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 #11 at Light House Project Chennai, Tamil Nadu

Date : 14.07.2022 , Thursday | Time : 3:00 PM

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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 11th July, 2022]

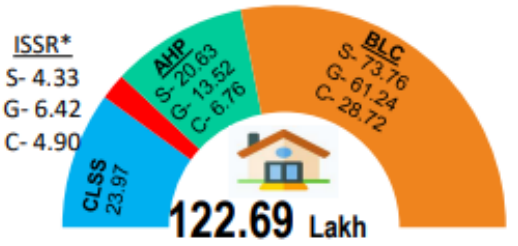
Overall Sanctions for 1.23^ crore Houses

Construction of Houses (Nos in lakh)

Demand	Sanctioned	Grounded*	Completed/ Delivered*
112.24	122.69	101.94	61.15

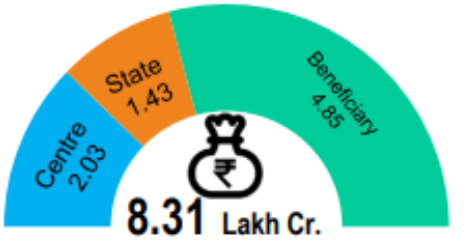
Financial Progress (₹ in Cr)

Committed	Released	Expenditure	UC Received
2,03,427	1,20,130	1,12,551	1,12,135

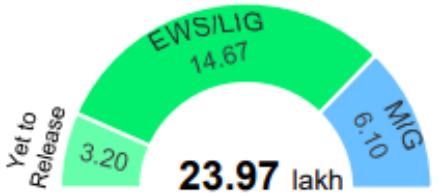


Houses in verticals (Nos in Lakh)

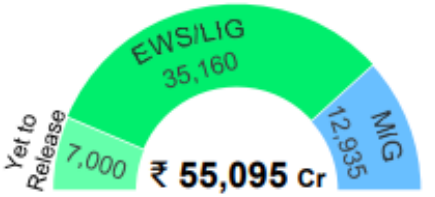
S- Sanctioned G- Grounded C- Completed



Investment Approved (Rs in Lakh Cr.)



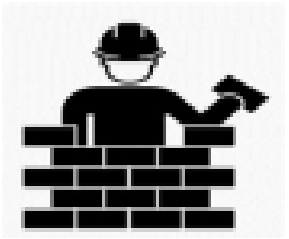
Beneficiaries under CLSS (in lakh)



Interest Subsidy under CLSS (Rs in Cr.)

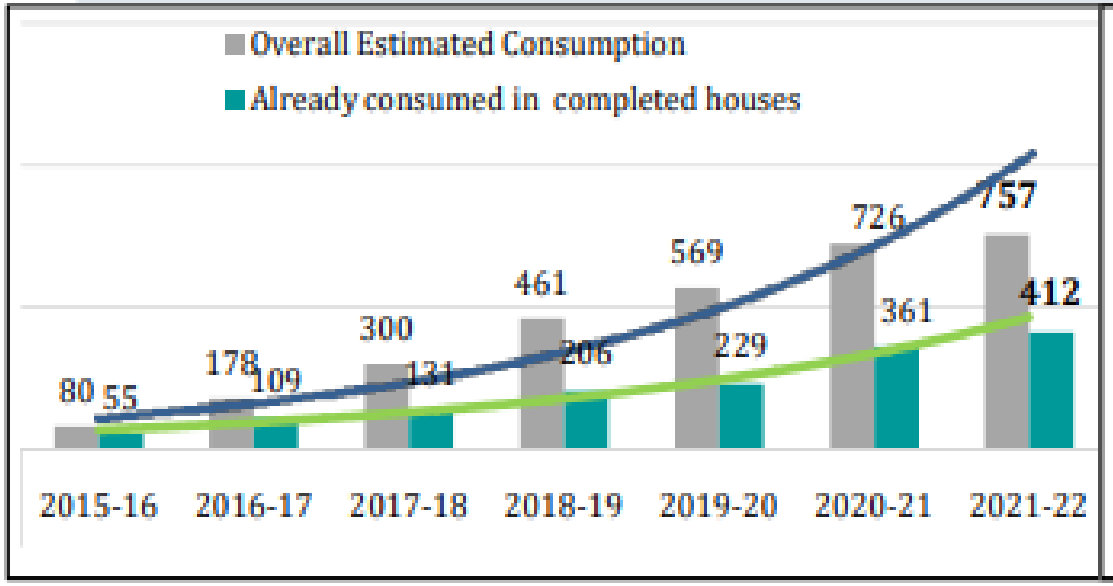
16 lakh houses are being constructed using New Technologies

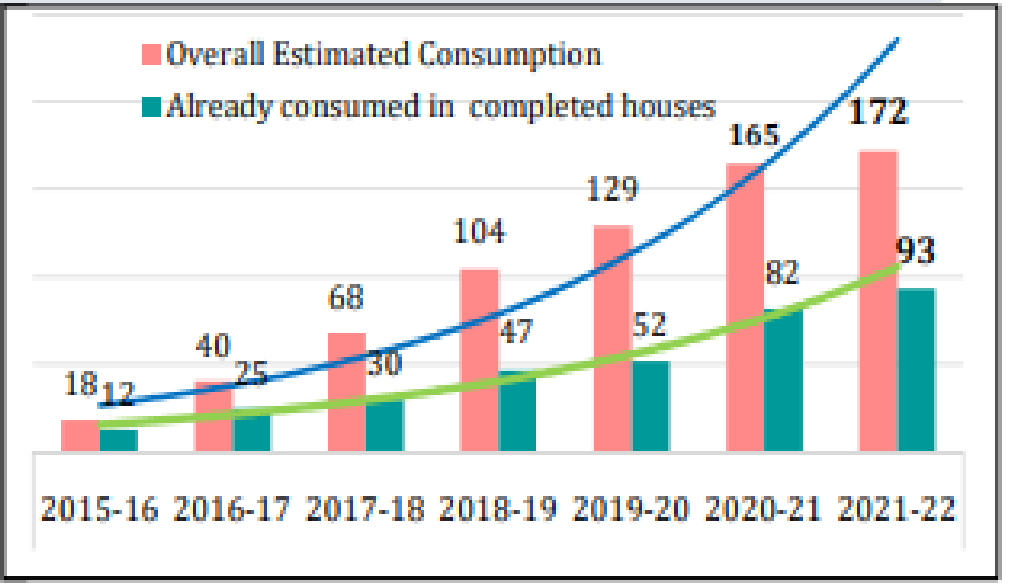
16 lakh houses are being constructed using New Technologies



Generation of Employment

Details	Direct	Indirect	Total
Person days (Nos in Cr.)	212	474	**686**
Jobs (in lakh)	76	169	**245**

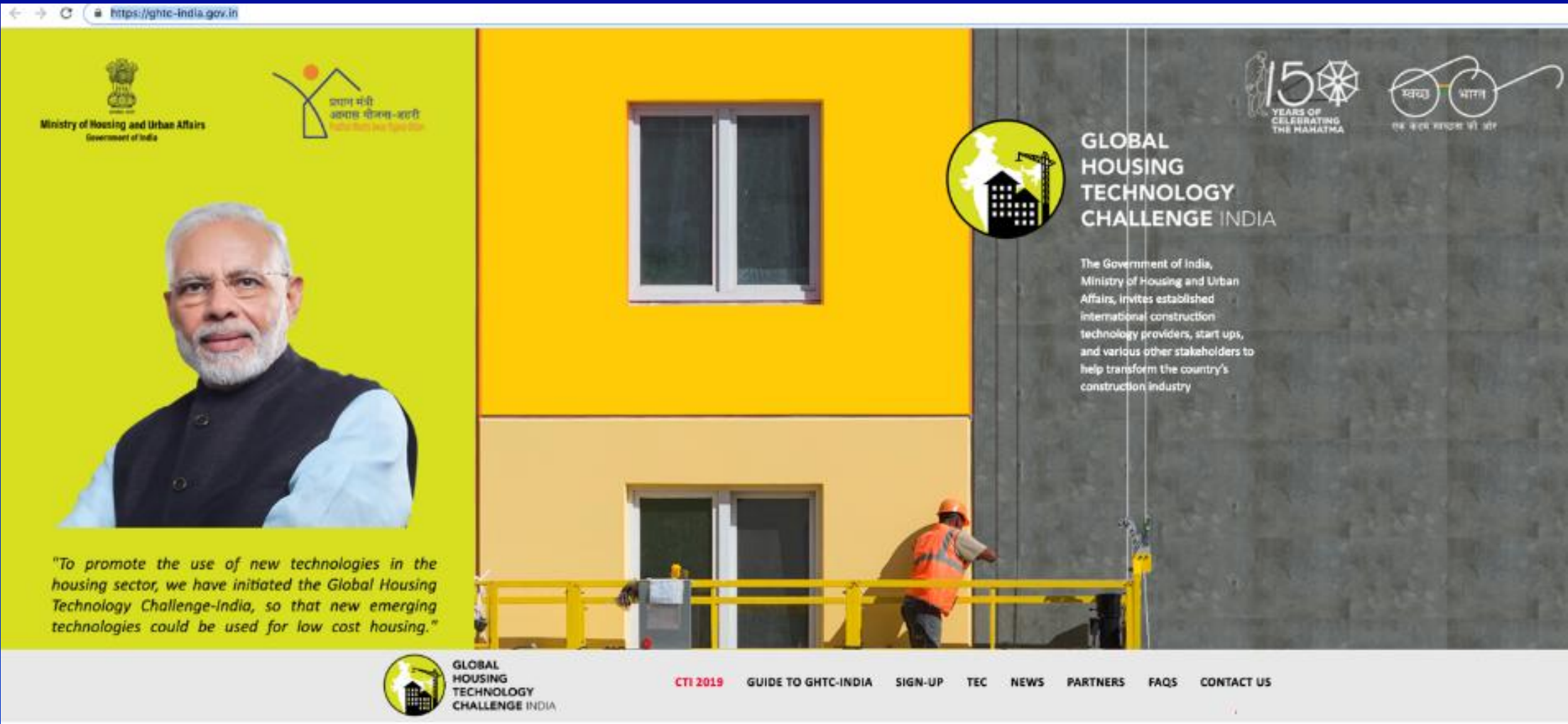




* *includes incomplete works of earlier NURM.*

GLOBAL HOUSING TECHNOLOGY CHALLENGE INDIA

Global Housing Technology Challenge - India (GHTC-I)



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**

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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

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 :

Global Housing Technology Challenge - India (GHTC-I)

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)

No. of Dwelling Units : 1008 Nos. (G+8)
No. of Block / Tower : 7 Blocks
Units in each Block / Tower : 144 Nos.

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

Global Housing Technology Challenge - India (GHTC-I)

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

GLOBAL HOUSING TECHNOLOGY CHALLENGE INDIA

Global Housing Technology Challenge - India (GHTC-I)

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

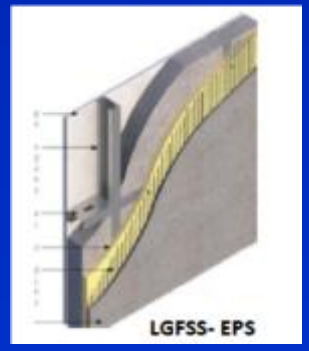
Light House Project (LHP) at Agartala, Tripura

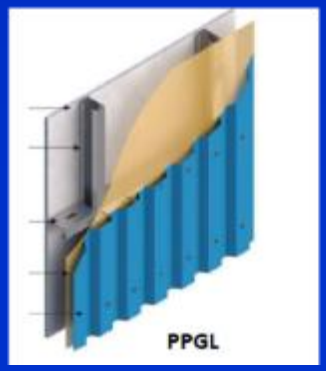
(Technology: Light Gauge Steel Structural System & Pre-Engineered Steel Structural System)

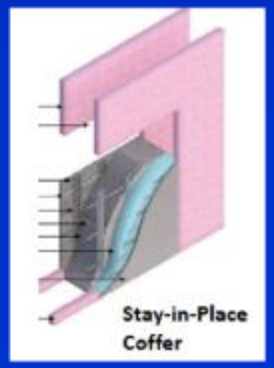
No. of Dwelling Units : 1000 Nos. (G+6)
No. of Block / Tower : 7 Blocks
Units in each Block / Tower : A(112), B(154), C(118), D(168), E(168), F(168) & G(112)

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

Global Housing Technology Challenge - India (GHTC-I)

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

Global Housing Technology Challenge - India (GHTC-I)

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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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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	Joseph Jebastin (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.

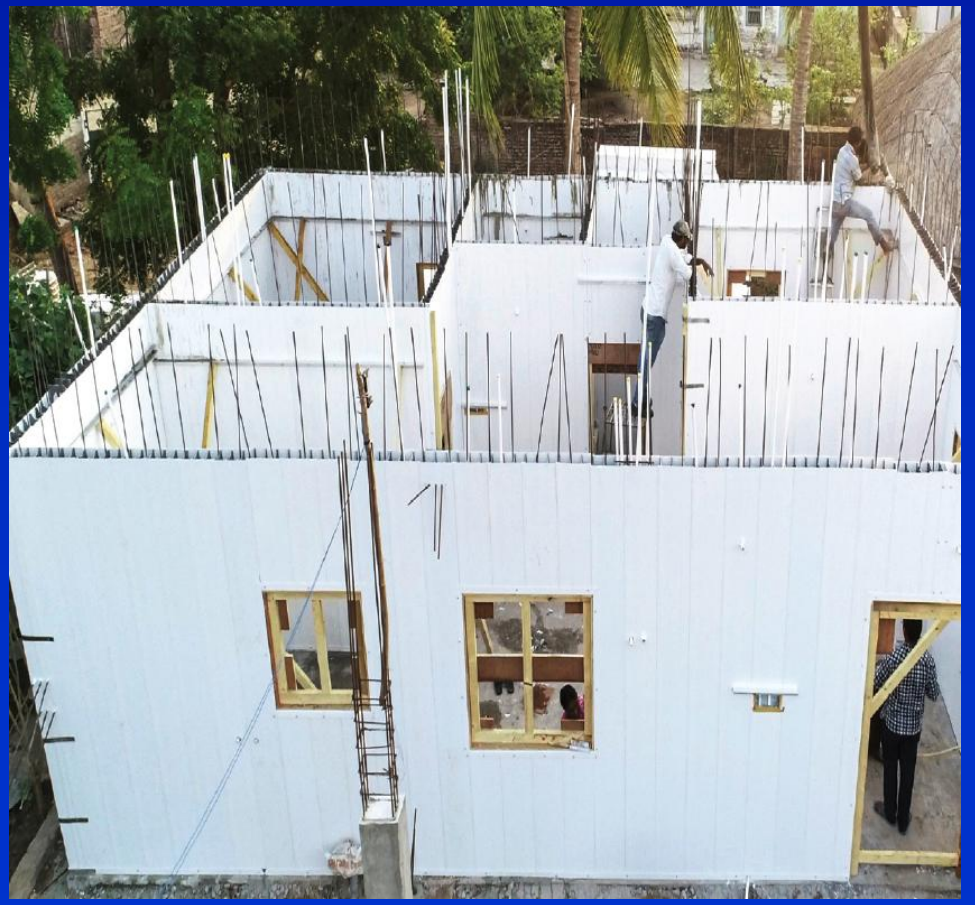
(Technology: Stay in-place Formwork System & Pre-Engineered Steel Structural System)

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)

Stay-In-Place PVC Wall Forms

- 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.

- 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.



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	

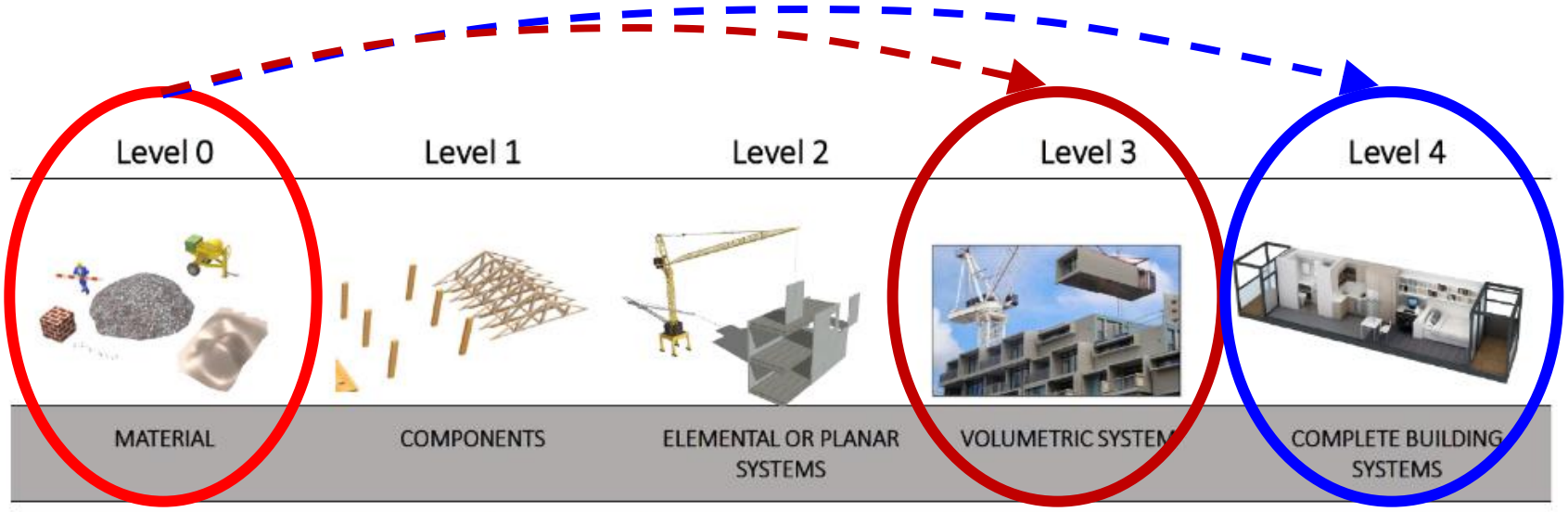
54
Alternate technologies Identified

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
Basic materials for site-intensive construction	Manufactured components	Linear or 2D components	3D components in the form of modules	Modular components - fully finished and delivered to site
✓ Involves more Labour ✓ Time consuming	✓ Fabricated in Factory ✓ Can't be build On-site ✓ Assist in construction speed & quality	✓ Series of Pre fabricated elements assembled to form the shell ✓ Requires on-site work	✓ Volumetric, forms a completed part of the building ✓ Involves more than one trade in the factory	✓ 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

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LIGHT HOUSE PROJECT AT CHENNAI

GHTC-India Category:
Precast Concrete Construction System – Precast components assembled at site

Technology:
Industrialized 3-S system using RCC Precast Columns, Beams, Semi-Precast Solid Slab with AAC Block masonry

CONTENTS

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
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Monolithic Concrete Construction	9
Stay In Place Formwork System	8
Total	54

Summary of Six Light House Projects (LHPs)

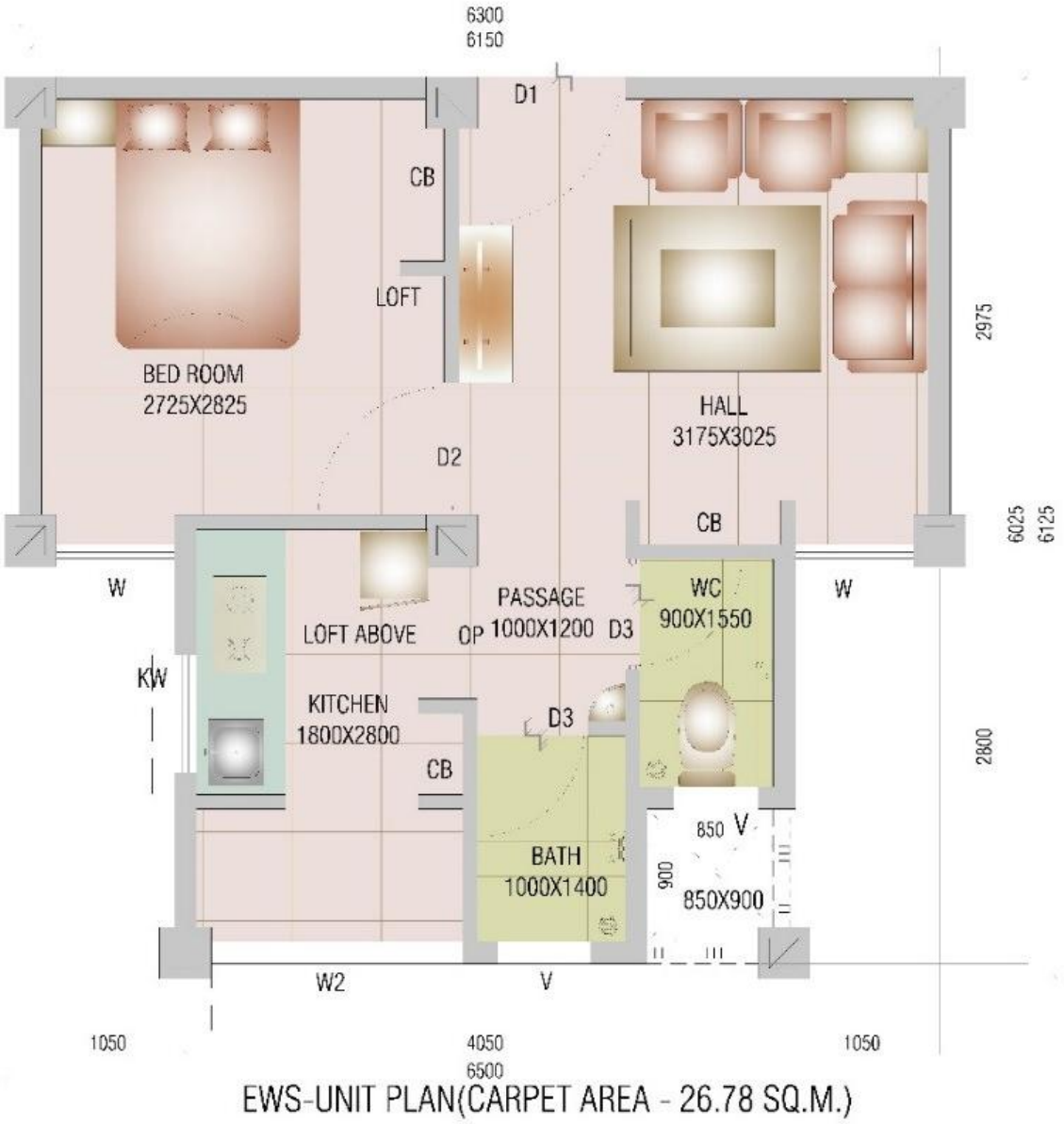
LHP Location			Chennai (Tamil Nadu)	Rajkot (Gujarat)	Indore (Madhya Pradesh)	Ranchi (Jharkhand)	Agartala (Tripura)	Lucknow (Uttar Pradesh)
Sl. No	**Particulars**	**Units**						
1	Name of Technology	Name	Precast Concrete Construction System-Precast Components	Monolithic Concrete Construction using Tunnel 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	G+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

- 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

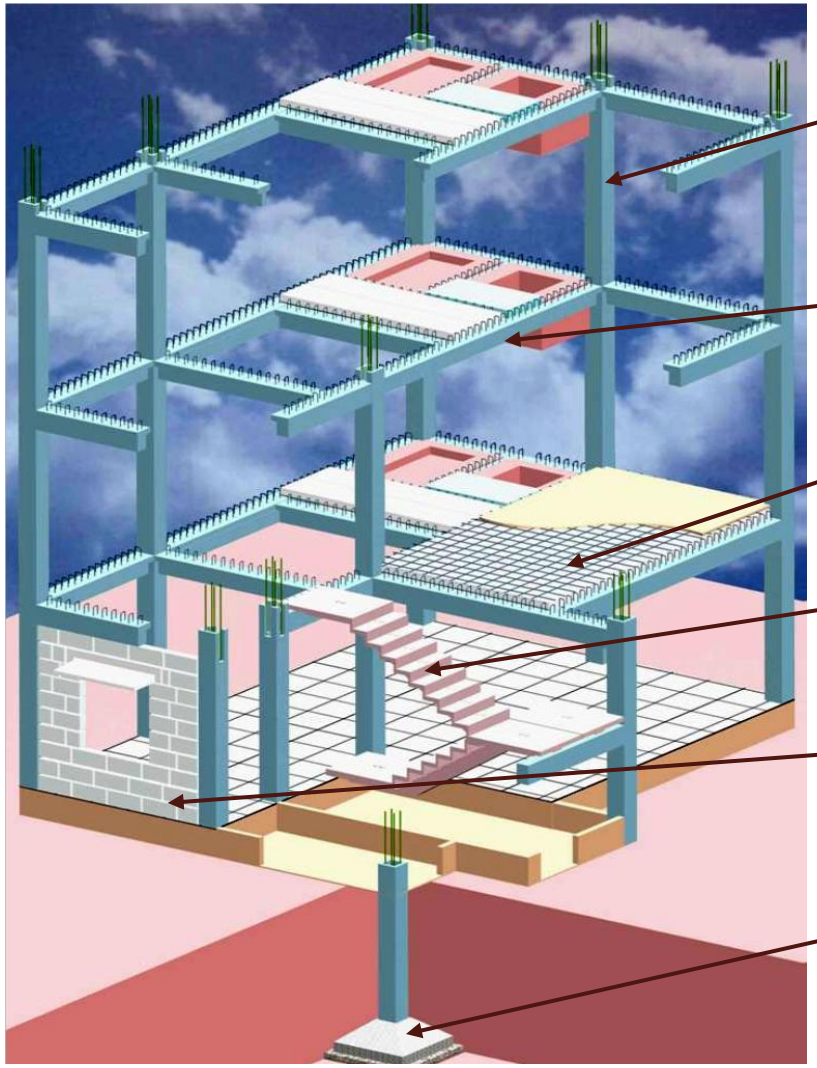
Prevalent Construction Systems

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

Structural Elements

- Foundation
- Structural System
- Floor/ Roof Slab
- AAC Block Masonry

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.

Floor/ Roof Slab

- The partially precast slab, precast beam and column are assembled together and wet jointed through screed of reinforced concrete laid on top making it monolithic structure.

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.

Advantages

- Quality of construction is enhanced significantly due to pre-casting of components by using sophisticated moulds and machineries in factory like environment, assured curing, assured specified cover to reinforcement, proper compaction of concrete results in to dense and impermeable concrete etc. Thus lesser maintenance cost during lifetime of project.
- Inbuilt eco-friendly method of construction in terms of more off-site works in controlled factory like environment results in to significant reduction in wastage of water, natural resources, air pollution and noise pollution.
- Safety of workforce achieved automatically as most of the works are carried out at ground floor in factory like environment, which ultimately enhances the work efficiency and quality.
- Wooden shuttering material is completely avoided and wastage of other construction materials reduced significantly; which results in to conservation of scarce natural resources like soil, sand, aggregate, wood etc.
- Advance procurement of major construction materials, advance pre-casting of structural components and assured completion of work within stipulated completion period will save cost towards escalation & early returns on investments, thus Substantial cost benefit to the client.

Limitations

- Capital intensive since establishment of precast factory is required.
- Minimum number of dwelling units required to achieve cost economy.
- Skilled manpower is required for production and erection of precast components.

Mass scale field implementation of new technology

Light House Project at Chennai

on

Design & Build Basis

Agency & Technology Provider:

M/s B. G. Shirke Construction Technology Pvt. Ltd., Pune

Design Philosophy

- The aim of design is to achieve an acceptable probability that structures being designed will perform satisfactorily during their intended life as per the guidelines provided under IS 456.
- The limit state method of design is adopted. The design of various members is carried out in accordance with the provisions, laid down in IS 456, IS 16700 and IS 13920.
- To meet the durability & service ability requirements, various provisions as regards to maximum w/c ratio, minimum cement content, minimum percentage of steel, detailing of reinforcement, curtailment of reinforcement etc., as laid down in IS456 and other applicable national / international codes are complied with.
- The RC moment resisting frames are detailed as per ‘3-S’ system and relevant applicable BIS/International standards’ provisions to meet the design ductility level.

Design Basis

- Safe Bearing capacity: 25 T/m^2, depth of foundation varying from 2.5 to 3.5 m
- Shallow Foundation as per IS-1080-1985 and IS-1904:1986. Minimum M35 grade of concrete is proposed for RCC structural elements in sub-structure.
- Structural Frame
  - Composite precast RCC solid slabs, precast RCC solid beams (T shape / L shape / rectangular) and precast dense concrete reinforced hollow core columns shells (core of which is concreted after erection using self-compacting concrete with the provision for suitable reinforcement for effective jointing), are manufactured in special steel moulds at site factory under stringent quality control and ISO / OSHAS quality norms.
  - The jointing of various precast RCC elements is proposed as 'Wet Jointing' i.e. concreting with self-compacting concrete for achieving required rigid joints.
- Wind speed: High damage risk zone with basic wind speed (V_b=50m/sec) as per IS875(Part-3)
- Design wind speed:

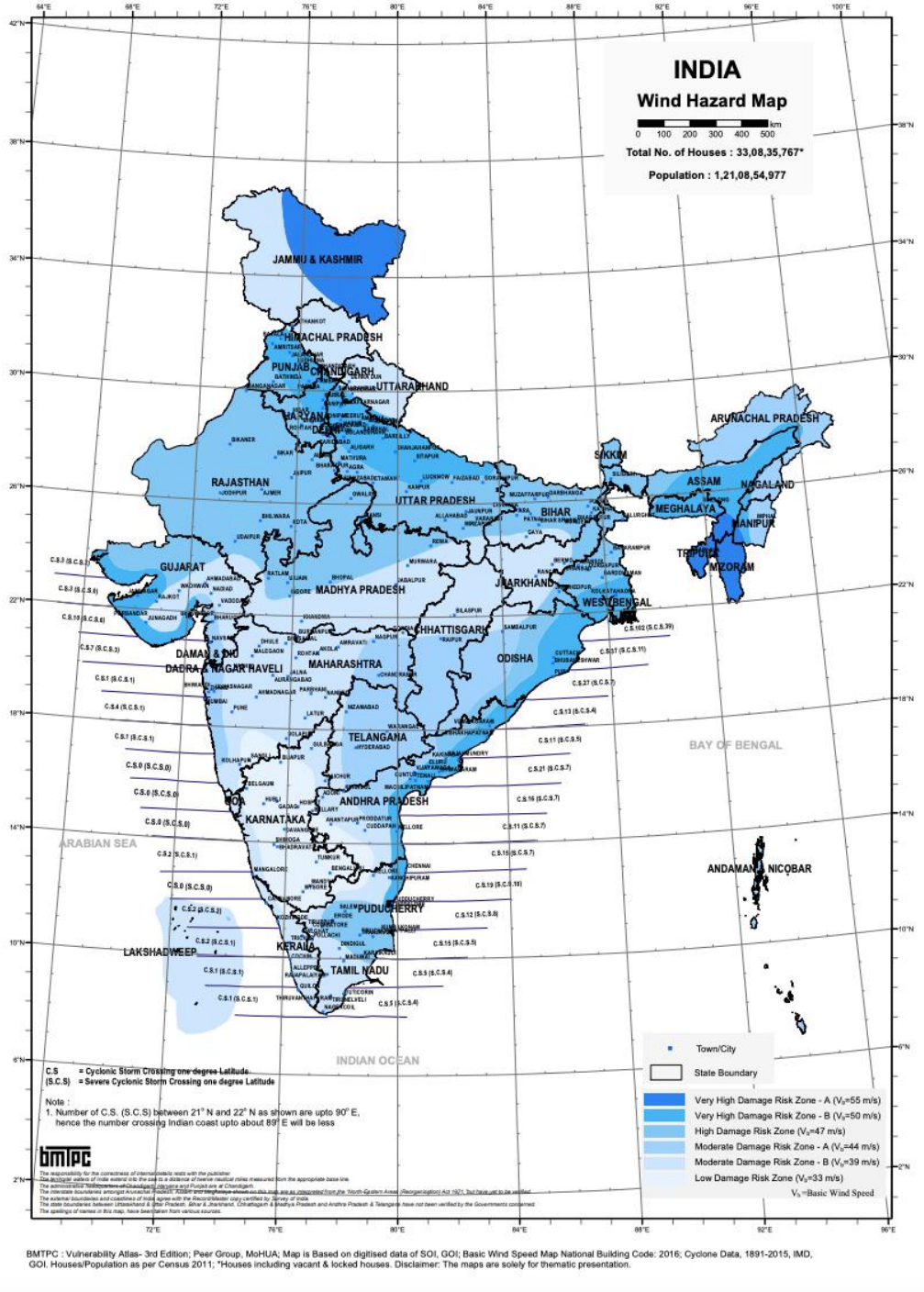
  $V_z=V_b.k_1.k_2.k_3.k_4$

  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.



BMTPC : Vulnerability Atlas- 3rd Edition; Peer Group, MoHUA; Map is Based on digitised data of SOI, GOI; Basic Wind Speed Map National Building Code: 2016; Cyclone Data, 1891-2015, IMD, GOI. Houses/Population as per Census 2011; *Houses including vacant & locked houses. Disclaimer: The maps are solely for thematic presentation.

Design Basis

- Earthquake : Zone-III as per Seismic Zoning Map of India IS: 1893 (Part-1):2016
  - Designed as dual system with ductile RC structural walls and few special moment frames in structural steel in both direction, Response Reduction Factor=5 (Table-9 iv of IS: 1893 (Part-1):2016), Z=0.16, I=1.2, R=5, Damping Ratio=5%.
  - Design Horizontal Seismic Coefficient (A_h)

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

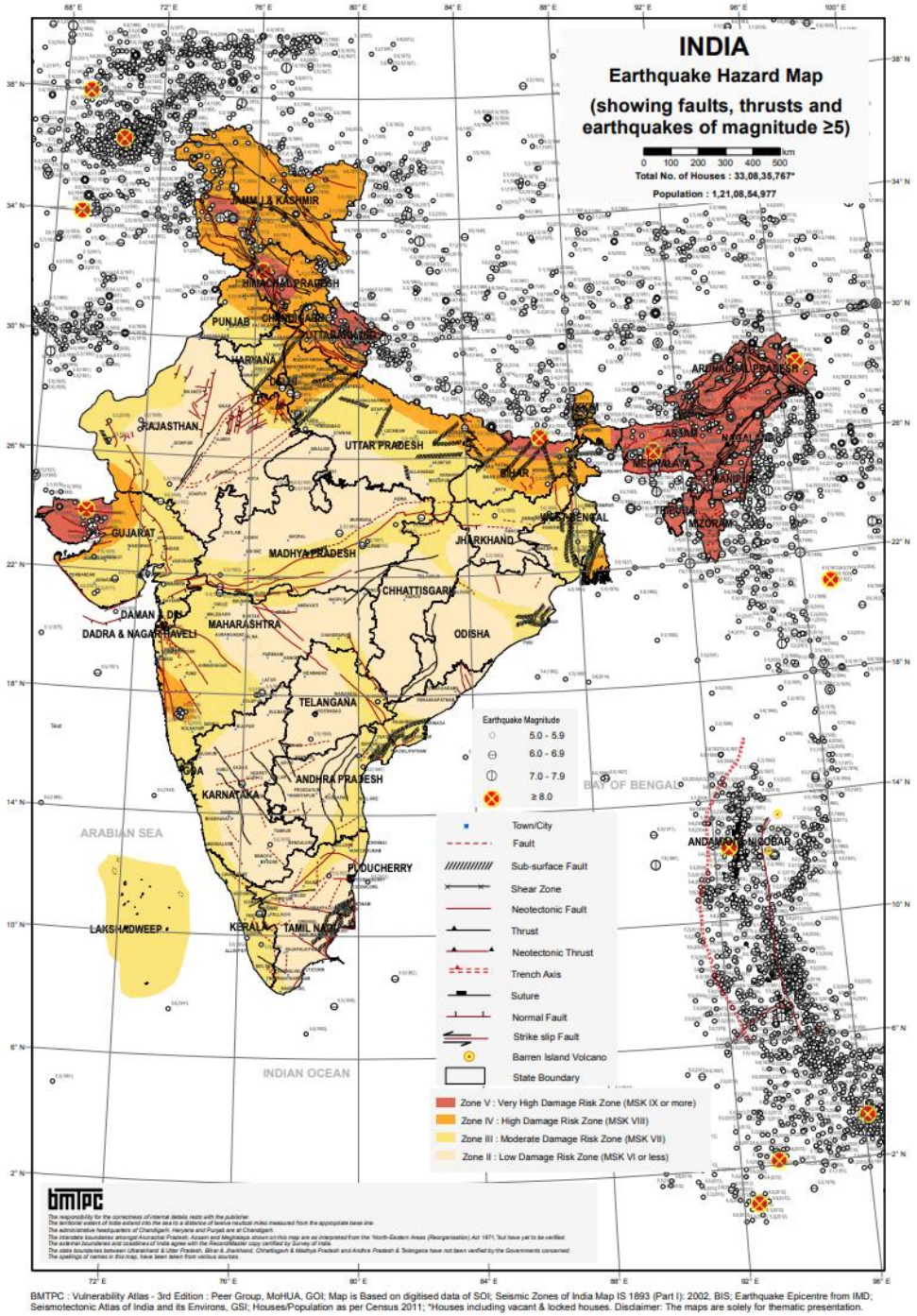
S_a/g is design acceleration coefficient for different soil types corresponding to natural period (T) of building

  - Design Lateral Force (V_B)

$$V_B=A_h.W$$

W is seismic weight of building

  - 3D dynamic analysis using response spectrum method using ETABS.
  - Moment resisting forces are designed to resist the total design force in proportion to their lateral stiffness.
- 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.
- Reinforced cement concrete used for floor elements are minimum M35 Grade and minimum M40 Grade for vertical load bearing elements.
- Thermal comfort levels are ensured as per IS: 3792 by selecting walling material having thermal transmittance well within 2.56 W/m'K.



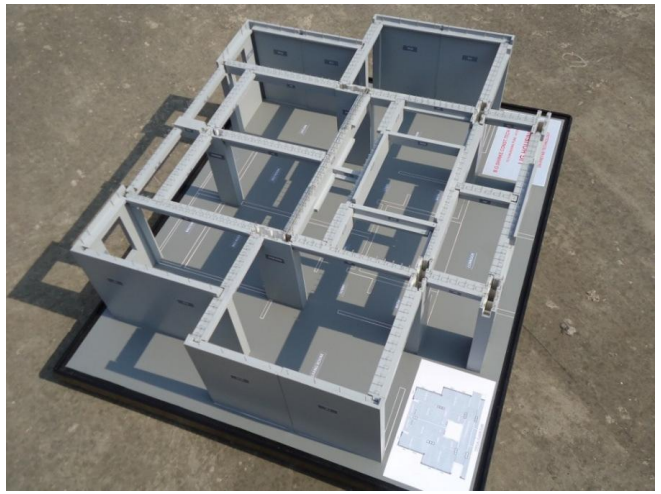
BMTPC : Vulnerability Atlas - 3rd Edition : Peer Group, MoHUA, GOI; Map is Based on digitised data of SOI; Seismic Zones of India Map IS 1893 (Part I): 2002, BIS; Earthquake Epicentre from IMD; Seismotectonic Atlas of India and its Environs, GSI; Houses/Population as per Census 2011; *Houses including vacant & locked houses. Disclaimer: The maps are solely for thematic presentation.

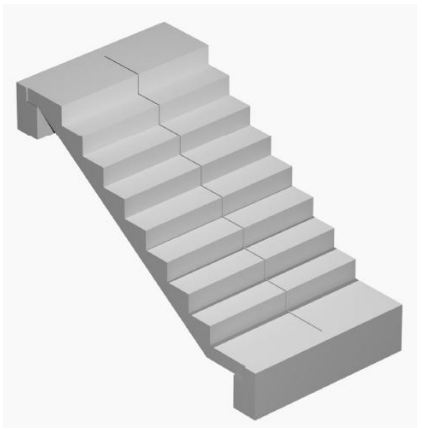
STRUCTURAL ANALYSIS & DESIGN

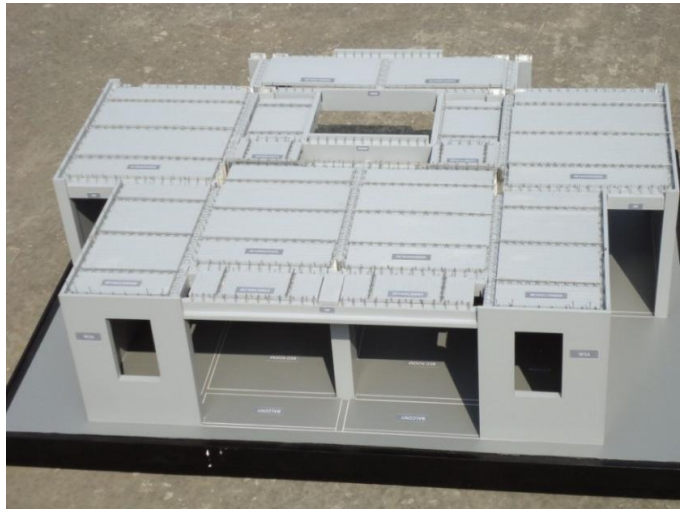
- 2D and 3D Modeling

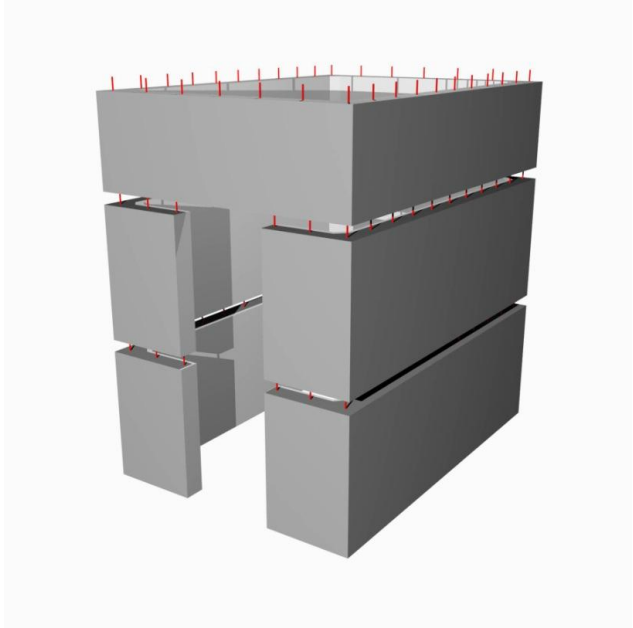
- Load Combinations :
  - 1.5 (DL+LL)
  - 1.2 (DL+LL±EL/WL)
  - 1.5 (DL±EL/WL)
  - 0.9DL ±1.5EL/WL

(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.)









- Structural system can be easily modeled in the CAD software such as STAADPRO, ETABS, SAFE, SAP, ABACAS 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

Concrete mix design for M40 (IIT Madras)

1. Mix Proportions:

C	:	W	:	F.A	:	CA*
1	:	0.37	:	1.787	:	2.225

2. Cement content	**(84.26%)**	=	**375 kg/m^3**
3. G.G.B.S content (JSW)	**(15.73%)**	=	**70 kg/m^3**
4. Water content		=	**164.65 lit**
5. Admixture (Fosroc Auracast 270M)		=	**3.11 lit**
6. Fine aggregate content (M-sand)		=	**795 kg/m^3**
7. Coarse aggregate content		=	**990 kg/m^3**
(Quantity of 12.5 mm size aggregate		=	**594 kg/m^3**
Quantity of 20 mm size aggregate		=	**396 kg/m^3)**
8. Compressive Strength of concrete obtained at **a. 7 days**		=	**46.76 N/mm^2**
9. Slump		=	**70 mm**

BATCHING PLANT

Casting of Precast Elements

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

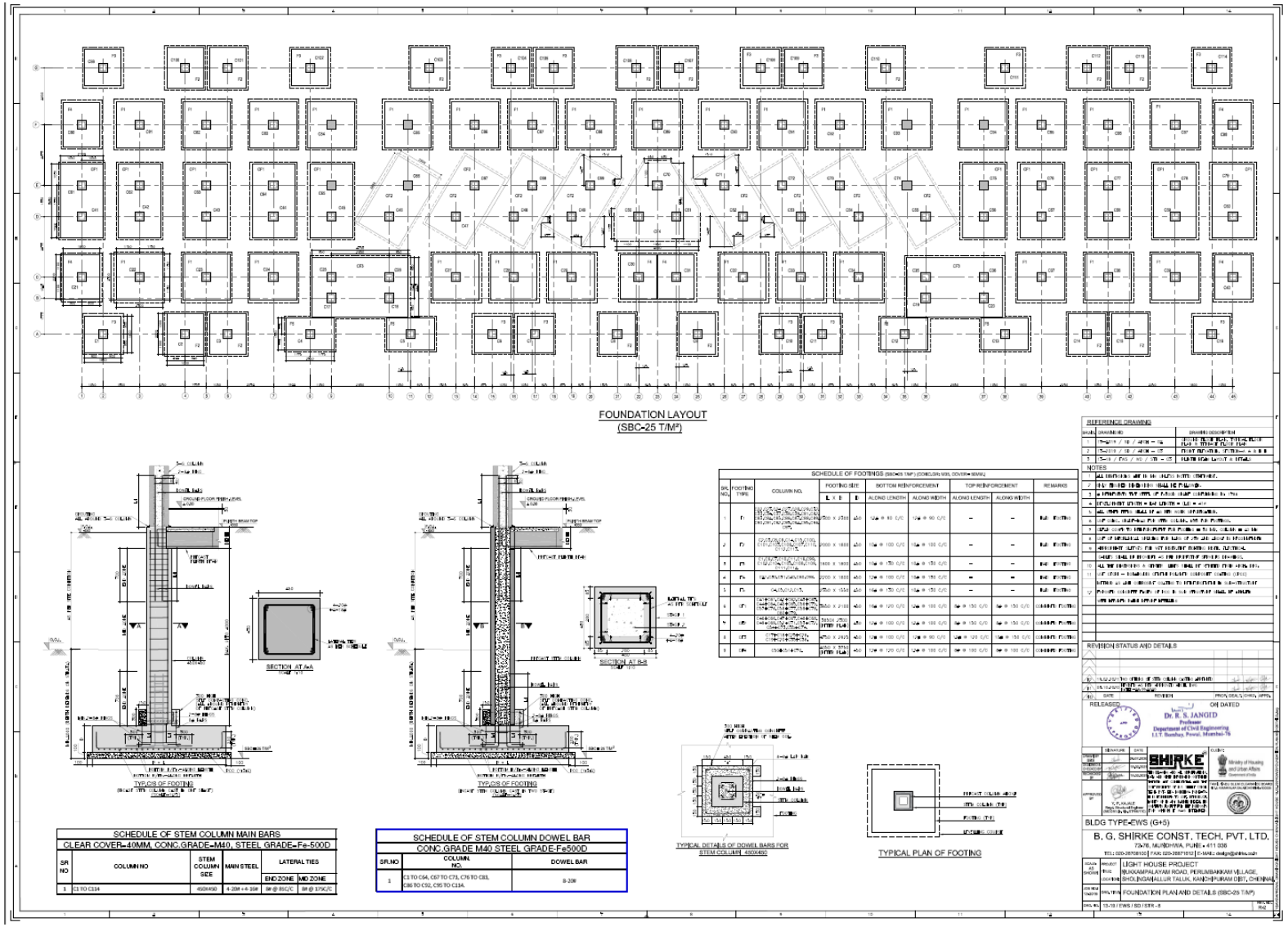
Precast Stairs

Construction Sequence

- Sub-Structure: Foundation
- Super-structure: Structural System
  Floors/ Slab
  AAC Block Masonry for walls
- MEP: Plumbing & Electrical
- Finishing

FOUNDATION

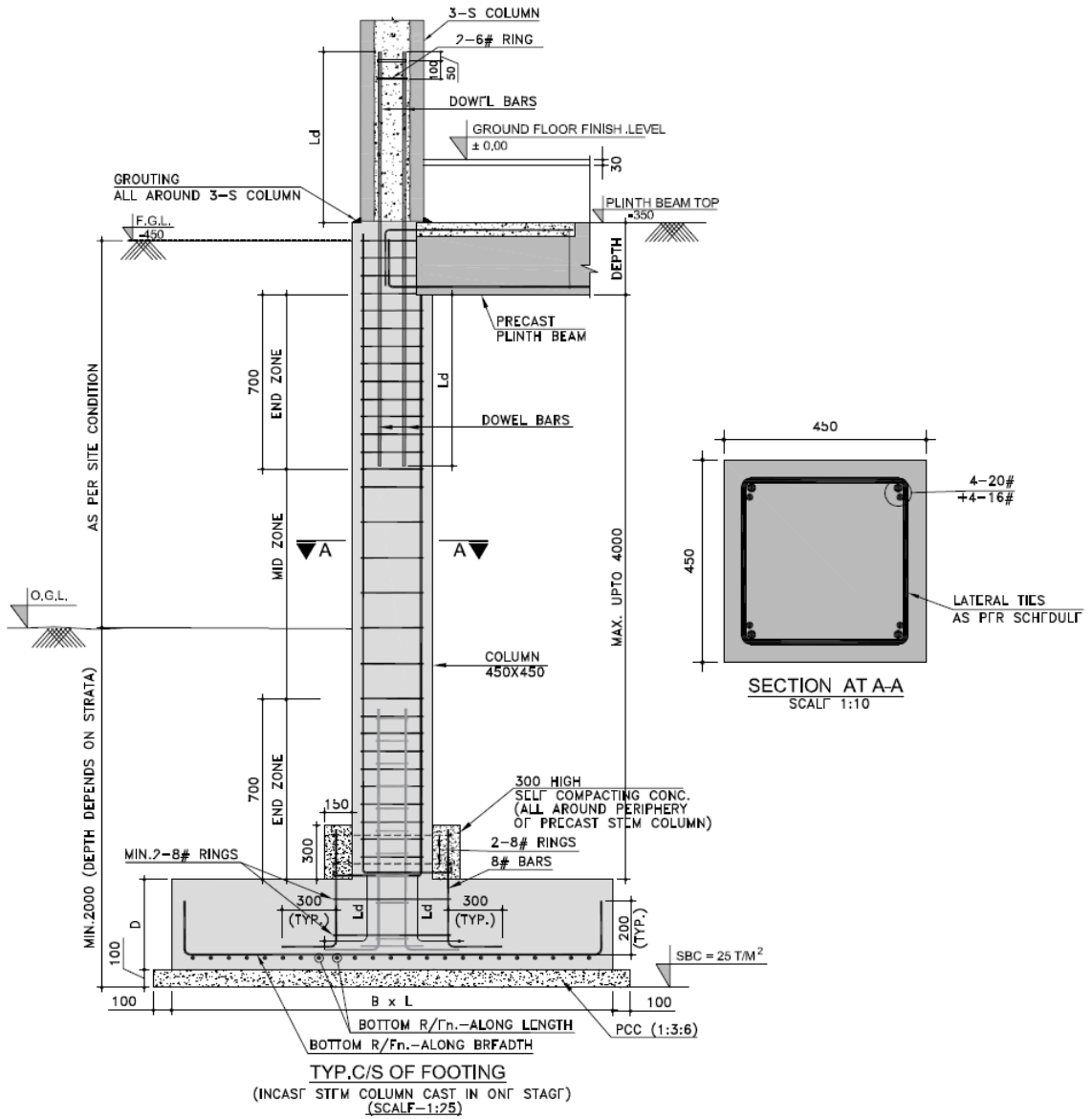
Structural Drawings



FOUNDATION

Concrete & Reinforcement Steel Specifications

- Isolated footing / combined footing have been used of varying size depending on the load.
- The footing is designed for SBC of 25 T/m^2 as calculated in soil investigation report.
- After leveling of the ground 100 mm thick PCC is placed and depth of the footing is 450mm.
- M35 grade of concrete has been used with cover of 50mm. reinforcement has been placed as per the drawings.
- Dowels are left in place to place the precast stem column self compacting concrete is placed around the stem column for its alignment.
- Anti corrosive coating is applied on reinforcement in such sub-structure due high chloride content in the sub soil.
- Exposed surfaces of RCC in sub-structure have been applied with bitumen paint before refilling.



FOUNDATION

- The typical project starts with layout and excavation.
- After the layout at site, the excavation of each block is done using mechanical excavators upto the required depth of foundation.

FOUNDATION

- In Chennai project, ground water was encountered during the excavation which was continuously drained during the foundation work.

FOUNDATION

- Before laying the foundation, the plain cement concrete is laid.
- The foundation work started with the PCC of 100 mm thickness.

FOUNDATION

Plate Load Test

- Safe bearing capacity of 25t/m^2 has been considered for design of isolated and combined footing based on the soil investigation done at site by the construction agency.
- The construction agency also conducted plate load test to verify the SBC at representative locations.
- The plate load test was conducted at a depth of 3.0 m from ground level.
- Plate used for test was 0.3mX0.3m having area of 0.09sqm.Capacity of the jack 200KN.
- Least count of settlement gauge was 0.01mm and hydraulic pressure gauge of 10 kg/sq.cm.
- Load increment was done for 24 hrs. Maximum load applied was 576KN. The gross settlement was 4.04mm which was well within the acceptable limit.

FOUNDATION

- After PCC, isolated and combined RCC footings of varying thickness depending upon structural design with M35 concrete are placed.

FOUNDATION

- After PCC, isolated and combined RCC footings of varying thickness depending upon structural design with M35 concrete are placed.

FOOTING
REINFORCEMENT

CASTING OF FOOTING

CASTING OF FOOTING

FOOTING COMPLETE

FOUNDATION

Stem Column

- Precast stem column are placed on the RCC footing.
- The size of the typical stem column is 450mmX450mm and its' height is upto the plinth beam. Main bars consist of 4No 20 dia and 4 no. 16 dia.
- The grade of concrete used is M40.
- Column core is formed by using EXPAMESH which acts as a sacrificial formwork to maintain the dimensional accuracy.
- Clear cover to reinforcement is kept at 40mm. OPC cement of grade 53 with C3A content (5% to 8%) has been used below ground level due to high chloride content in the soil as recommended in soil investigation report.
- Exposed surfaces of RCC in sub-structure have been applied with bitumen paint before refilling.

FOUNDATION

- Backfilling of foundation after completion of erection of stem column and plinth beam.

STEM COLUMN
ERECTION

STEM COLUMN ERECTION

STEM COLUMN WORK IN PROGRESS

FOUNDATION

- After erection of these hollow core stem columns, precast plinth beam are integrated in the column notches.

Plinth Beam Erection work in progress

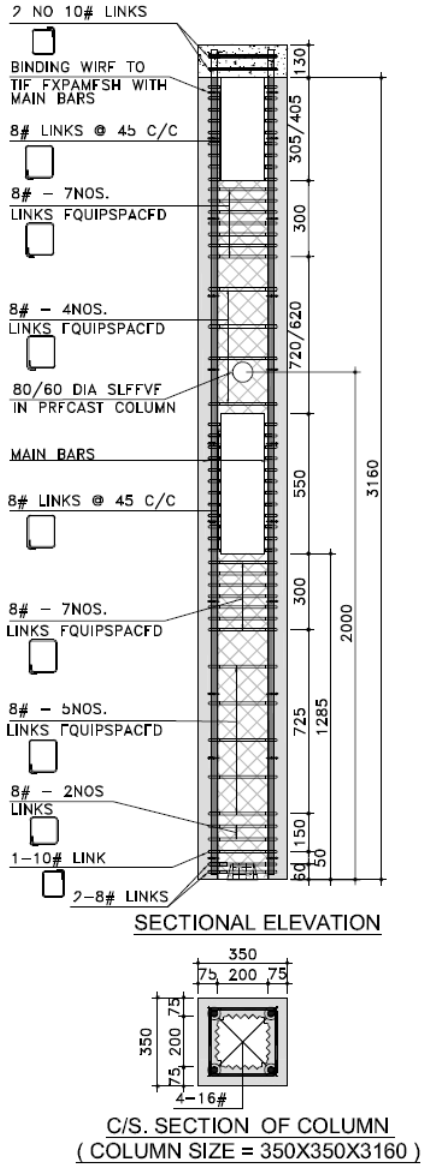
Backfilling work in progress

Backfilling works in progress

STRUCTURAL SYSTEM

Precast Column in Superstructure

- Hollow core precast columns are used which are filled with the self compacting concrete after placement of precast beams for monolithic joint.
- Typical size of the Precast column in ground floor and upper floors is 350mm by 350mm having varying height depending upon the architectural requirement.
- Grade of concrete used is M40 and clear cover to reinforcement is 40mm. Demoulding of side shutter is done after 12 hrs of concreting and 18 hrs for bottom shuttering.



STRUCTURAL SYSTEM

Precast Column in Superstructure

- Column core is formed by using EXPAMESH which acts as a sacrificial formwork to maintain the dimensional accuracy.
- A sleeve 60mm dia is created in the column at the time of casting to insert a steel rode with hook to lift the column.
- A mesh of mild steel is placed in the hollow core column which acts as sacrificial form work.

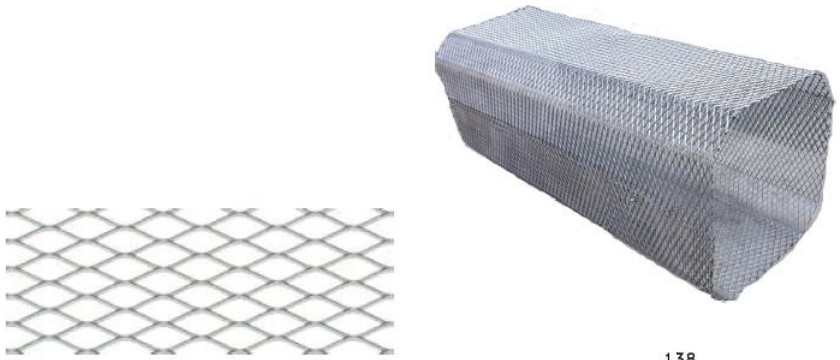
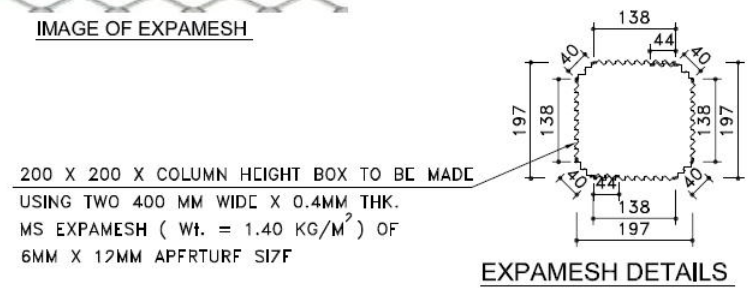
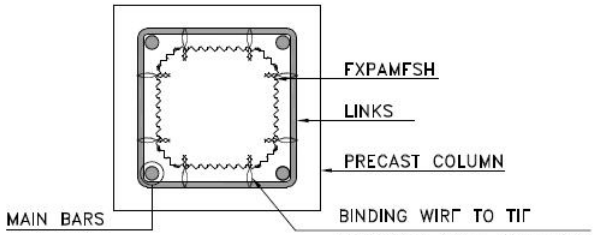


IMAGE OF EXPAMESH



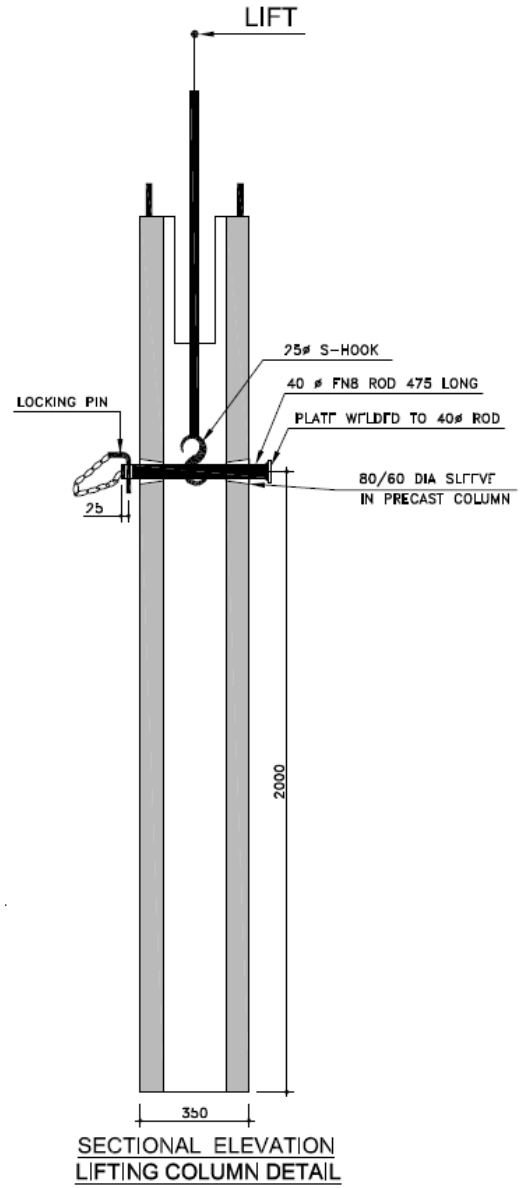
EXPAMESH DETAILS



DETAILS OF EXPAMESH

SCALE 1:10

COLUMN CORE FORMED USING EXPAMESH AS SACRIFICIAL FORMWORK



SECTIONAL ELEVATION
LIFTING COLUMN DETAIL

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.

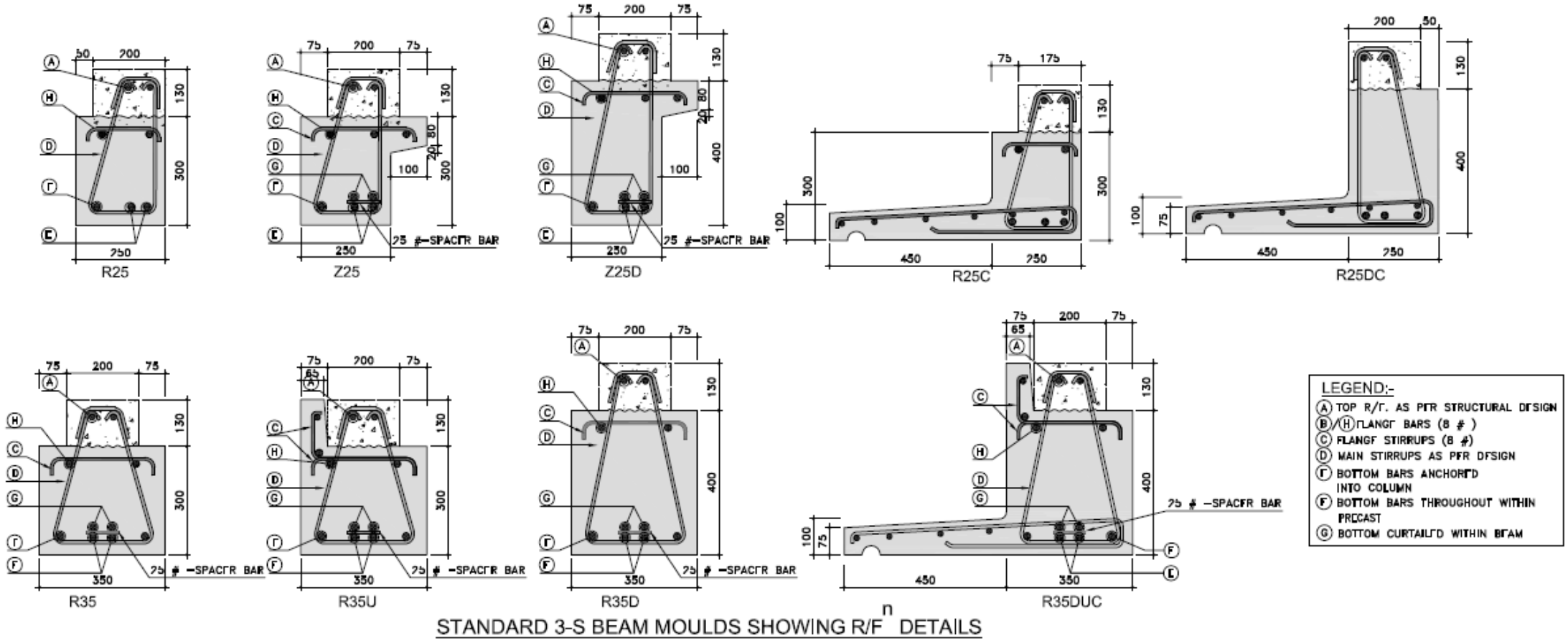
STRUCTURAL SYSTEM

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

Before Jointing

After Jointing

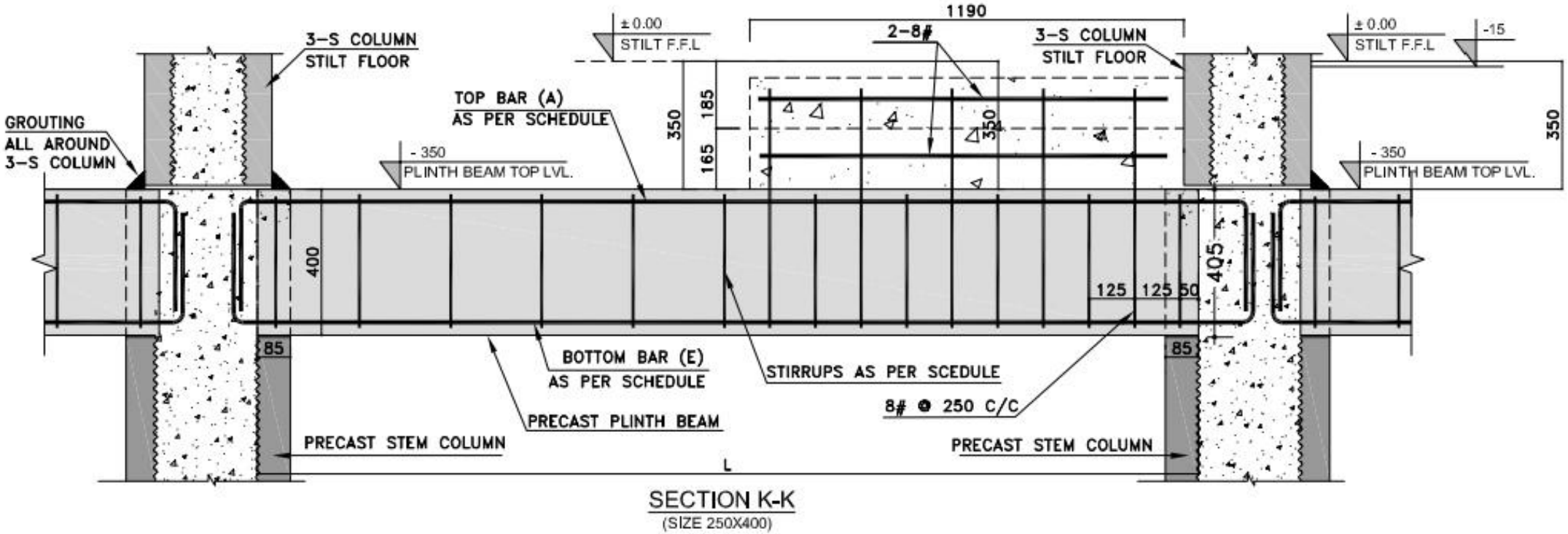
STRUCTURAL SYSTEM



STANDARD 3-S BEAM MOULDS SHOWING R/F DETAILS

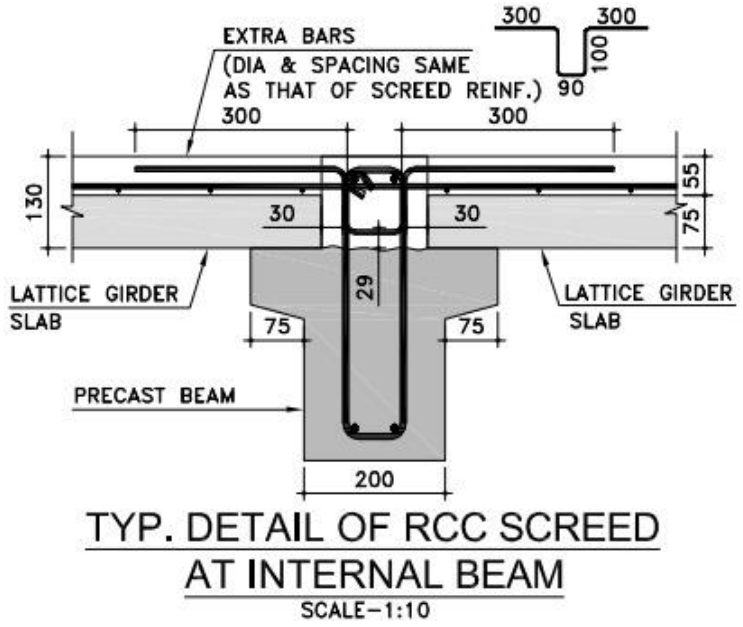
Typical beam details

STRUCTURAL SYSTEM



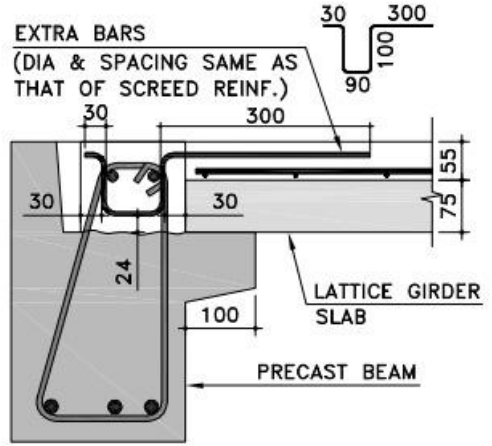
Typical Joint between Beam & Column

STRUCTURAL SYSTEM



TYP. DETAIL OF RCC SCREED AT INTERNAL BEAM

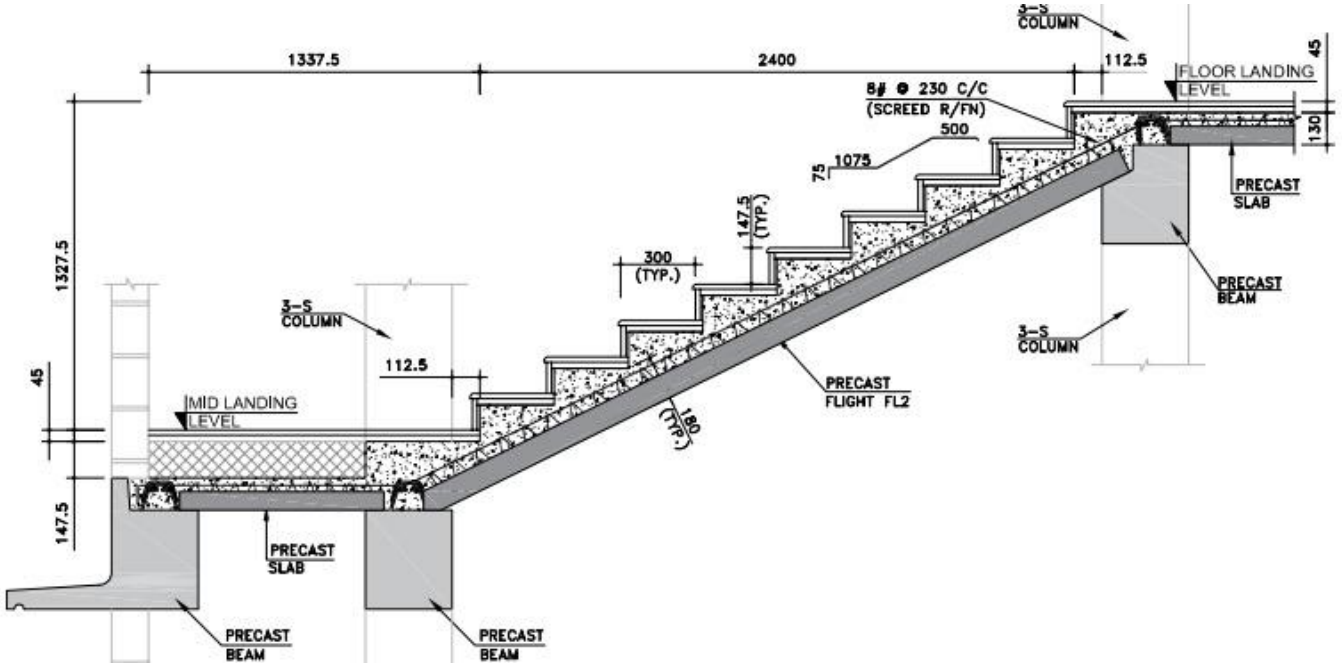
SCALE–1:10



TYP. DETAIL OF RCC SCREED AT PERIPHERAL BEAM

SCALE–1:10

Typical Joint between Beam & slab

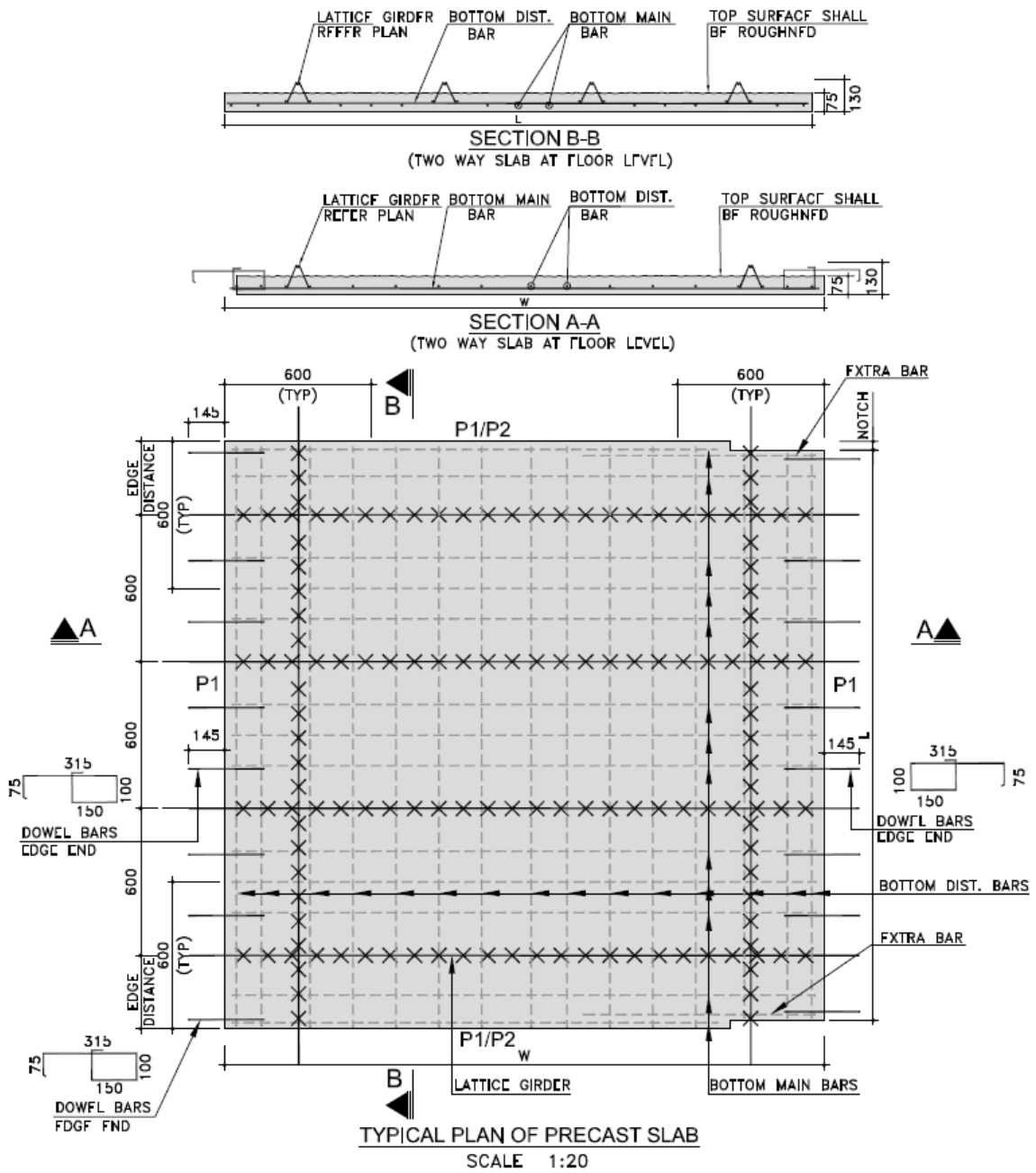


Typical Staircase connection detail

FLOORS/ SLAB

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

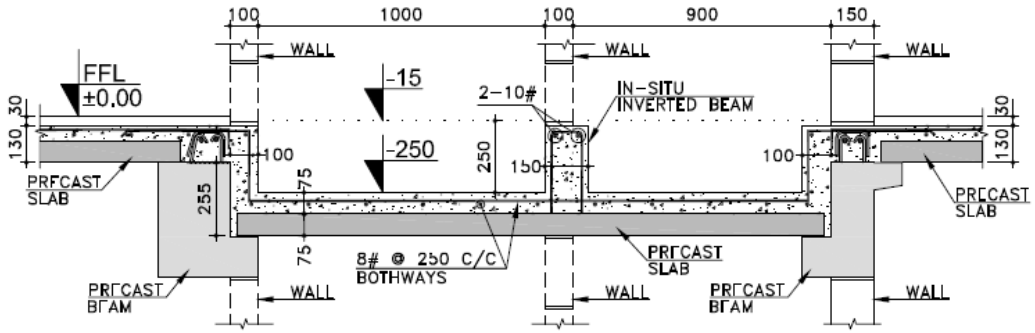
FLOORS/ SLAB



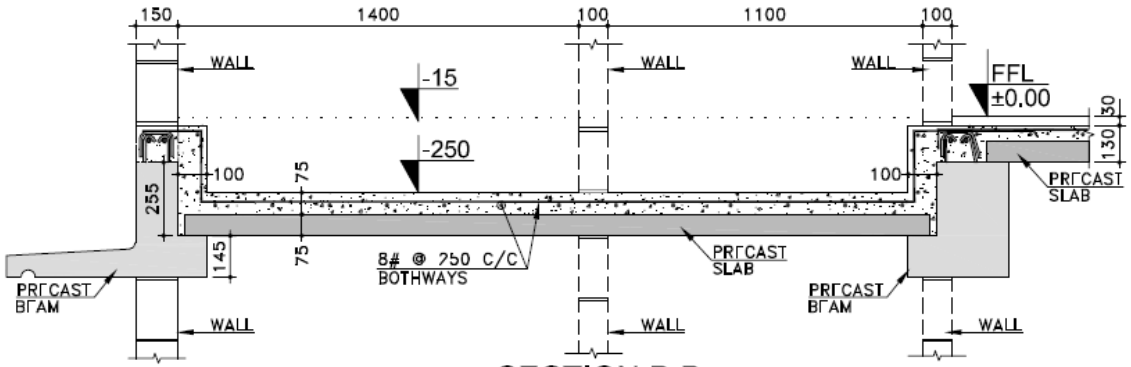
REPRESENTS TMT STEEL OF Fe500D GRADE CONFORMING IS: 1786
DEVELOPMENT LENGTH = LAP LENGTH = (Ld) = 41ø
ALL OTHER ITEMS SHALL BE AS PER WORK SPECIFICATION.
USE CONC. GRADE–M35 FOR PRECAST SLAB.
USE OF MECHANICAL SPLICING FOR BARS OF 25ø AND ABOVE IS RECOMMENDED
APPROPRIATE SLEEVES FOR WET RISER,FIRE FIGHTING RISER, ELECTRICAL
CABLES SHALL BE PROVIDED AS PER RESPECTIVE SERVICES DRAWINGS.
CLEAR COVER TO R/F FOR SLAB = 20 MM.

- Typical beam - slab details

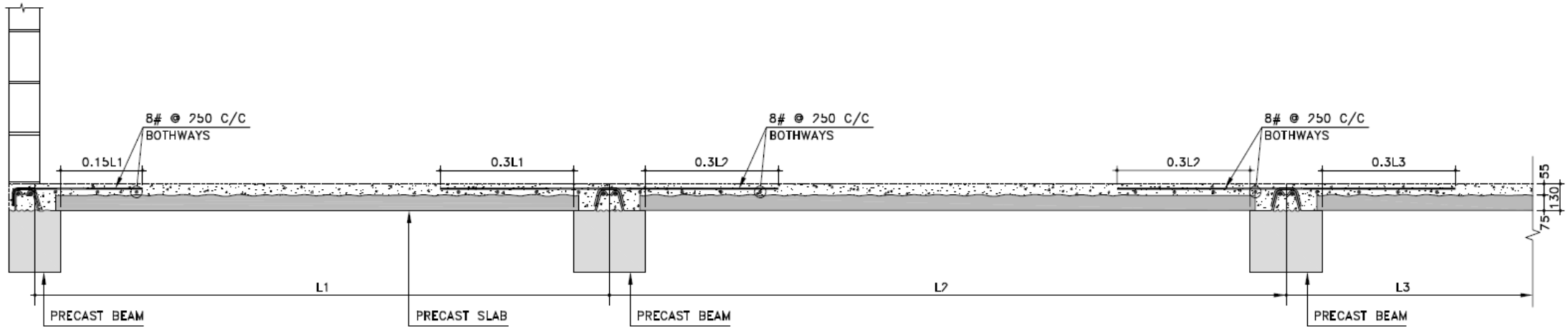
FLOORS/ SLAB



SECTION A-A
SCALE 1:20



SECTION B-B
SCALE 1:20



SECTION AT C-C

- Typical beam - slab details

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.


PARTIAL PRECAST
SLAB

Partial Precast Slab


PARTIAL PRECAST SLAB WITH
REINFORCEMENT
2021/5/15 10:53

First Floor Column, Beam Erection

SECOND FLOOR COLUMN, BEAM ERECTION

SECOND FLOOR COLUMN, BEAM ERECTION

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

Third Floor Beam, Column, Slab and Second Floor Block Masonry

FOURTH FLOOR BEAM, COLUMN, SLAB AND SECOND FLOOR BLOCK MASONRY

Fifth Floor Masonry work in Progress

EXTERNAL PLASTERING WORK IN PROGRESS

External Plastering work in Progress

OVERALL SITE VIEW

Site View

External Painting in progress

EXTERNAL PAINTING IN PROGRESS

EXTERNAL PAINTING IN PROGRESS

QUALITY CONTROL LAB AT SITE

- Quality control and quality assurance is essential for a project and therefore a quality control lab has been established at site for testing of raw materials and finished products.

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

FINISHING ITEMS

- The finishing items include pressed steel door frame with flush shutters and PVC doors in toilets.
- uPVC frame with glazed panel and wire mesh shutter are used in windows.
- Vitrified tiles are used in flooring in rooms and kitchen.
- Anti-skid ceramic tiles are used in bath & WC.
- Kota stone flooring is used in common areas & Staircase steps.

INFRASTRUCTURE ITEMS

- The external infrastructure includes
- Laying of Sewerage Pipe Line,
- RCC storm water drain,
- Provisions for Fire Fighting
- Bituminous Internal Road & Paver blocks for Pathway,
- Providing Lifts in building blocks,
- Landscaping of site,
- Street light with LED lights,
- Solar Street Light System,
- Sewerage Treatment Plant (STP),
- External Electrification,
- Water Supply System including underground water reservoir,
- Compound wall with Boundary Gates,
- Horticulture facilities,
- Rain Water Harvesting,
- Solid Waste Management.

BOUNDARY WALL

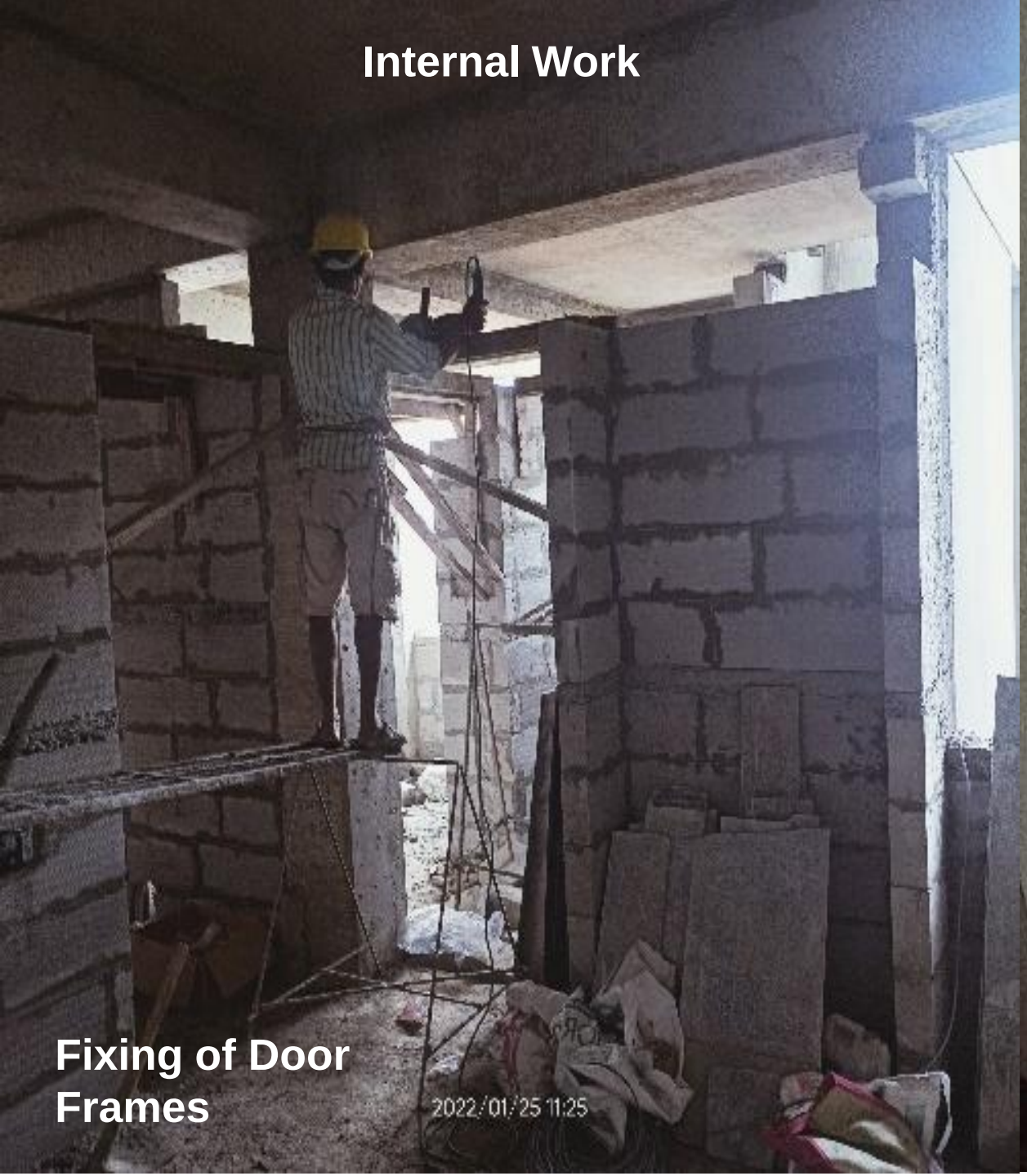

CABINE
T

Internal Work

TOILET


Internal Work
AAC BLOCK
WALL
2021/5/15 16:49

Internal Work



Fixing of Door Frames

Kitchen Cabinet work

Internal Work

Fixing of Windows

Electrical Work

Internal Work

Floor Tile work

PUTTY & PRIMER WORK


Internal Work
2022/02/21 15:19
Wall Tile fixing


Internal Work
2022/02/26 15:31
Corridor Paint


Internal Work
2022/02/26 1:59
Plumbing work

Internal Work

Sanitary fitting

Internal Work

Electrical room connection


BATH
1000MM X 1400MM


KITCHEN
1800MM X 2800MM


2022 05 08 11:14

For More Details Please Visit

https://ghtc-india.gov.in

Thank You

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