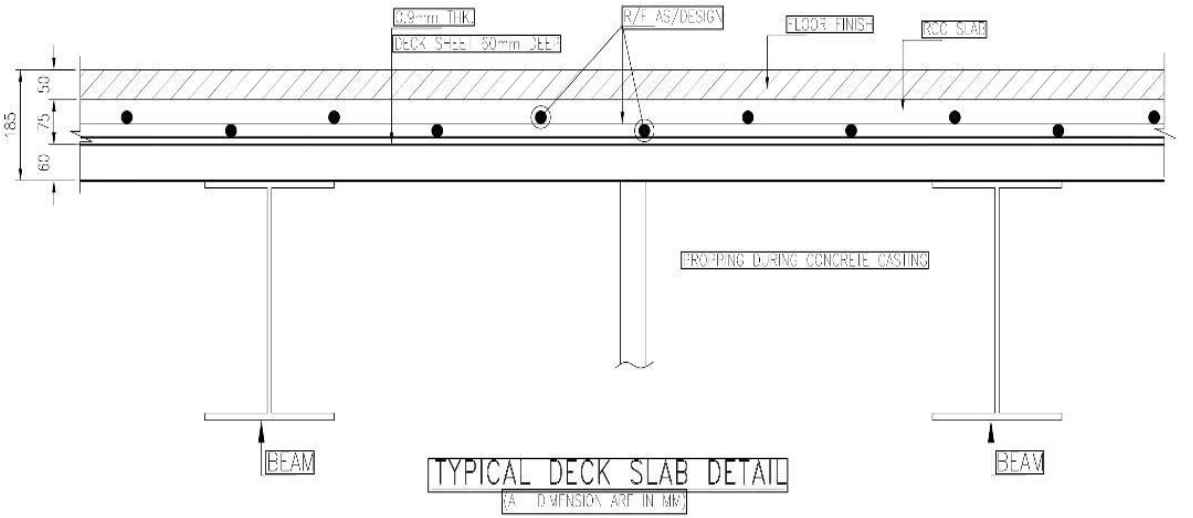
FLOORS

- Floor slab details : Deck slab

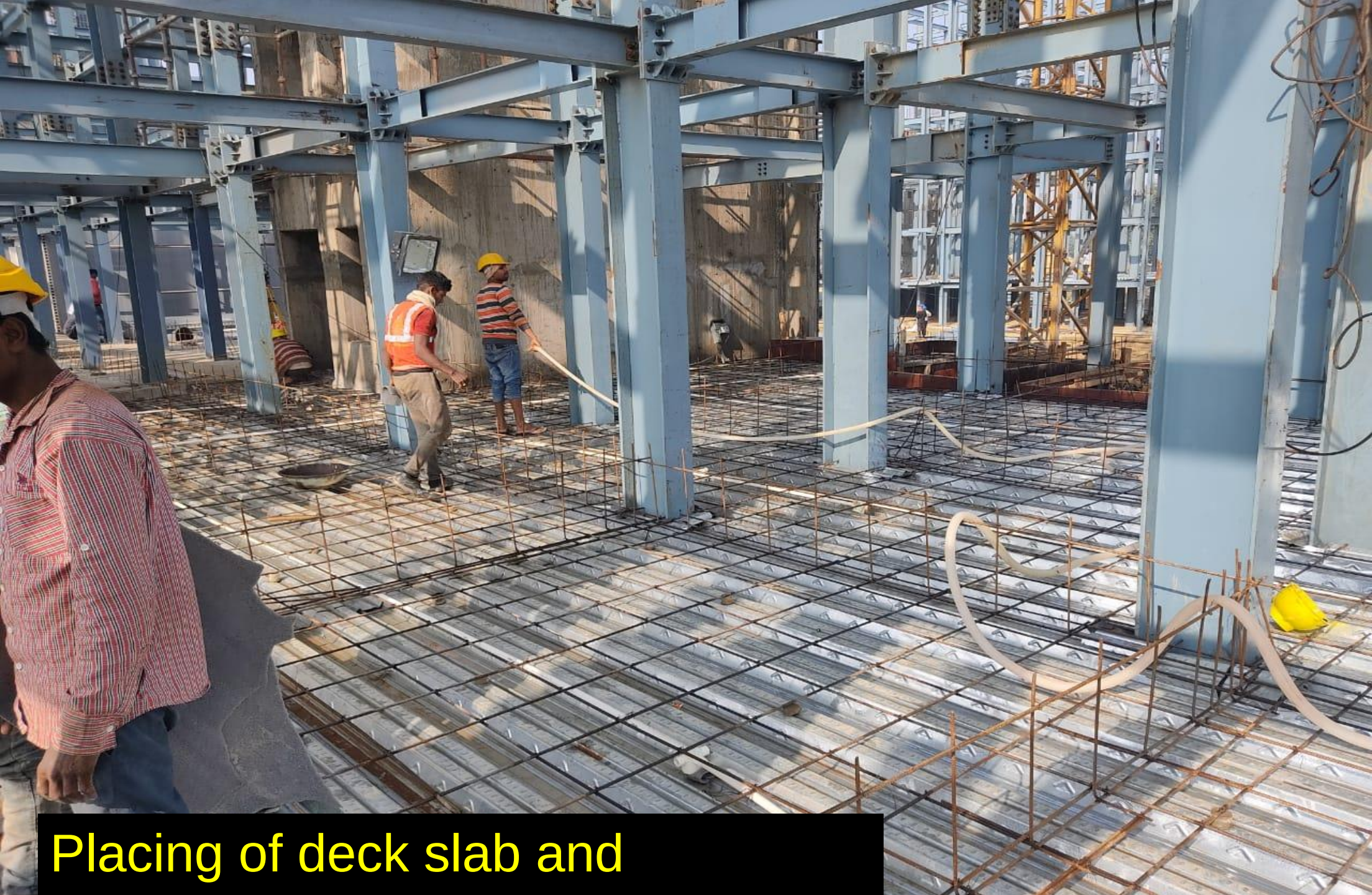
  - After erection of steel beams and column (PEB Structure), steel deck sheet of thickness 0.9 mm are placed with required bearing on the beams.
  - Concrete screed of 75 mm is poured on the deck sheet in M25 with reinforcement as per structural design.
  - Structural design for reinforcement is as per IS 456-2000.
  - Generally, nominal reinforcement is provided in concrete screed of deck slab to take care of shrinkage & cracking.



a) Typical deck sheet profile



b) typical deck slab detail


Placing of deck slab and


Concrete on deck

Wall Panels - Stay in Place PVC formwork System

- The formwork components are manufactured from extruded polyvinyl chloride (PVC).
- The extrusions consist of two layers, the substrate (inner) and Modifier (outer).
- The two layers are co-extruded during the manufacturing process to create a solid profile.

Stay in Place PVC formwork System

- Typical manufacturing plant for production of PVC formwork

- **Typical Wall Panel Dimensions**

Application	Novel	Wall Thickness		Weight of Panel with concrete
		Overall (Nominal)	Concrete Core	
External Wall	N126	126 mm	120 mm	8.5 kg/m
Internal Wall	N64	64 mm	60 mm	4.25 kg/m

- Width of the individual panel components = 300 / 250 mm.
- Height is as per the requirement. In LHP at Lucknow, it is full storey height about 3 mtr.

Stay in Place PVC formwork System

- The rigid poly-vinyl chloride (PVC) based form work system serve as a permanent stay-in-place durable finished form-work for concrete walls.
- The extruded components slide and interlock together to create continuous formwork with the two faces of the wall connected together by continuous web members forming hollow rectangular components.
- The web members are punched with oval-shaped cores to allow easy flow of the poured concrete between the components.

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Wall Panels

- Typical view of PVC wall panels and steel frame construction

Fixing of Wall

Concreting in Wall

MEP

- The plumbing and electrical services are incorporated as done in conventional method of construction i.e. chasing and filling

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