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

GLOBAL HOUSING TECHNOLOGY CHALLENGE INDIA

Ministry of Housing and Urban Affairs
Government of India

Azadi Ka Amrit Mahotsav

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LIGHT HOUSE PROJECT: LIVE LABORATORIES

WEBINAR SERIES: e-learning & webcasting of LHPs for TECHNOGRAHIS

March - November 2022

An 'e-Learning series and webcasting of LHP's construction process' to widespread the knowledge about the technology, construction process, sustainability, and mass cum fast construction to TECHNOGRAHIs.

Webinar Session #10 at Light House Project Ranchi, Jharkhand

Date: 30.06.2022, Thursday | Time: 15:00

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Light House Projects : Live Laboratories
Webinar Series

Emerging Construction Systems for Mass Housing

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PMAY (U) Achievement (provisional)

[as on 30th May, 2022]

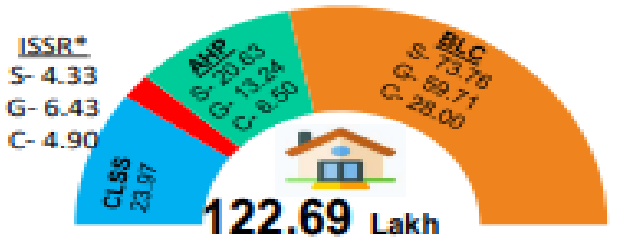
Overall Sanctions for 1.23 crore Houses

Construction of Houses (Nos in lakh)

Demand	Sanctioned	Grounded	Completed/ Delivered
112.24	122.69	100.16	60.17

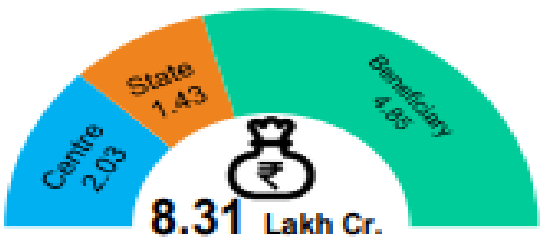
Financial Progress (₹ in Cr)

Committed	Released	Expenditure	UC Received
2,03,427	1,18,020	1,10,856	1,10,401

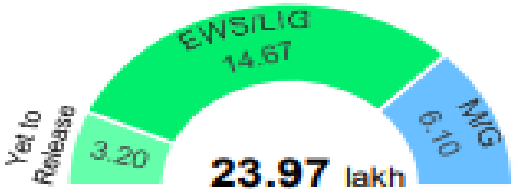


Houses in verticals (Nos in Lakh)

S- Sanctioned G- Grounded C- Completed



Investment Approved (Rs in Lakh Cr.)



Beneficiaries under CLSS (in lakh)

Interest Subsidy under CLSS (Rs in Cr.)

16 lakh houses are being constructed using New Technologies

GLOBAL HOUSING TECHNOLOGY CHALLENGE INDIA

Global Housing Technology Challenge - India (GHTC-I)

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

GLOBAL HOUSING TECHNOLOGY CHALLENGE INDIA

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**

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स्वच्छ भारत
एक कदम स्वच्छता की ओर

GLOBAL HOUSING TECHNOLOGY CHALLENGE INDIA

Light House Projects

Hon'ble Prime Minister laid the foundation stone of six LHPs on 01.01.2021

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Conventional Construction Systems

business as usual approach

The prevalent construction systems in India are:

Load bearing Structure

In this system, walls are constructed using bricks/stone/block masonry and floor/roof slabs are of RCC/stone/composite or truss. It is cast in-situ system and called load bearing system as load of structure is transferred to foundation and then to ground through walls.

RCC Framed Structure

In this cast in-situ system, the skeleton of a structure is of RCC column and beam with RCC slab. The infill walls can be of bricks/blocks/stone /panels. The load of the structure is transferred through beam and column to the foundation.

Conventional Construction Systems	Alternate Construction Systems
Slow	Fast
Maximum Use of Natural Resources	Optimum use of Resources
Waste Generation	Minimum Waste
Air/Land/Water Pollution	Minimum Pollution
Labour Intensive	Industrialized System
Prescriptive Design	Cost-effective Design
Unhealthy Indoor Quality	Better health & Productivity
Regular Maintenance	Low Life Cycle Cost
Energy Intensive	Energy Efficient
Cast-in-situ Poor Quality	Factory Made Quality Products
High GHG Emissions	Low GHG Emissions
Unsustainable	Sustainable

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Emerging construction systems help to build

SAFER structures

Sustainable Buildings

- 30%-50% reduction in energy use
- 40% reduction in water use
- 35% reduction in GHG emission
- 75% reduction in waste

E Economical - low life cycle cost, better quality

R Resilient - disaster-resistant, structurally superior

3D Precast Volumetric Construction

- Replacing cast in situ RCC structural frame with factory made structural components – 3D
- Customized factory made volumetric construction i.e. the entire module (room)

3D MONOLITHIC VOLUMETRIC Construction

Courtesy :

1

Precast Concrete Construction System – 3D Volumetric

1	Pre-cast concrete system with columns, beams, walls, slabs, hollow core slabs & also 3D Volumetric components	Katerra
2	Vertical structural modules cast in Plant/Casting yard are assembled together through casting of floor panel. The unit is transported & installed at site.	Moducast Pvt. Ltd
3	3D Modular casting using steel mould and high performance concrete of building modules in factory. These pods are transported to the construction site & assembled	Magicrete Building Solutions,
4	Modules with 3D Volumetric Precast concrete unit, various units make on house	Ultratech Cement Ltd,

Light House Project (LHP) at Ranchi, Jharkhand

(Technology: Precast Concrete Construction – 3D Volumetric Construction)

2D Precast Concrete Construction

- Replacing cast in situ RCC structural frame with factory made structural components – 2D planar elements
- Customized Factory made beams, columns, wall panels, slab/floors, staircases etc.

Concrete components prefabricated in precast yard or site and installed in the building during construction

2

Precast Concrete Construction System – Precast components assembled at site

1	Precast Large Concrete Panel (PLCP) System with structural members (wall, slab etc.) cast in a factory/ casting yard and brought to the building site for erection & assembling	Larsen & Toubro
2	Pre-cast Concrete Structural system comprising of pre-cast column, beam, precast concrete / light weight slab, AAC blocks/ infill concrete walls.	B.G. Shirke Construction Technology Pvt. Ltd
3	Optimal Pre-cast concrete System through structural Analysis, design & equipment support	Elematic India,
4	Precast concrete construction system using precast walls with precast plank floor	PG Setty Construction Technology Pvt Ltd,
5	Precast components comprising of beams, coloumns, staircase, slab, hollow core slab etc. manufactured in plant & erected on site	Teemage
6	Pre-cast sandwich panel system & Light weight Pre cast Light Weight concrete slab	Nordicflex
7	Prefabricated Interlocking Technology (without mortar) with Roofing as Mechnized Precast R.C. Plank & Joist system	Adalakha Associates Pvt. Ltd
8	Large Hollow wall prefab concrete Panel (lightweight, interlocking, concrete panel) using factory produced large standard hollow interlocking concrete block	William Ling,

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.

PRE-ENGINEERED STEEL STRUCTURAL SYSTEM

- **Replacing cast in situ RCC structural frame with factory made steel (hot rolled) structural system**

Steel skeleton with Aerocon panel infills

LIGHT GAUGE STEEL STRUCTURAL SYSTEMS

- Replacing cast in situ RCC structural frame with factory made light gauge steel (cold rolled) structural system

3

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

1	LGS Framing with various walling & roofing options	Mitsumi Housing Pvt. Ltd,
2	LGS Framing with various walling & roofing options	Everest Industries Ltd,
3	LGS Framing with various walling & roofing options	JSW Steel Ltd.,
4	LGS Framing with various walling & roofing options	Society for Development of Composites
5	LGS Framing with various walling & roofing options	Elemente Designer Homes
6	LGS Framing with various walling & roofing options	MGI Infra Pvt. Ltd.,
7	LGS Framing with various walling & roofing options	RCM Prefab Pvt. Ltd,
8	LGS Framing with various walling & roofing options	Nipani Infra and Industries Pvt. Ltd.,
9	LGS Framing with various walling & roofing options	Strawcture Eco
10	LGS Framing with various walling & roofing actions	Visakha Industries Ltd.
11	Prefabricated steel structural system with Dry wall system as AAC panels, PUF panels etc	RCC Infra Ventures Ltd.
12	Hot rolled steel frame with speed floor	Jindal Steel & Power Ltd.
13	Hot rolled steel section with AAC Panels as floor & slab	HIL Ltd.
14	AAC wall and roof panel system to provide integrated solution. AAC products are reinforced and used in both load and non-load bearing applications	Biltech Building Elements Ltd
15	AAC Panels are Wire mesh/ steel reinforced for use as wall & slab. Appears to be non load bearing panels to be used with structural framing.	SCG International India Pvt Ltd
16	Precast Light Weight Hollow-core wall Panel is a non-structural construction material with framed structures.	Pioneer Precast Solutions Private Limited

Light House Project (LHP) at Agartala, Tripura

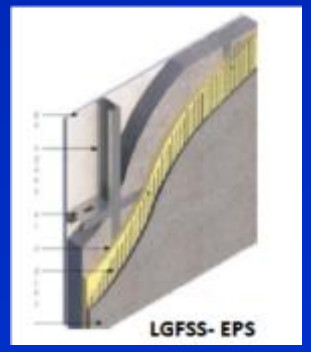
(Technology: Light Gauge Steel Structural System & Pre-Engineered Steel Structural System)

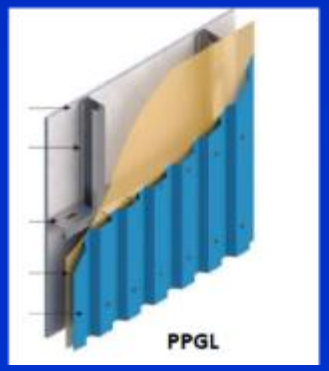
No. of Dwelling Units : 1000 Nos. (G+6)
No. of Block / Tower : 7 Blocks
Units in each Block / Tower : A(112), B(154), C(118), D(168), E(168), F(168) & G(112)

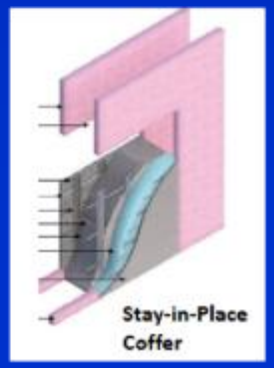
PREFABRICATED SANDWICH PANEL SYSTEMS

- **EPS Core Panel Systems**

- **Other Sandwich Panel Systems**
  - **Fibre cement board**
  - **MgO Board**
  - **AAC panels**







- **Replacing brick and mortar walls with dry customized walls made in factory**

SINGLE

DOUBLE

4

Prefabricated Sandwich Panel System

1	Reinforced Expanded Polystyrene sheet core Panel with sprayed concrete as wall & slab	Worldhaus
2	EPS Cement sandwich Panel: wall & slab with EPS Cement sandwich Panel to be used with RCC or Steel structural frame. Load bearing upto G+1 storey	Bhargav Infrastructure Pvt.Ltd
3	EPS Cement sandwich Panel: wall & slab with EPS Cement sandwich Panel to be used with RCC or Steel structural frame. Load bearing upto G+1 storey	Rising Japan Infra Private Limited
4	Reinforced Expanded Polystyrene sheet core Panel with sprayed concrete as wall & slab	Bau Panel Systems India Pvt Ltd,
5	Reinforced Expanded Polystyrene sheet core Panel with sprayed concrete as wall & slab	BK Chemtech Engineering
6	Reinforced Expanded Polystyrene sheet core Panel with sprayed concrete as wall & slab	MSN Construction
7	Reinforced Expanded Polystyrene sheet core Panel with sprayed concrete as wall & slab	Beardshell Ltd.
8	Pre-fab PIR (Poly-isocyanurate) based Dry Wall Panel System" as non-load bearing wall	Covestro India Pvt. Ltd.,
9	Sandwich panels as wall & slab	Project Etopia Group

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.

Rising EPS (Beads) Cement Panels

- Rising EPS (Beads) Cement Panels are patented panels from M/s Rising Japan Infra Pvt. Ltd. These are lightweight composite wall, floor and roof sandwich panels made of thin fiber cement/calcium silicate board as outer and inner faces with a core of EPS granule balls, adhesive, cement, sand, fly ash 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 framed structure.
- These panels were manufactured by the firm in China and now two plants at Nagpur & Pune are operational in India.

MONOLITHIC CONCRETE CONSTRUCTION

- Replacing cast-in-situ Formwork with factory made customized formwork systems
- Formwork material is Aluminium / composites / steel having 100 to 500 repetitions
- Assembly line construction i.e. placing the formwork, pouring the concrete, moving the formwork to upper level

5

Monolithic Concrete Construction

1	Aluminium formwork system for Monolithic Concrete construction	Maini Scaffold Systems
2	Aluminium formwork system for Monolithic Concrete construction	KumkangKind India Pvt. Ltd
3	Aluminium formwork system for Monolithic Concrete construction	S-form India Pvt. Ltd.,
4	Aluminium formwork system for Monolithic Concrete construction	ATS Infrastructure Ltd.
5	Aluminium formwork system for Monolithic Concrete construction	Innovative housing & Infrastructure Pvt. Ltd
6	Aluminium formwork system for Monolithic Concrete construction	MFS formwork Systems Pvt. Ltd.
7	Aluminium formwork system for Monolithic Concrete construction	Knest Manufacturers LLP
8	'Tunnel form' construction technology, an cast in situ RCC system, based on the use of high-precision, re- usable, room-sized, steel forms or moulds for monolithic concrete construction	Outinord Formworks Pvt. Ltd.
9	Aluminium formwork system for Monolithic Concrete construction	Brilliant Etoile

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.

Modular Tunnel form

- Tunnel formwork is a mechanized system for cellular structures. It is based on two half shells which are placed together to form a room or cell. Several cells make an apartment. With tunnel forms, walls and slab are cast in a single day.
- The formwork is set up for the day's pour in the morning. The reinforcement and services are positioned and concrete is poured in the afternoon. Once reinforcement is placed, concrete for walls and Slabs shall be poured in one single operation. The formwork is stripped the early morning and positioned for the subsequent phase.
- Here the walls and slabs are cast in a form of a tunnel leaving two sides open whereas in monolithic concrete construction the entire room is cast in a single pour..

STAY-IN-PLACE FORMWORK SYSTEM

- Replacing cast-in-situ Formwork with factory made formwork systems
- It is sacrificial formwork or lost formwork means formwork is left in the structural system to later act as insulation or reinforcement cage

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6

Stay In Place Formwork System

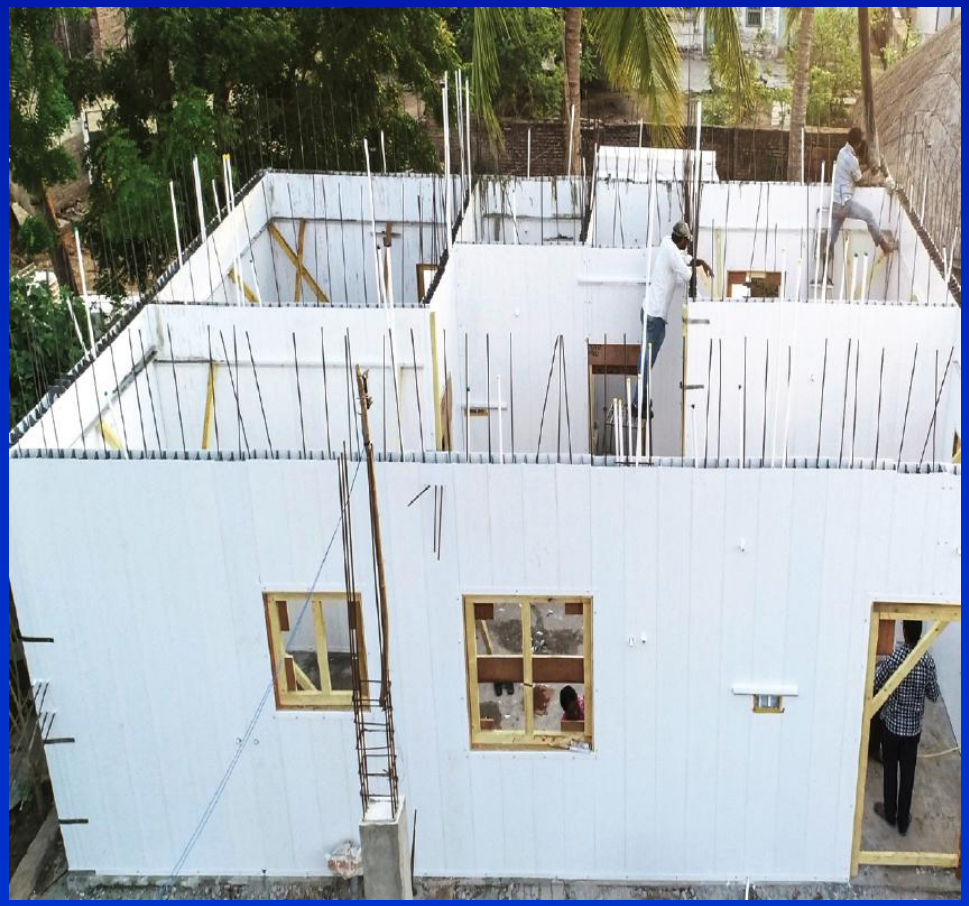
1	Expanded-Steel Panel reinforced with all- galvanised Steel Wire-Struts serving both as the load- bearing steel structure and as the stay-in-place steel formwork filled with EPS-alleviated concrete	JK Structure
2	Factory made prefab Glass fibre reinforced Gypsum cage panels suitable for wall & slab with reinforcement & concrete as infill as per the requirement	FACT-RCF Building Products Limited
3	Structural Stay In Place Galvanized Steel formwork system for walling with the same bottom single layer formwork for slabs/ in-situ slab	Coffor Construction Technology Pvt.Ltd
4	Factory produced PVC Stay in place formwork with concrete & reinforcement in walling units with cast in-situ RCC Slab	Novel Assembler
5	Fully load bearing walls with 150 mm monolithic concrete core sandwiched inside two layers of EPS as walling The forms are open ended hollow polystyrene interlocking blocks which fits together to form shuttering system	Reliable Insupack
6	Ready to use Stay in place polymer formwork, light weight, with flooring slab (combination of ferro cement and natural stone) placed on RCC precast joists)	Kalzen Realty Pvt. Ltd
7	Fast Bloc, Insulated Concrete Form (ICF), acts as formwork for concrete and rebar, Co1oumn/post and beam construction, creating an strong skeleton in the walls.	Fastbloc Building Systems
8	Formwork system "Plaswall with Two fibre cement boards (FCB) & HIMI (High Impact Molded Inserts) bonded between two sheets of FCB in situ and erected to produce a straight-to-finish wall with in-situ concrete	FTS Buildtech Pvt.Ltd

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

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

Stay-In-Place PVC Wall Forms

- This is a prefinished wall formwork from M/s Novel Assembler Pvt. Ltd. comprising of rigid Poly-Vinyl Chloride (PVC) based polymer components that 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.
- The hollow Novel Wall components are erected and filled with concrete, in situ, to provide a monolithic concrete wall.

Adoption of New Technologies by States

AHP houses in Pune, Maharashtra using Precast Construction Technology

- Around **16 Lakh houses** are being built using innovative technologies under PMAY(U) & other state schemes.

State	Technology
Andhra Pradesh	EPS, Monolithic and Steel Technology
Chhattisgarh	Monolithic and Precast Technology
Gujarat	Monolithic, Precast (Waffle-crete)
Kerala	Glass Fibre Reinforced Gypsum (GFRG)
Maharashtra	Precast (3S) & Monolithic Technology
Odisha	Precast concrete construction
Jharkhand	Global Tender floated
Tamil Nadu	Precast Concrete Technology
States like Assam, Karnataka, Madhya Pradesh, Telangana & Uttarakhand have also expressed interest in Technology neutral bidding process	

54

Alternate technologies Identified

54

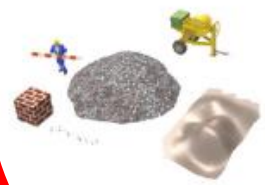
technologies approved by CPWD

29

SoRs issued for alternate technologies by CPWD (22+7)

Looking Back / Rear view

Levels of Construction Technology

Level 0	Level 1	Level 2	Level 3	Level 4
				
MATERIAL	COMPONENTS	ELEMENTAL OR PLANAR SYSTEMS	VOLUMETRIC SYSTEM	COMPLETE BUILDING SYSTEMS
Basic materials for site-intensive construction ✓ Involves more Labour ✓ Time consuming	Manufactured components ✓ Fabricated in Factory ✓ Can't be build On-site ✓ Assist in construction speed & quality	Linear or 2D components ✓ Series of Pre fabricated elements assembled to form the shell ✓ Requires on-site work	3D components in the form of modules ✓ Volumetric, forms a completed part of the building ✓ Involves more than one trade in the factory	Modular components - fully finished and delivered to site ✓ Finished interior & exterior surfaces ✓ Less on-site work

Source: Gibb., A.G.F., *Off-site Fabrication—Pre-Assembly, Pre-Fabrication, and Modularization*

Courtesy : hoMission Abode All

Thank You

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"Creating Enabling Environment for Affordable Housing for All"

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सत्यमेव जयते

Ministry of Housing and Urban Affairs
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एक कदम स्वच्छता की ओर

LIGHT HOUSE PROJECT AT RANCHI

GHTC-India Category

Precast Concrete Construction - 3D Volumetric

Technology

3D Modular Precast Magic Pods

CONTENTS

- GHTC-India
- Six Light House Projects
- LHP at RANCHI
- Technology being used
- Structural Elements
  - Foundation
  - Structural System comprising of 3D modules, walling panels & pre-stressed slab
- Precast Concrete Construction System - 3D Precast Volumetric System (Design Basis)
- Construction Sequence
  - Foundation
  - Structural System comprising of 3D modules, walling panels & pre-stressed slab
  - Finishing
- Other Infrastructure Items

GLOBAL HOUSING TECHNOLOGY CHALLENGE INDIA

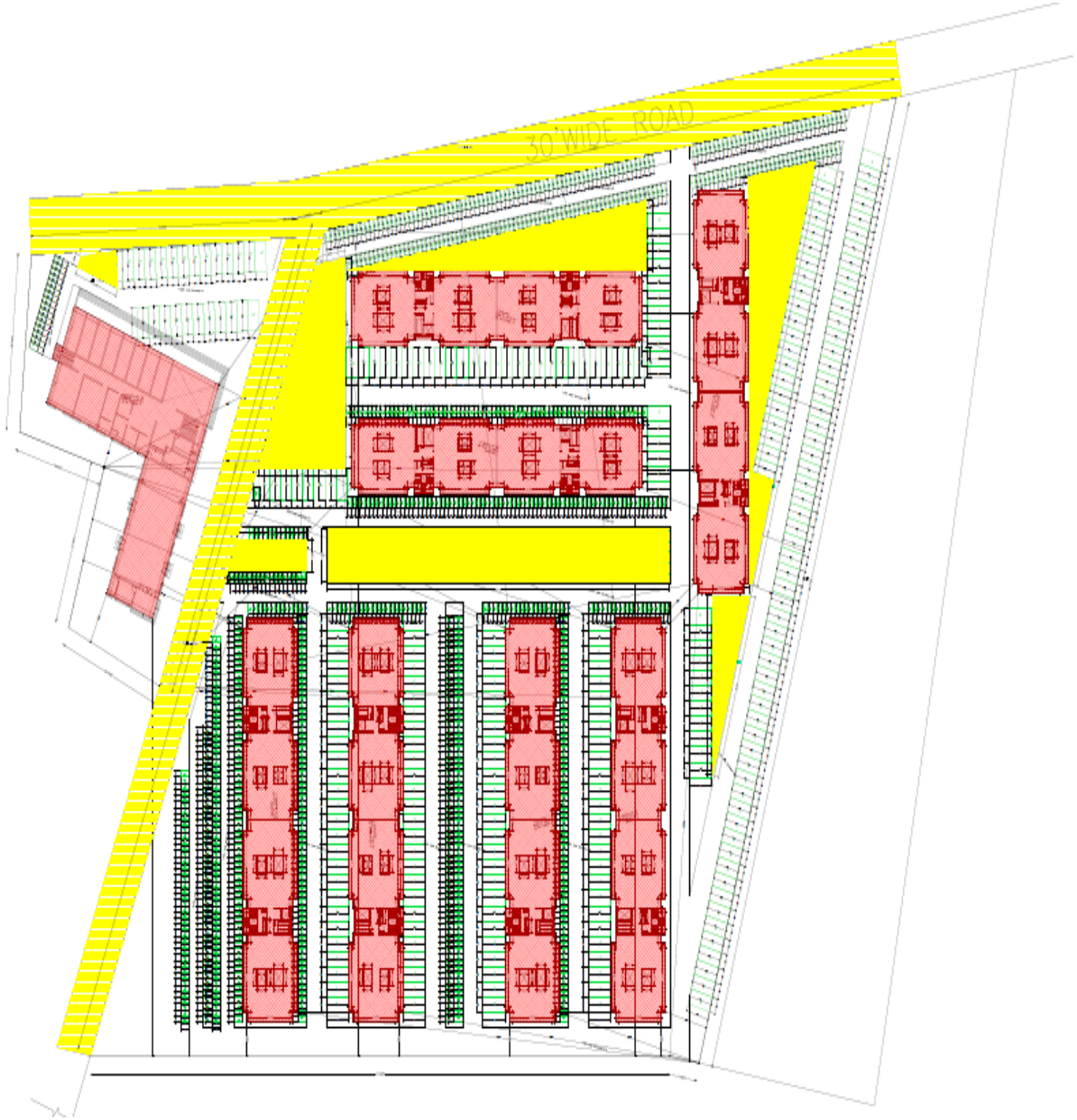
Global Housing Technology Challenge - India (GHTC-I)

Broad Category	*Technologies (Nos.)*
Precast Concrete Construction System - 3D Precast volumetric	4
Precast Concrete Construction System – Precast components assembled at site	8
Light Gauge Steel Structural System & Pre-engineered Steel Structural System	16
Prefabricated Sandwich Panel System	9
Monolithic Concrete Construction	9
Stay In Place Formwork System	8
Total	54

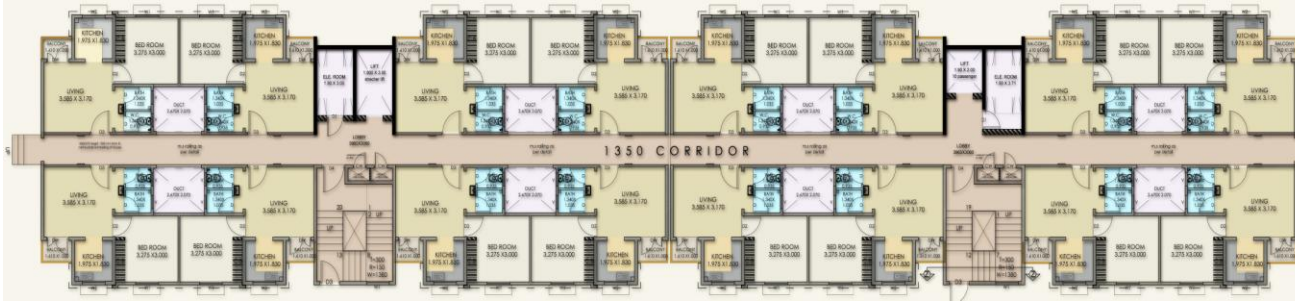
Summary of Six Light House Projects (LHPs)

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

- There are 7 blocks in Ground + 8 configuration with 1008 houses along with basic and social infrastructure.
- Ground coverage of the project is 29.3% and FAR is 2.21.
- Green space is 20%.

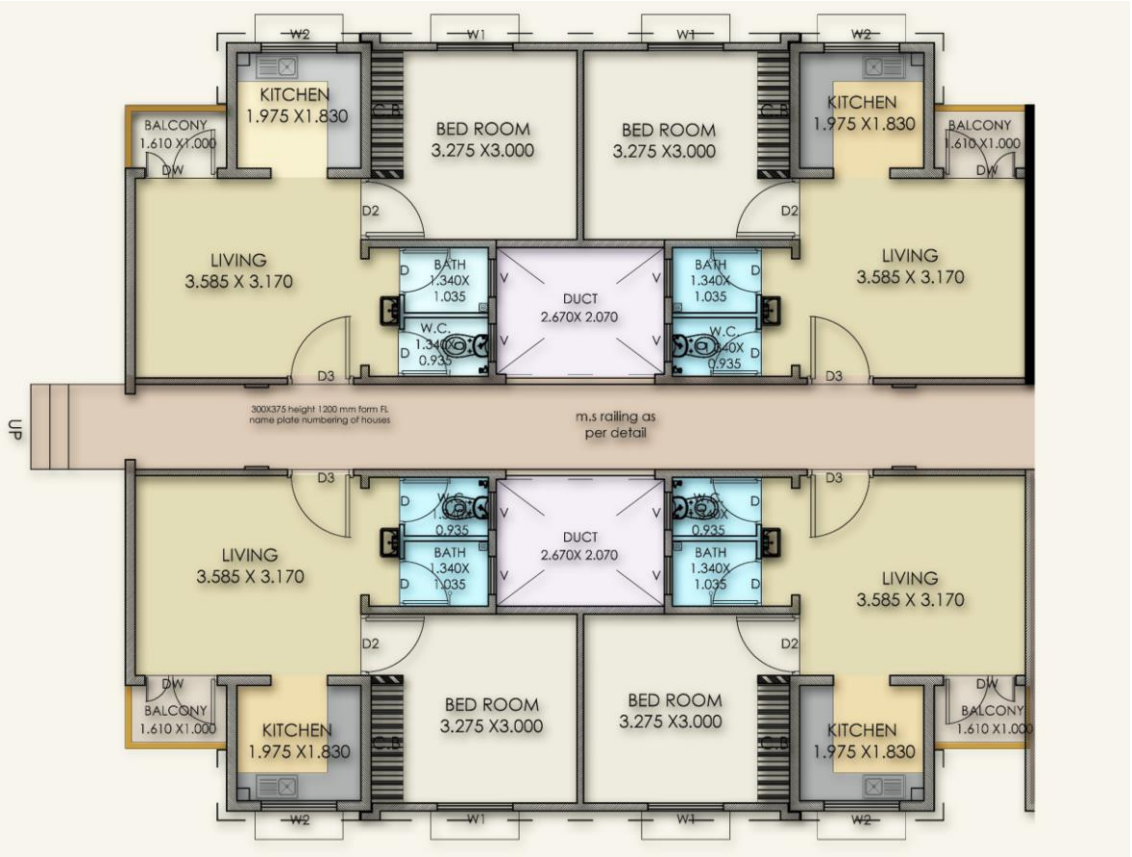


Typical floor plan



- 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 hall, one bed room, a kitchen, WC, Bath and a balcony. The carpet area of each unit is 29.85 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 System conforming to NBC

Prevalent Construction Systems → **Technology being Used**

Load bearing Structure

RCC Framed Structure

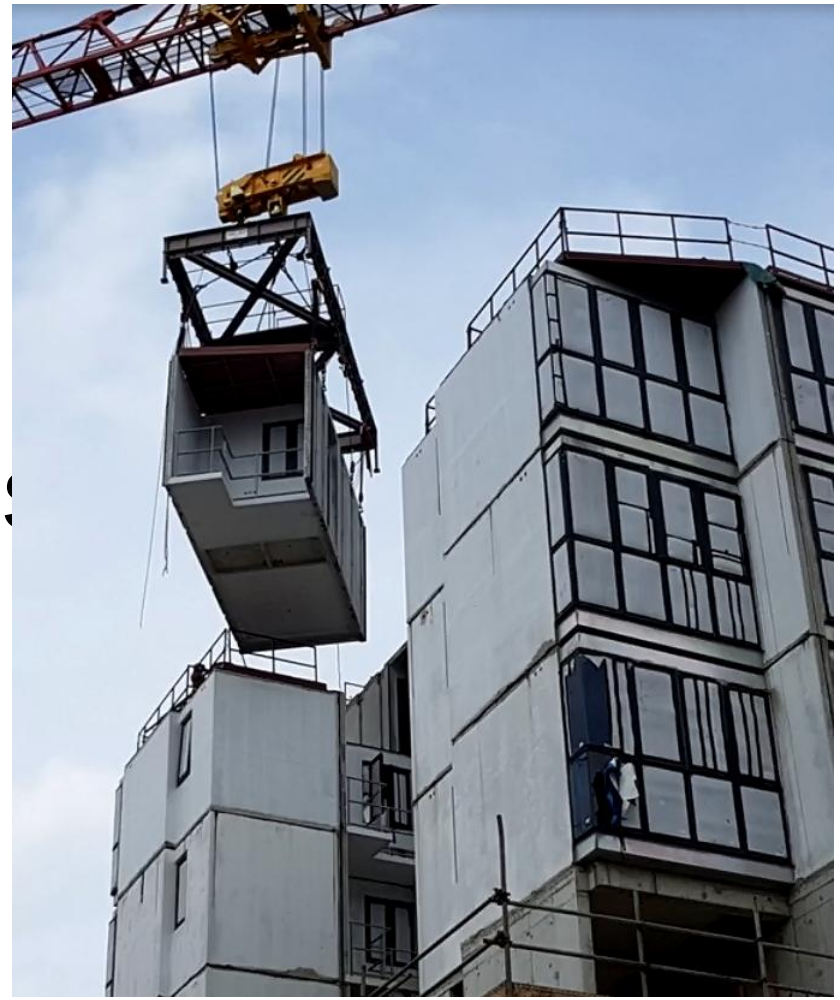
Precast Concrete Construction - 3D Volumetric

It is the modern method of building by which precast concrete structural modules like room, toilet, kitchen, bathroom, stairs etc. & any combination of these are cast monolithically in Plant or Casting yard in a controlled condition.

These Modules transported, erected & installed using cranes and are integrated together in the form of complete building unit.

Structural Elements

- Foundation
- Structural System comprising of 3D modules, walling panels & solid core pre-stressed slab



Foundation

- Conventional as per geo-technical investigations, bearing capacity, soil strata, water table, etc.
- Raft foundation with RCC shear wall upto plinth level.
- Grade slab at plinth level.

Structural system

Manufacturing of structural modules

- 3D Steel Moulds are created as suiting to various sizes of Building units (Pods).
- High strength steel as per the structural design is placed inside 3D moulds.
- Electrical and plumbing lines are set up. Block outs for doors and windows are also set up at the same time.
- The pods are cast into their final shape using high-performance concrete.
- Strict quality checks are taken for each pod before they are transported for erection and assembly at the site.

Casting Yard at Site

Casting Yard at Site

Casting Yard at Site

Advantages of the System

- Upto 90% of the building work including finishing is complete in plant/casting yard leading to significant reduction in construction & occupancy time
- The controlled factory environment brings resource optimization, improved quality, precision & finish
- The required concrete can be designed using industrial by-products such as Fly Ash, Ground granulated blast furnace slag (GGBS), Micro silica etc. resulting in improved workability & durability, while also conserving natural resources. In this project Portland slag cement is being used in concrete.
- With smooth surface it eliminates use of plaster
- The monolithic casting of walls & floor of a building module reduces the chances of leakage
- The system has minimal material wastage (saving in material cost), helps in keeping neat & clean construction site and dust free environment
- Use of optimum quantity of water through recycling
- Use of shuttering & scaffolding materials is minimal
- All weather construction & better site organization

Essential requirements

- Space for casting yard is required in addition to site for actual construction. The project is not viable if the factory is located far away. Setting up of casting yard requires time in month/(s) depending on project size & delivery schedule
- Approach road to site for movement of high capacity trailers, Cranes etc.
- Site should have space for proper leveraging & functioning of cranes
- Requires skilled labour & strict supervision
- Plumbing & electrical services need to be pre-planned

Being first time mass scale field implementation of new technology the Light House Project at Ranchi is on

Design & Build Basis

Agency:

M/s SGC Magicrete LLP, Mumbai

Technology Provider:

M/s Magicrete Building Solutions

Design Basis

- Structural System
  - Sub-structure up to the plinth level in Cast In-situ RCC (Raft foundation with Shear wall upto Plinth level)
  - Superstructure is designed as Shear wall system
- Safe Bearing capacity: 180 KN/m^2, depth of foundation 2.0 m
- Raft foundation as per IS:2950 (Part-1)-1981 (reaffirmed 2008)
- Wind speed: Basic wind speed (V_b=39 m/sec)
- Design wind speed:

$$V_z=V_b.k_1.k_2.k_3.k_4$$

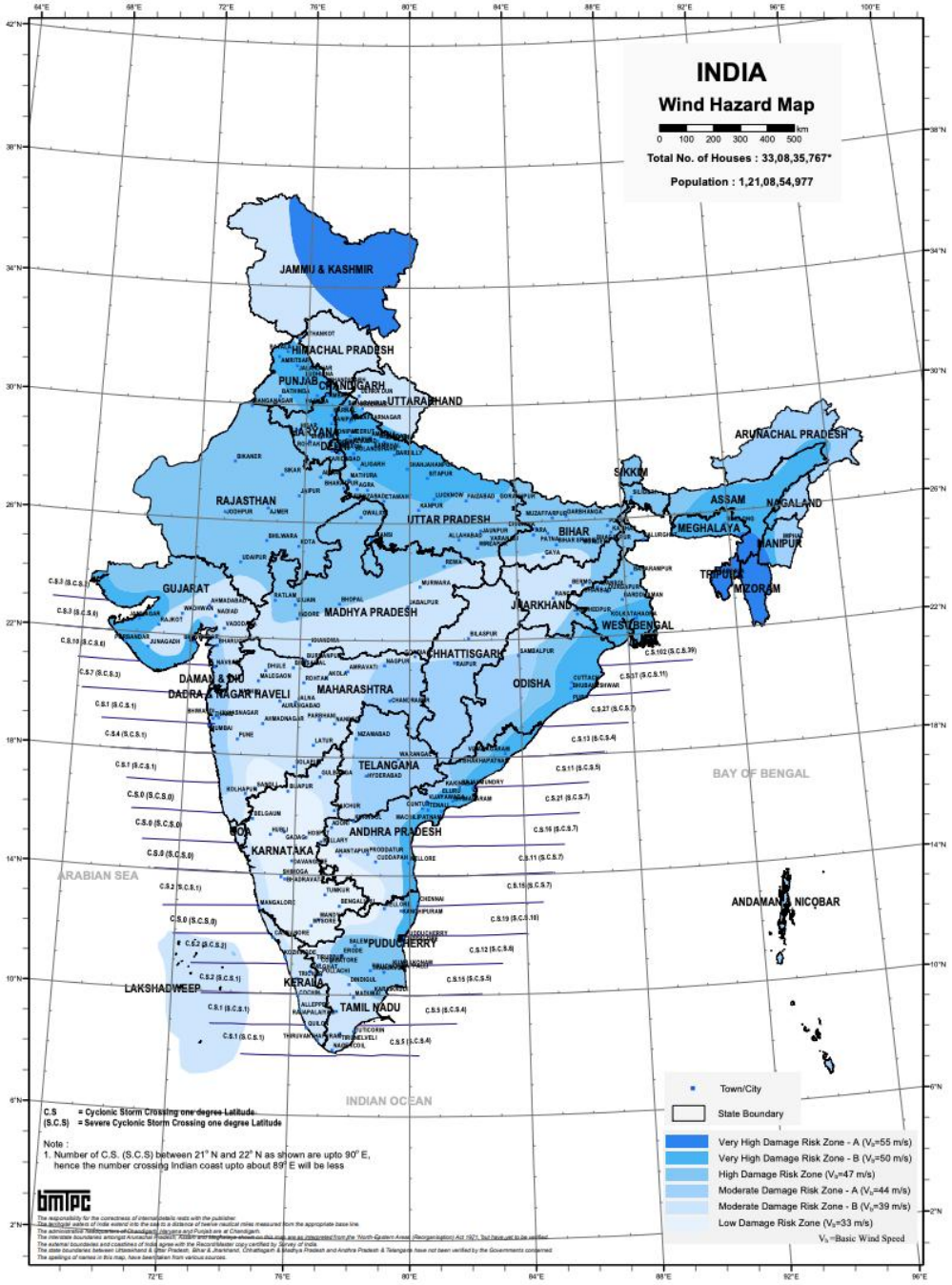
k_1 (Risk Coefficient)=1

k_2 (Size factor)=as per height

k_3 (topography factor)=1

k_4 (importance factor)=1

- Wind Pressure (P_z) = 0.6.Vz^2
- Wind pressure is converted into design wind pressure and then distributed at each storey as wind force.



Design Basis

- Earthquake : Zone-II as per Seismic Zoning Map of India IS: 1893 (Part-1):2016
  - Designed as shear wall system with Response Reduction Factor=3 (Table-9 iv of IS: 1893 (Part-1):2016), Z=0.1,I=1.2, R=3, Damping Ratio=5%.
  - Design Horizontal Seismic Coefficient (A_h)

$$A_h=(Z/2).(S_a/g).(I/R)$$

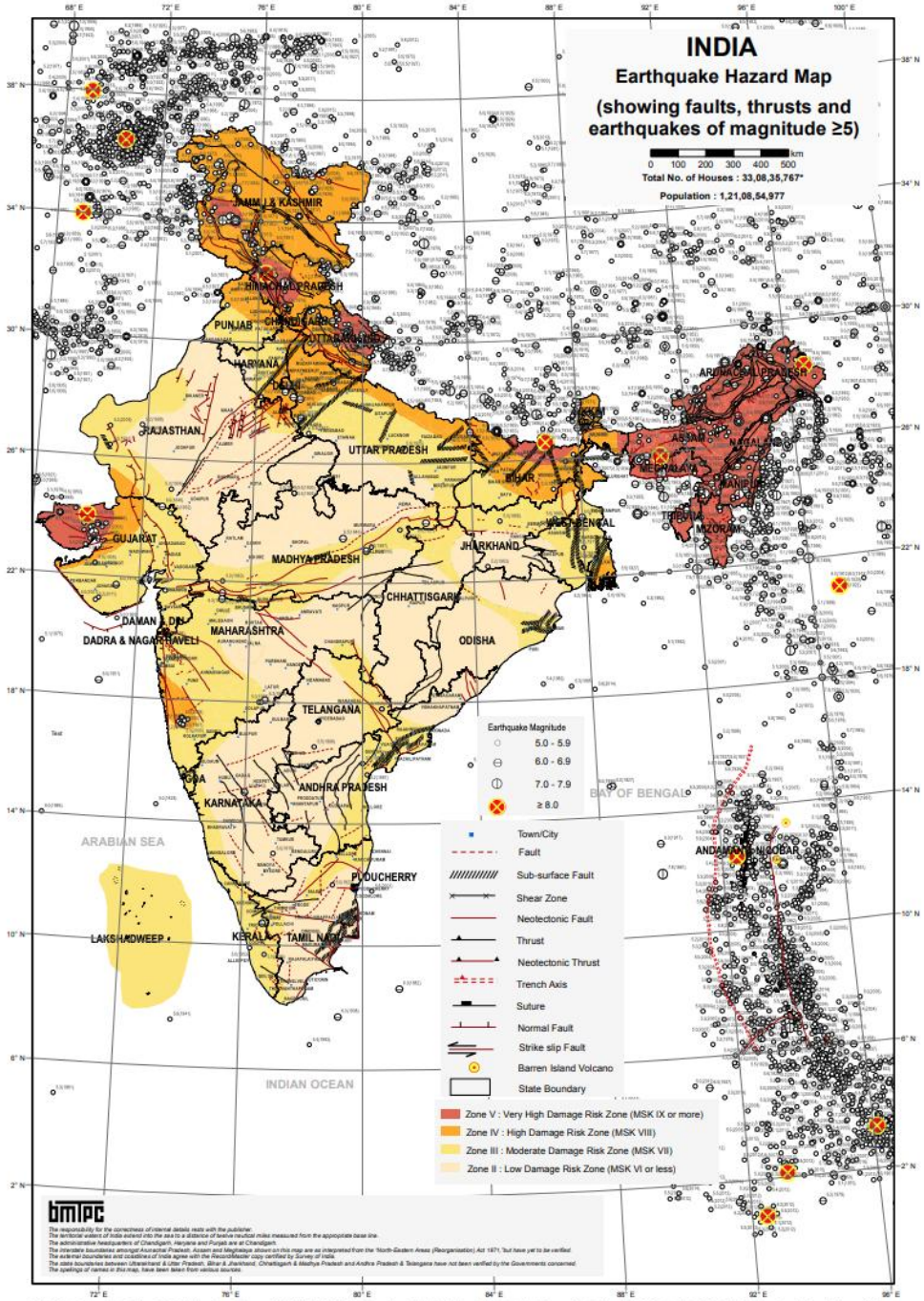
S_a/g is design acceleration coefficient for different soil types corresponding to natural period (T) of building

  - Design Lateral Force (V_B)

$$V_B=A_h.W$$

W is seismic weight of building

- Precast slabs have rebar lattice girders projecting above precast surface. Whenever, two or more panels are forming one slab of a room, such panels have in-situ topping of reinforced concrete laid over slab after erection and the thickness of such screed is as recommended in IS: 1893 / IS: 13920 there by making them “composite”. Staircase is also of precast RCC.
- Design has been carried out as per IS 456-2000 and NBC-2016.

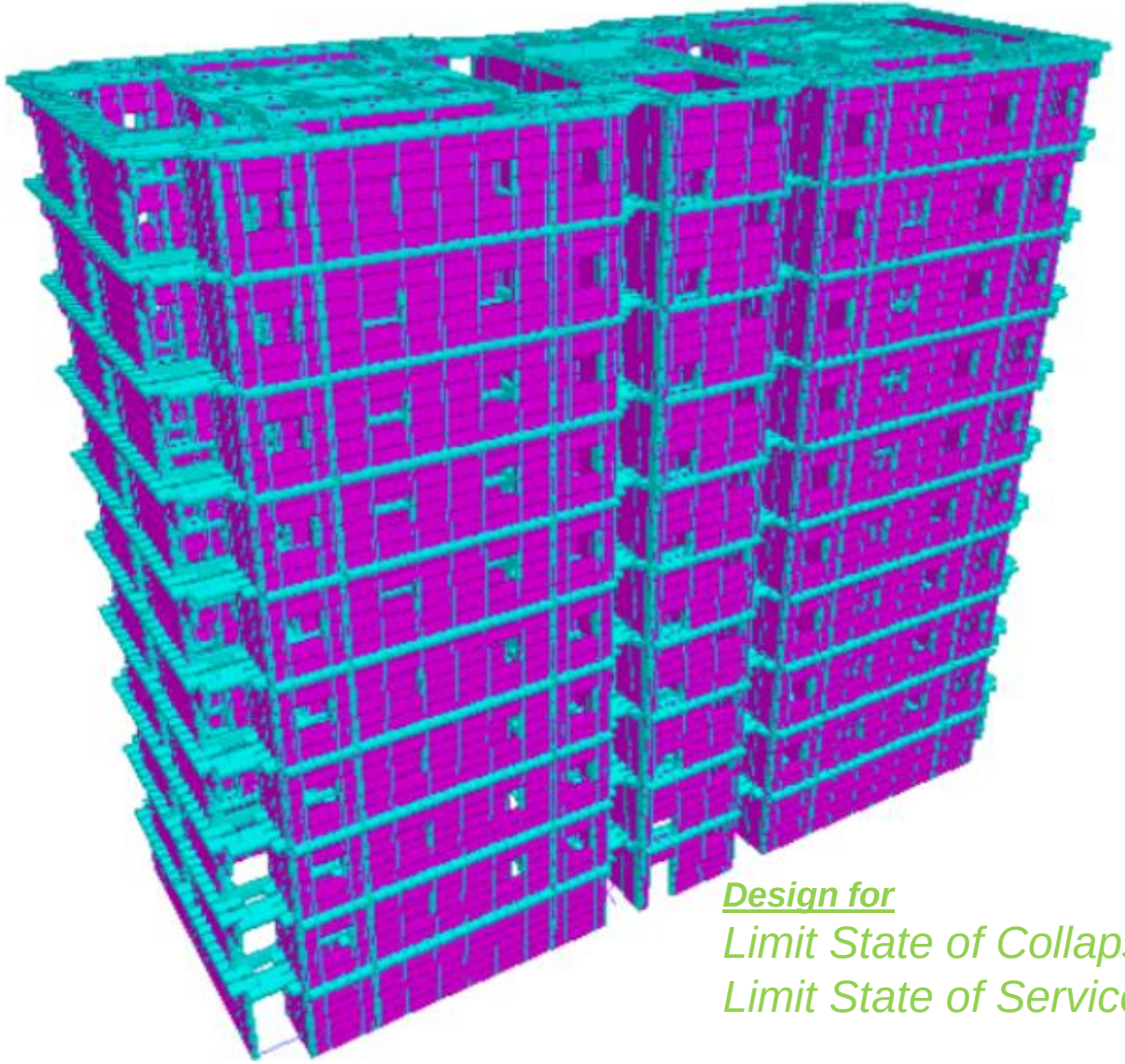


STRUCTURAL ANALYSIS & DESIGN

- 3D Model of typical tower

- Load Combinations :
  - 1.5 (DL+LL)
  - 1.2 (DL+LL±EL/WL)
  - 1.5 (DL±EL/WL)
  - 0.9DL ±1.5EL/WL

(EL/WL implies Earthquake/Wind Load in +X, -X, +Y, and –Y, directions . Lateral forces shall be considered acting from all directions but one at a time.)



- The structural system can be easily modeled in the CAD software such as STAADPRO, ETABS, SAFE, SAP, ABACUS and others for detailed structural analysis.
- 2D/ 3D Static and dynamic linear and non-linear analysis can be carried out using these software.
- The software can also be used for structural design as per Indian Standards.
- AUTOCAD for drawings

Design for

Limit State of Collapse

Limit State of Serviceability

Construction Sequence

- Sub-Structure: Foundation
- Super-structure: Structural System comprising of 3D modules, walling panels & solid core pre-stressed slab
- MEP: Plumbing & Electrical
- Finishing

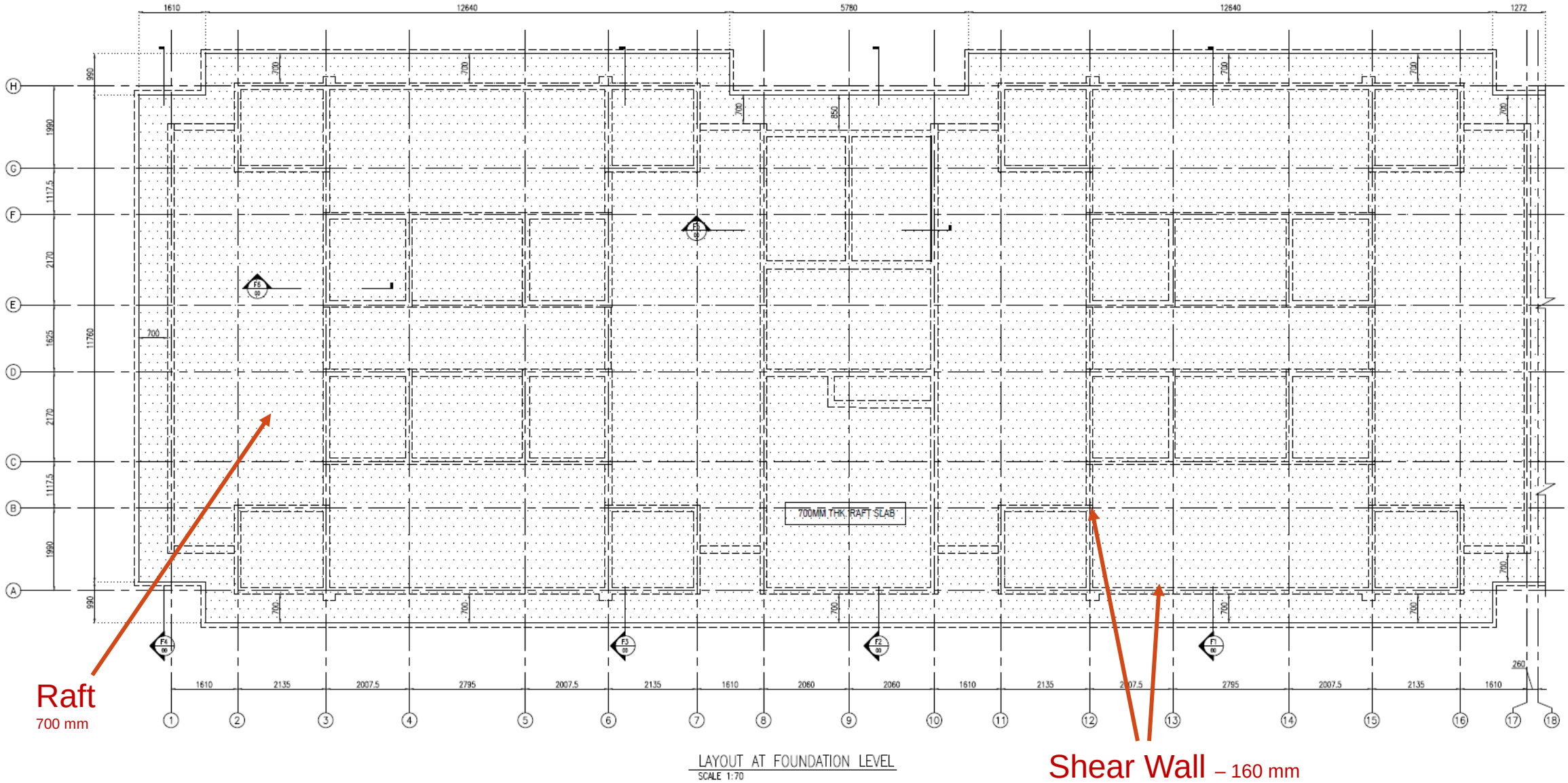
Construction Sequence

Construction sequence in the project;

- Making the designed foundation of the building ready, while manufacturing of precast concrete structural modules are taking place at the factory.
- Factory finished building units/modules are installed at the site with the help of tower cranes.
- Gable end walls are positioned to terminate the sides of building.
- Pre stressed slabs are installed as flooring elements.
- Rebar mesh is finally placed for structural screed thereby connecting all the elements together. Consecutive floors are built in similar manner to complete the structure.

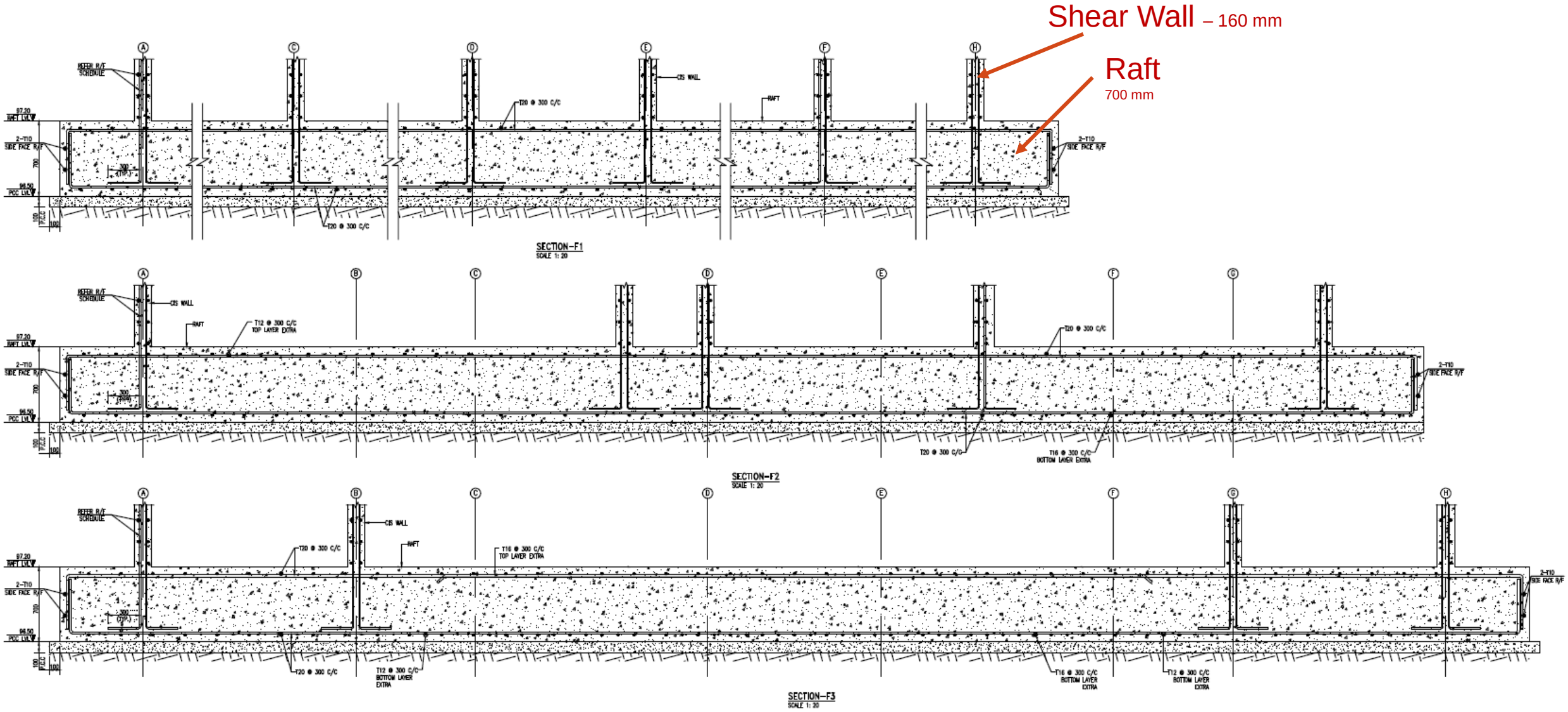
FOUNDATION

Structural Drawings



FOUNDATION

Structural Drawings



Concrete & Reinforcement Steel Specifications

Item	Concrete Grade
Raft foundation, Precast Shear wall, Precast Partition walls (Non-Load bearing)	M30
Precast Pre-stressed solid slab	M50
Structural Screed	M35

- Mix design for concrete and all Concrete work shall conform to IS 456-2000 & Liquid retaining structures shall conform to IS 3370:2009
- All Super structure precast walls, Reinforcement Steels are to be HYSD/TMT bars of Fe 500 as per IS 1786-2008.
- Flooring Pre-stressed solid slabs: fpu = 1860 N/mm^2
- Structural Screed: Fe 500 of wire mesh

Concrete mix design

Cement Name	Conc. Grade	Water (kg)	Cement (kg)	W/C Ratio	Fine Aggregates (kg)	Coarse Aggregate (kg)		Admixture(kg)	Yield (kg per cubic metre)
						10 mm	20 mm		
Portland Slag Cement	M-30	136	390	0.35	658	644	644	1.56	2473

28 days Target Strength: M30 38.25 Mpa

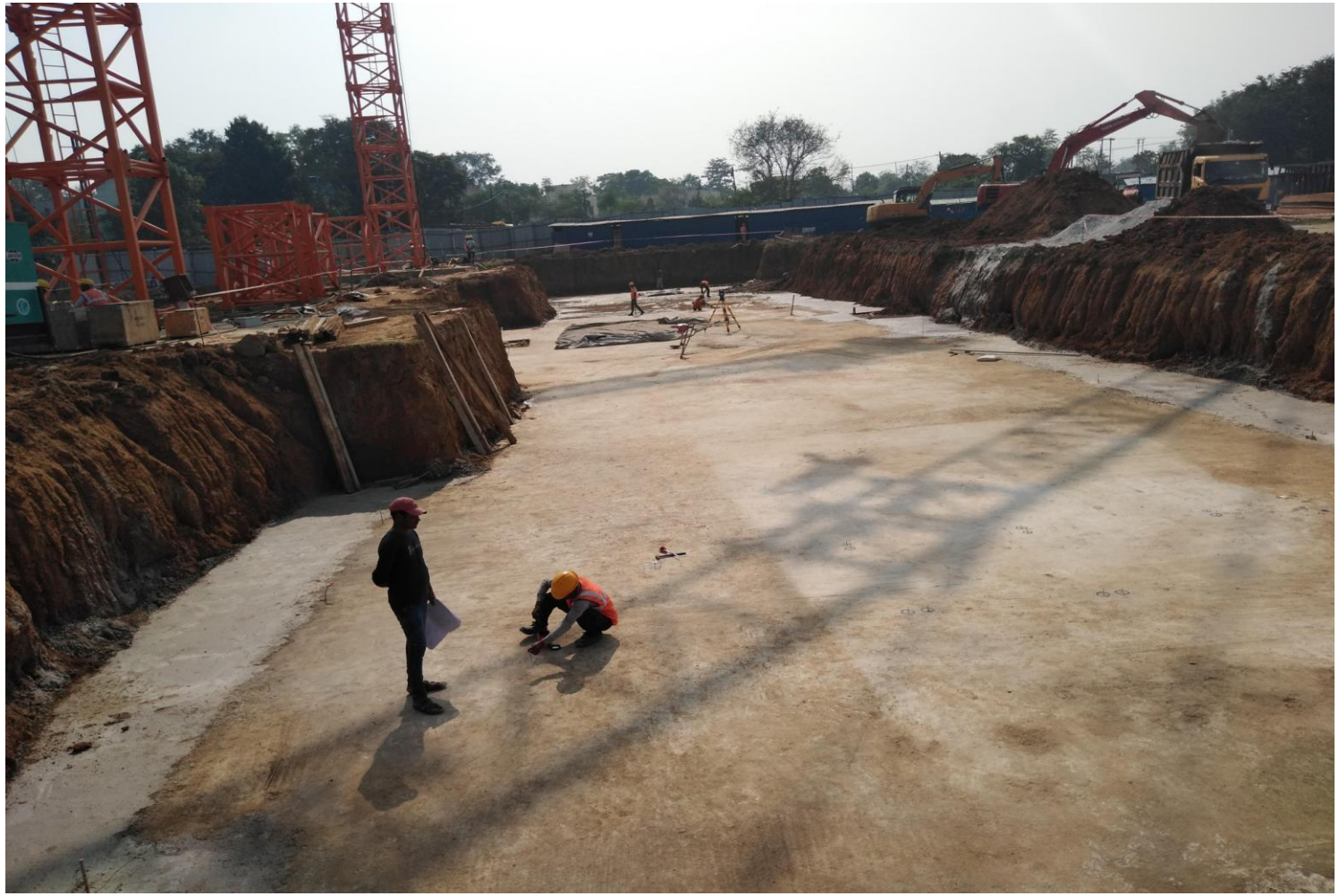
Design Slump range for the above mix: 100 mm

Portland slag cement has been used in the design mix of the Concrete, making the concrete **green and sustainable,** by conserving natural resources i.e. lime stone.

Batching Plant

To bring resource efficiency, optimization of building materials and for quality control, a computerized batching plant has been established at site.

FOUNDATION



- The project starts with layout and excavation.
- After the layout at site, the excavation of each block is done using mechanical excavators up to the required depth of foundation which is 2.0 m for blocks.

FOUNDATION

- The foundation work starts with the PCC of 100 mm thickness (M10 Grade)

FOUNDATION

- Reinforcement and shuttering for raft foundation

FOUNDATION

- All building blocks have Raft foundation with 700 mm thick M-30 Concrete.

FOUNDATION

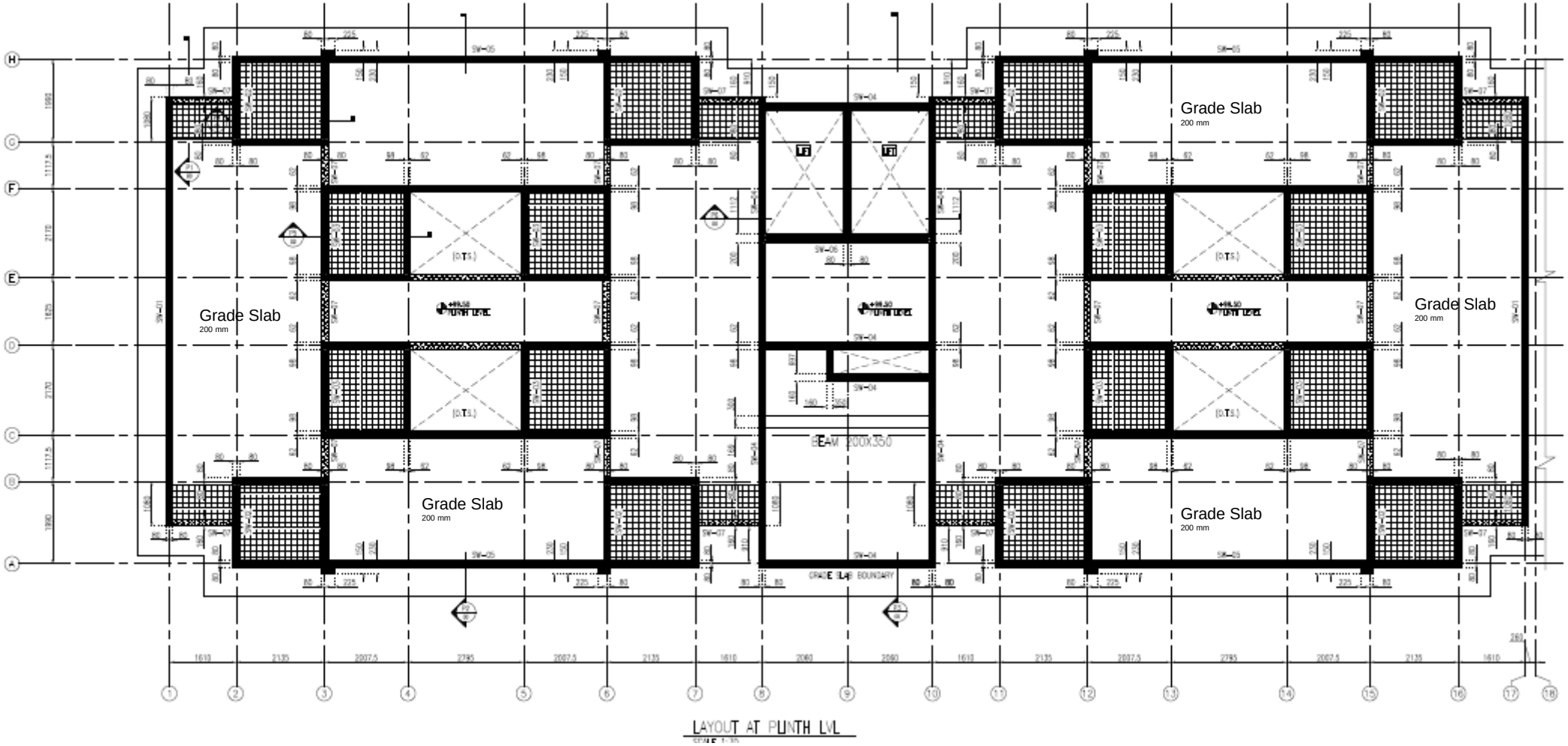
- Shear wall of M30 Grade Concrete are being cast upto plinth height over already laid cured raft.

FOUNDATION

- Deshuttering from wall.

STRUCTURAL SYSTEM

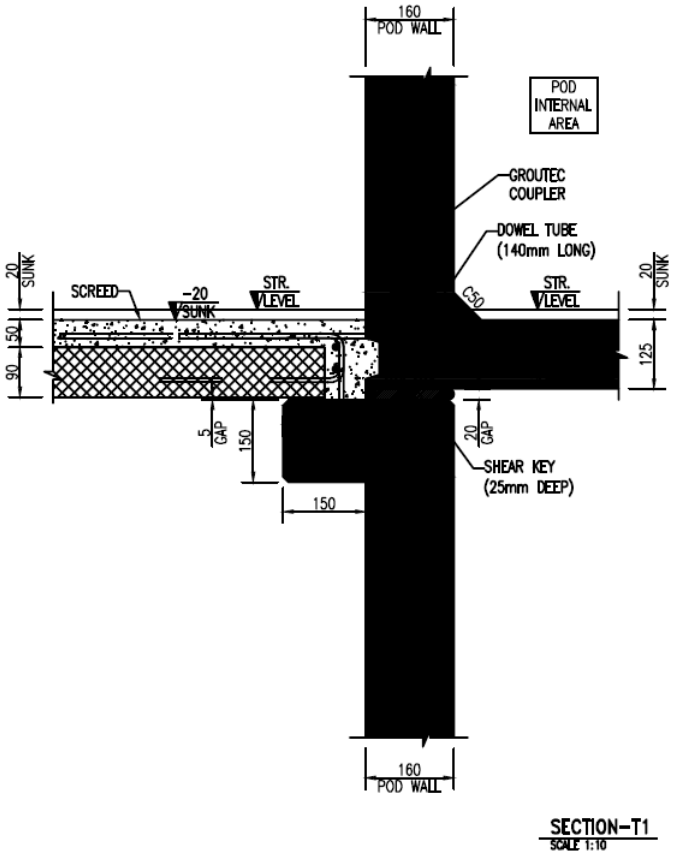
- Structural Plans and Connections

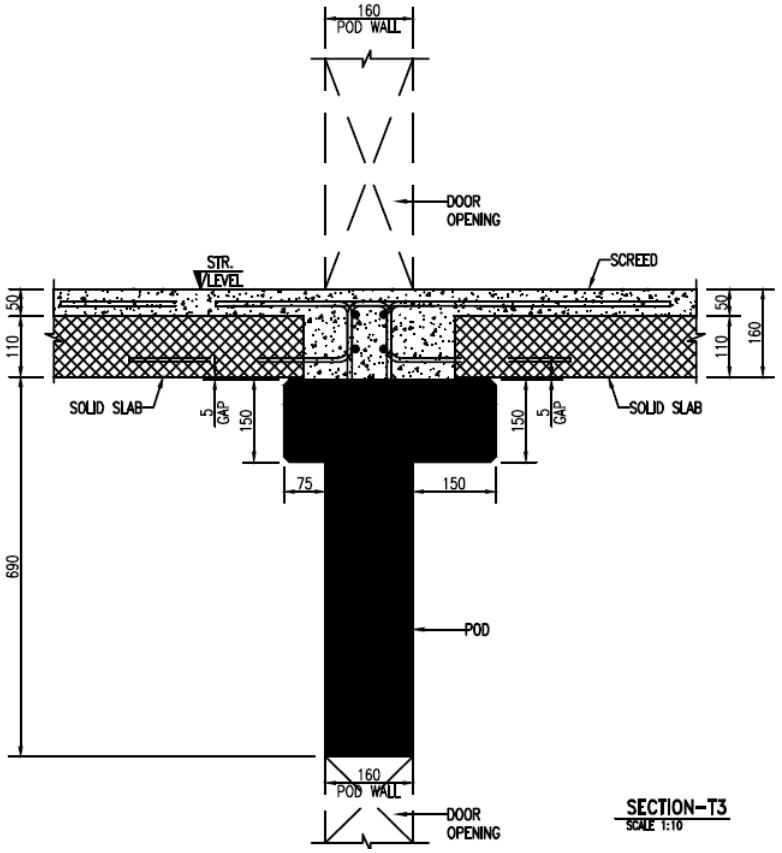


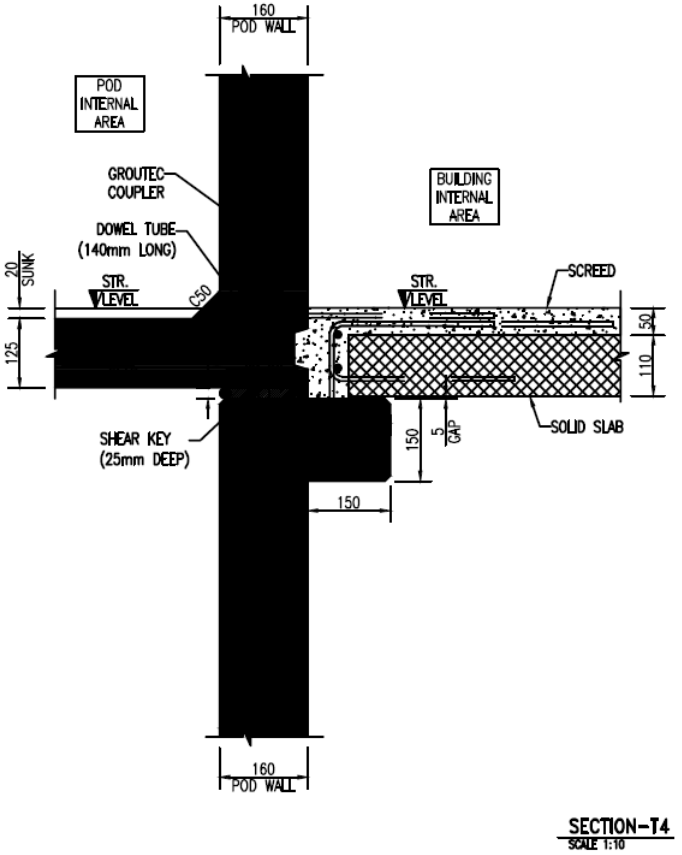
Plinth level Framing Plan

STRUCTURAL SYSTEM

- Typical Connection Details

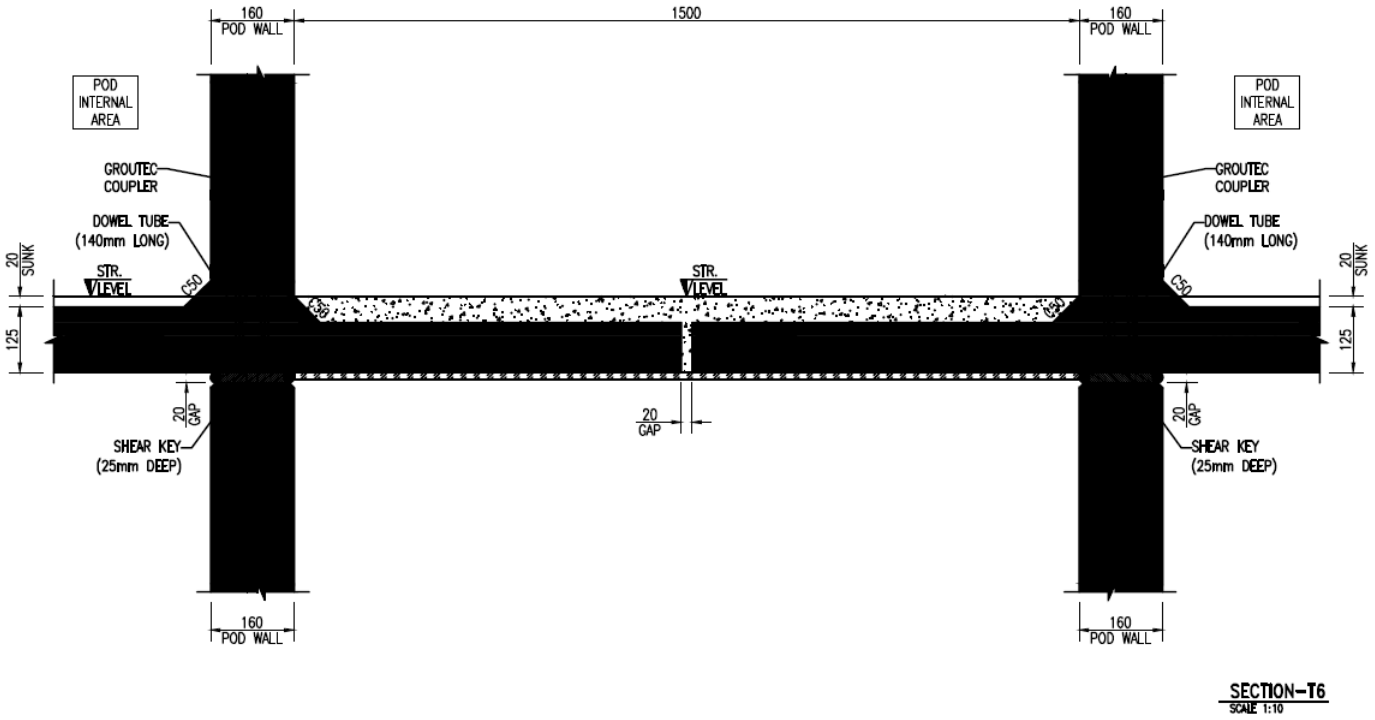


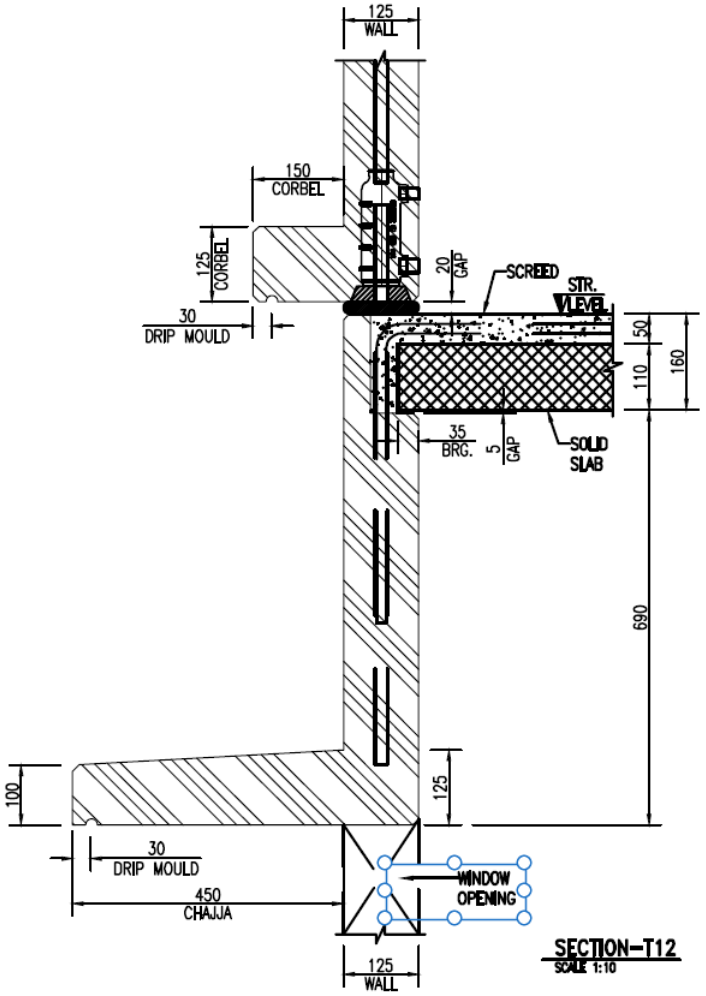




STRUCTURAL SYSTEM

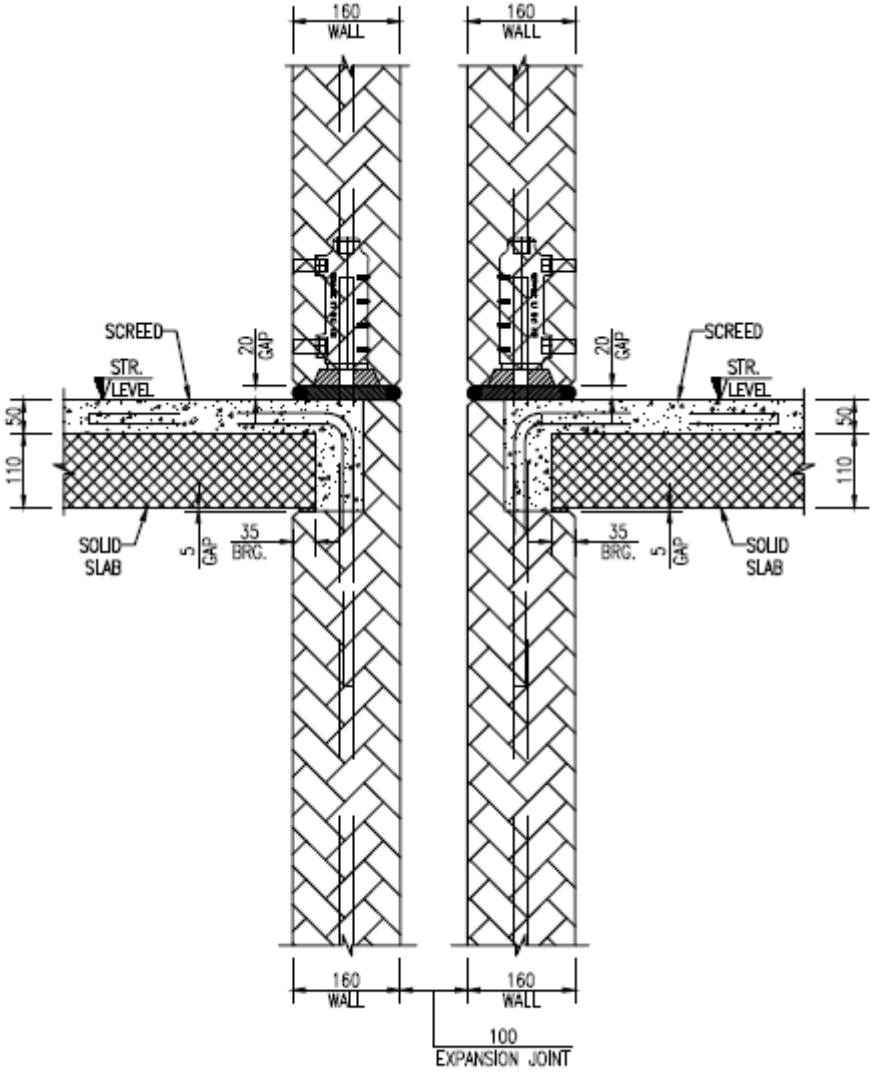
- Typical Connection Details



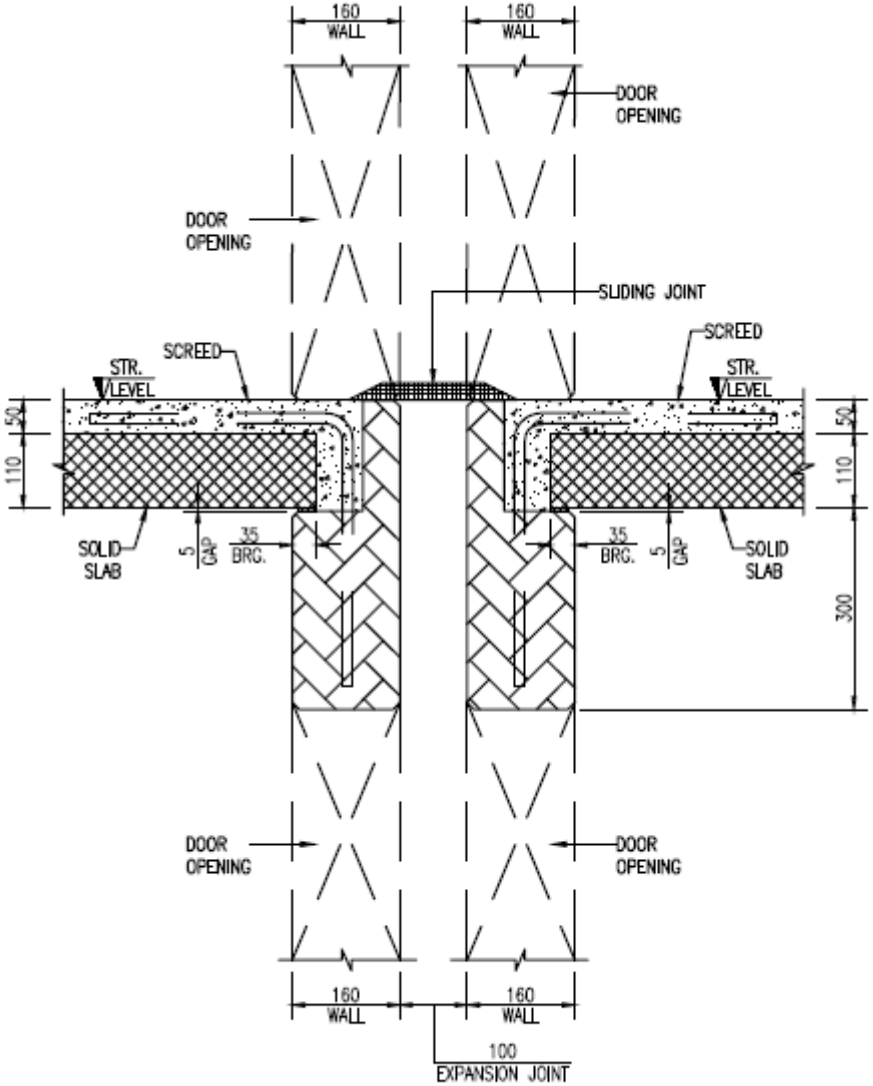


STRUCTURAL SYSTEM

- Typical Connection Details

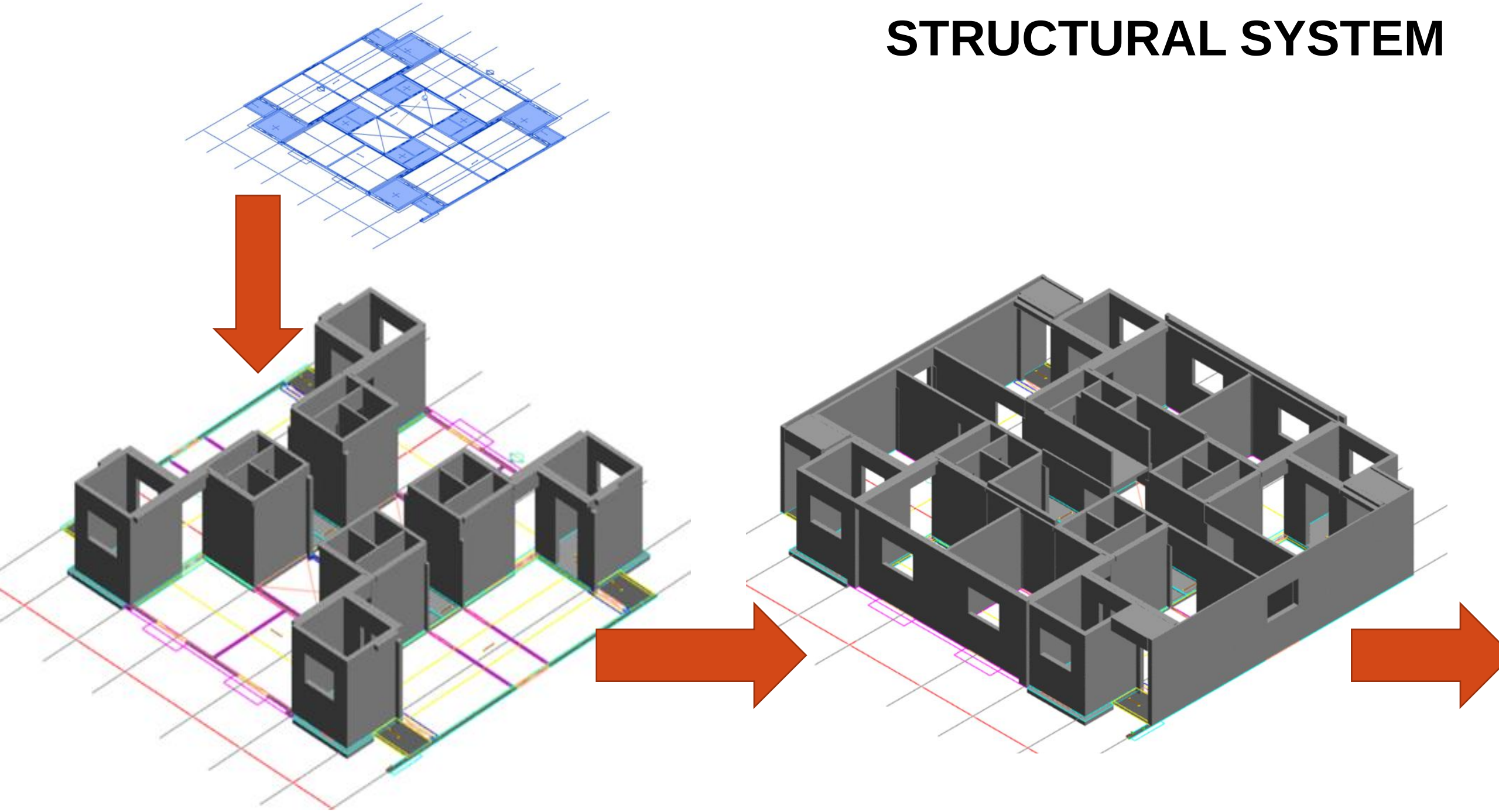


SECTION-T14
SCALE 1:10



SECTION-T15
SCALE 1:10

STRUCTURAL SYSTEM



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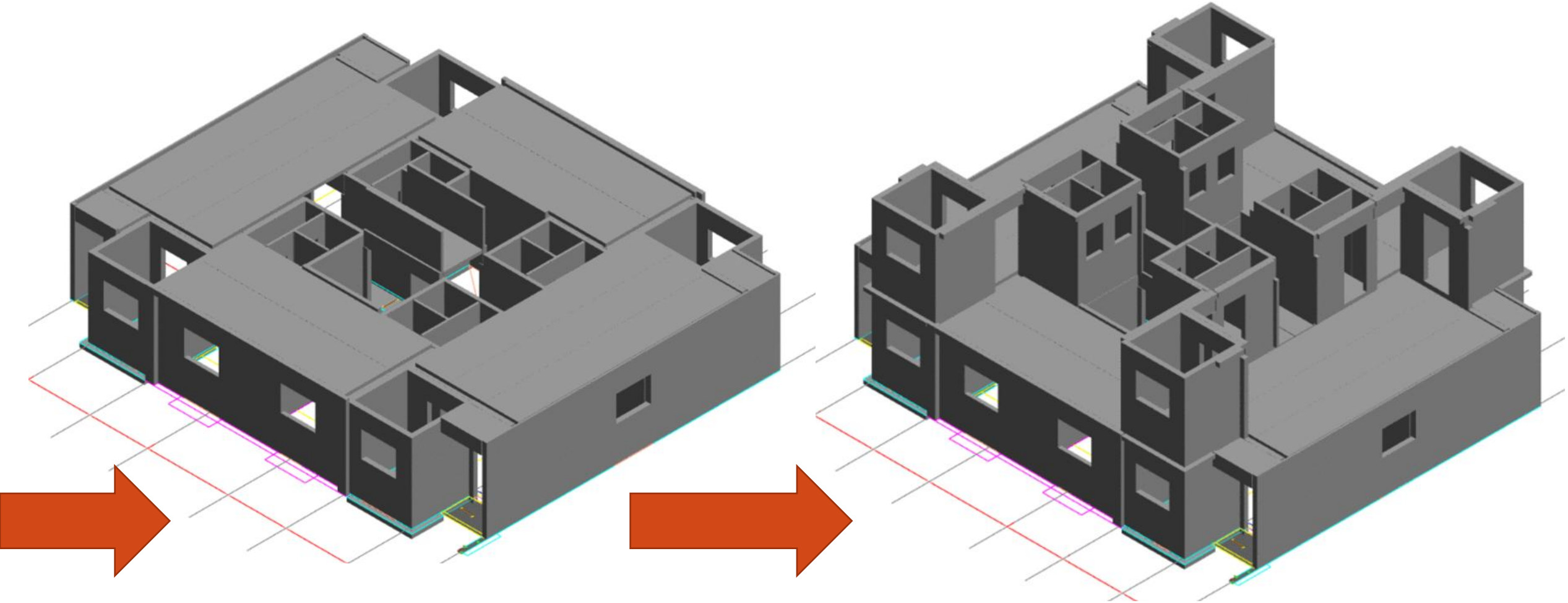

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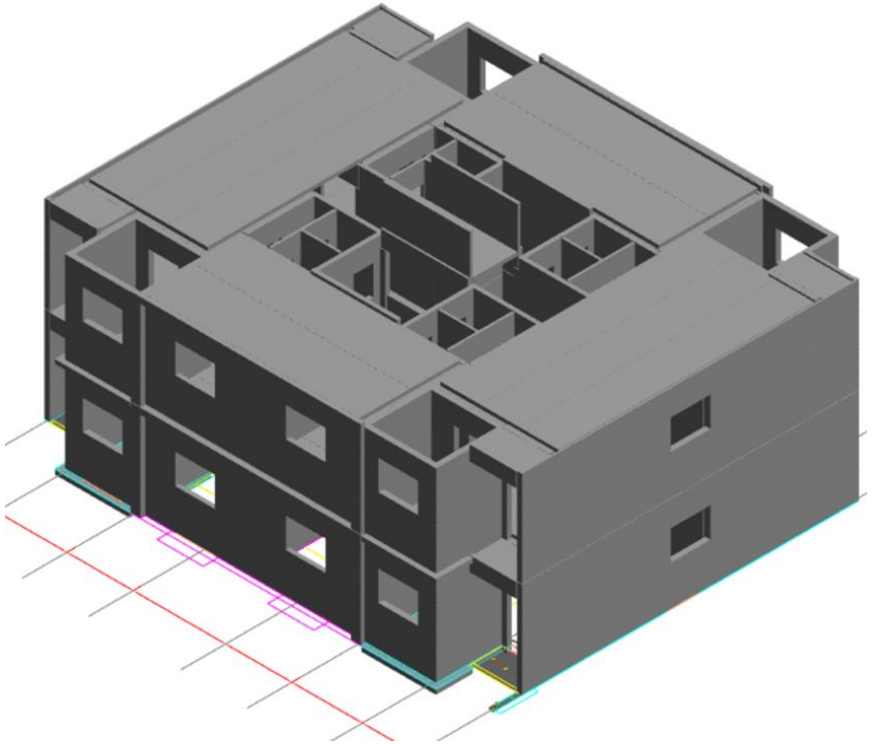

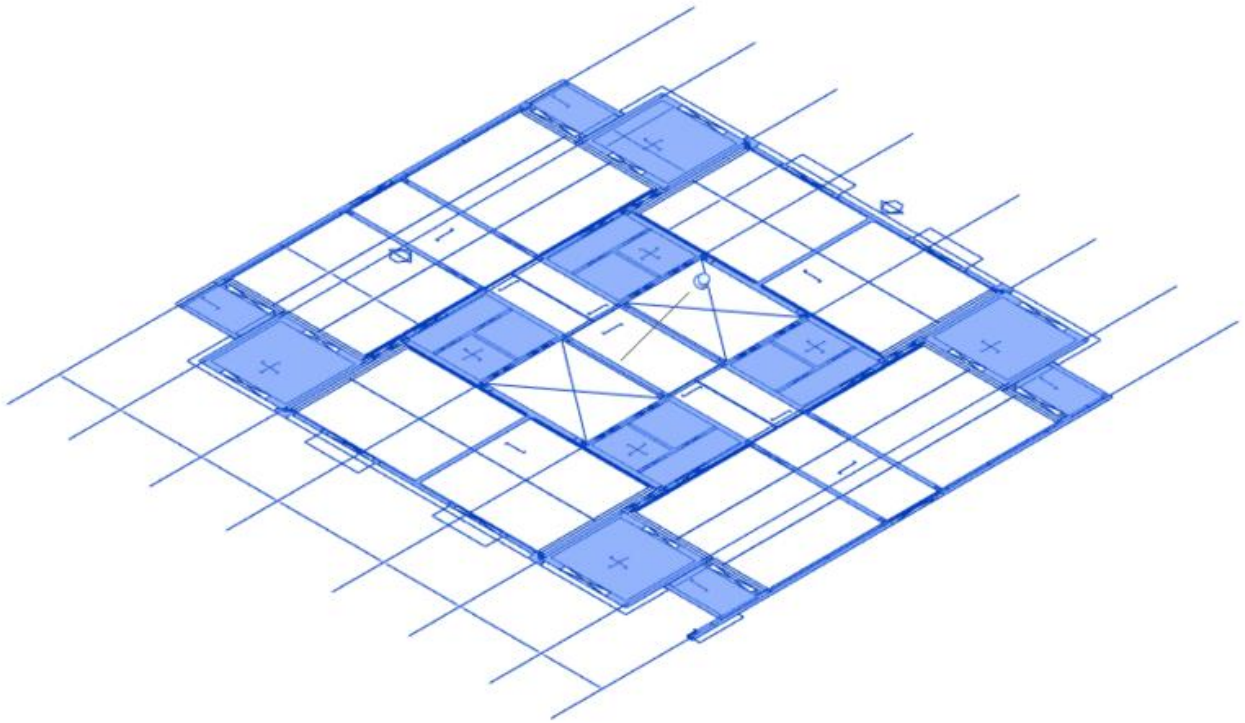

Animation

Erection

- Erection of Components

Erection

Erection

Present Status of the Project: (As on June 30, 2022)

S. No.	Building/Infra	Status
1.	Tower 1	Placement of Modules/ Components started at 2nd floor of superstructure
2.	Tower 2	Placement of Modules/Components at 1st floor level
3.	Tower 3	After completion of Grade slab, covering is going on
4.	Tower 4	50% Grade slab remains for casting
5.	Tower 5 & 6	Plinth work completed upto Grade slab
6.	Tower 7	After casting of shear wall, back filling is in Progress
7.	Boundary Wall	About 323 mt (56%) of precast boundary wall has been completed of the total length of 578 mt
8.	Impediments	Supply disruption of fine aggregate starting from 2nd fortnight of March, 2022 has substantially impacted the production of precast components

Building 1

Building 2

Building 3

Building 4 & 5

Building 5 & 6

Projected Completion Timeline

S. No.	Activities	Completion time
1.	Production of precast components (Capacity upto half floor/day)	63x2=126 days (About 5 months)
2.	Erection & installation of Components (4 Cranes are required simultaneously for Erection & Placing the produced components for half floor. 2 Tower Cranes are already installed at site & 2 additional Crawler Cranes are to be mobilized at site) for working simultaneously)	Simultaneously
3.	Finishing of modules & other infrastructure works	Additional 2 months time

Live status of LHP site can be accessed at

https://ghtc-india.gov.in

Further learning on the project will be covered in due course.

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