

Multistoried Residential Buildings at Bangalore using Precast Concrete Technology



NEW HAVEN
LIVE A BETTER TOMORROW

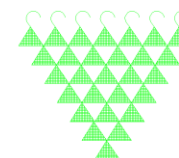
Project Information

Project Team

Developer Tata Housing Development Company Ltd.



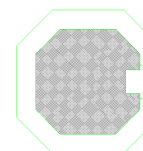
Architect Kemhabhavi Architects Foundation



Contractor Shapoorji-Pallonji Engineering & Construction



Structural Consultant Chetana Engineering Services Pvt. Ltd.



Precast Consultant Innovela Building Solutions Pvt. Ltd.



MEP Consultant Maple Service Consultants



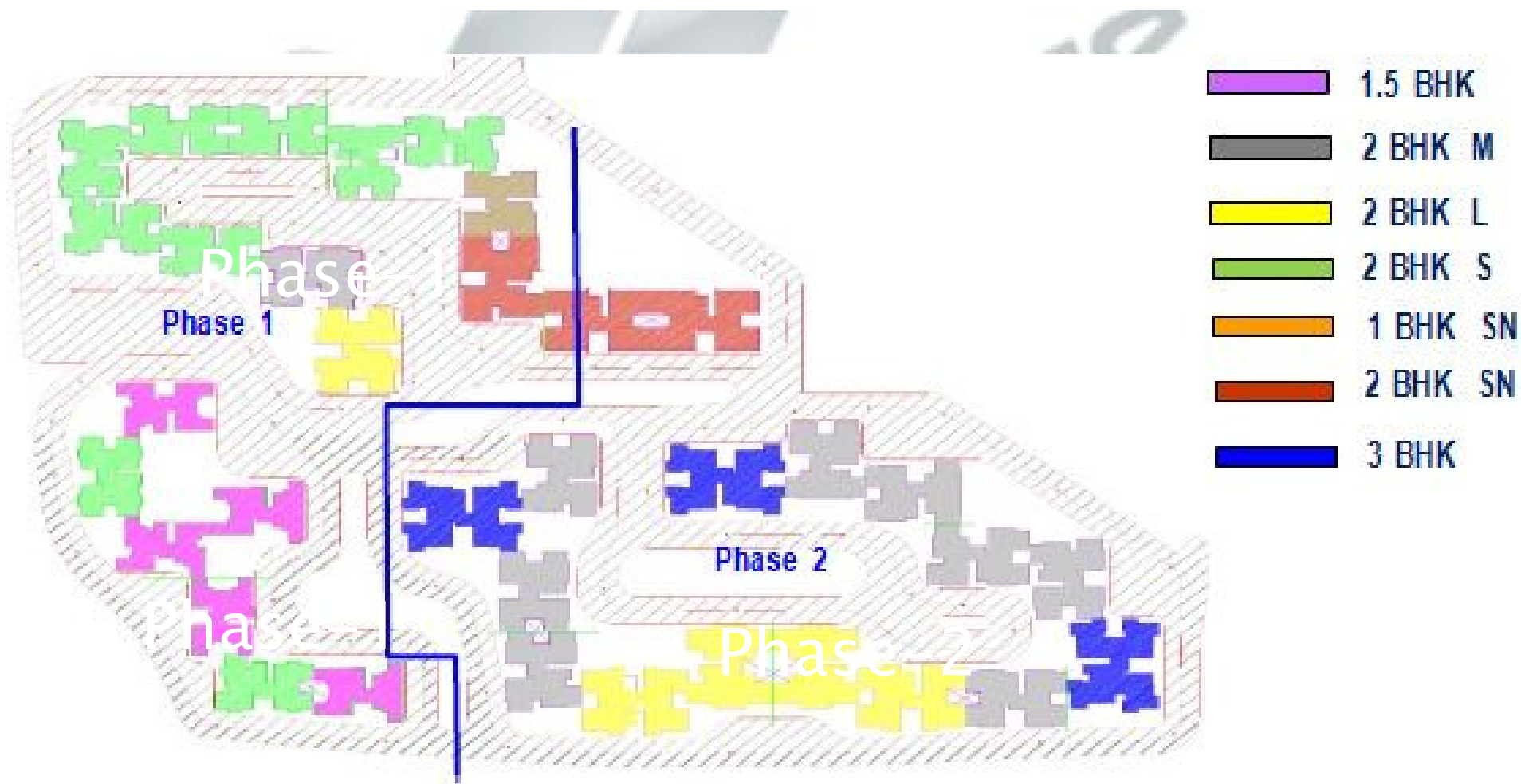
Project Brief

- ▶ 1892 apartments schemes in 2 phases.
- ▶ 35 towers (2B + 12/14 stories), Phase-1(18 towers–1000 apartments) and Phase-2 (17 towers–892 apartments)
- ▶ Load bearing precast walls of 160mm and 125mm thk.
- ▶ Non load bearing precast walls of 100mm thk.
- ▶ 125mm thk. Notched precast solid slab (room size)
- ▶ Site based precast plant
- ▶ Carousel system used for precast plant.

Location

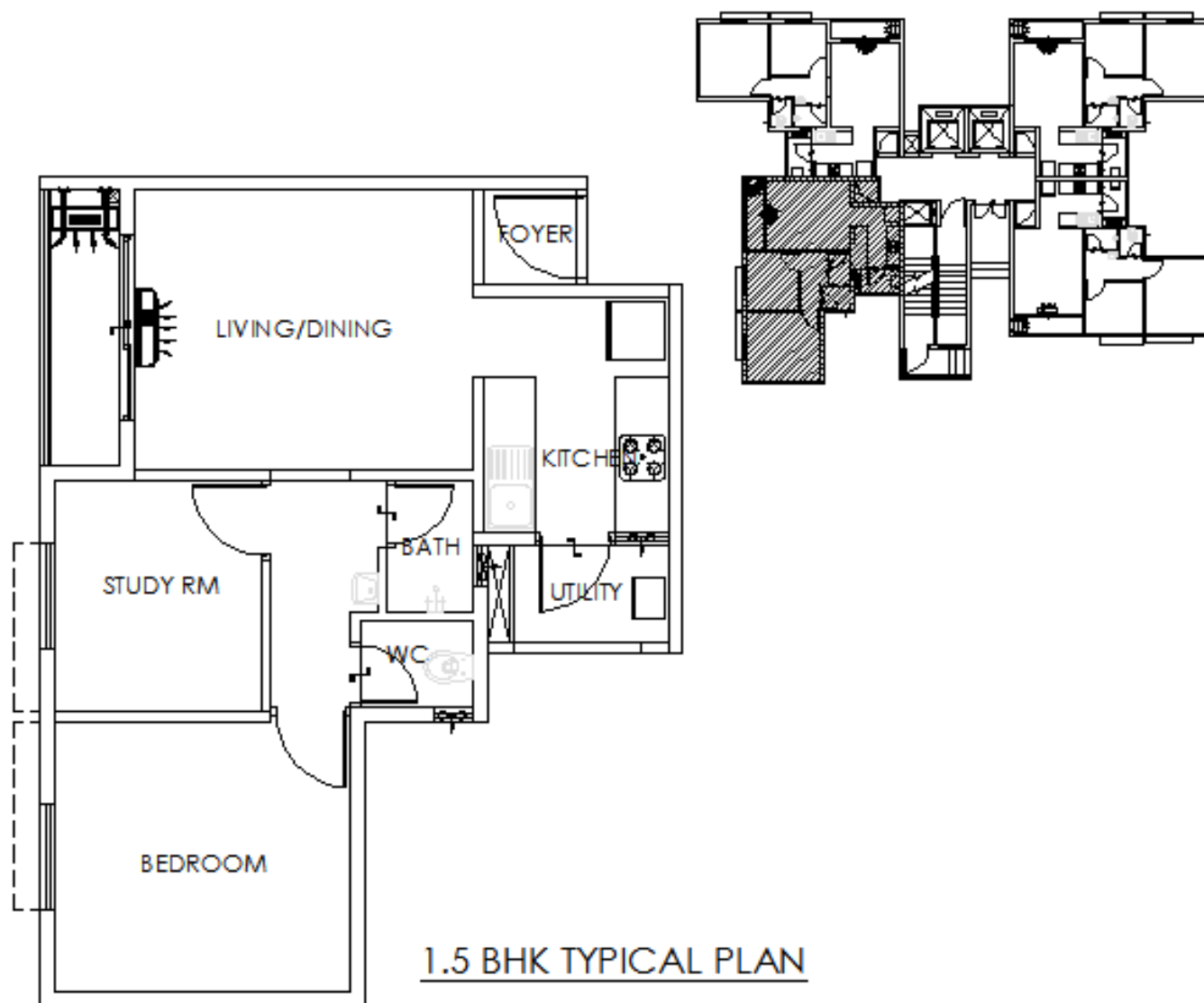


Master layout

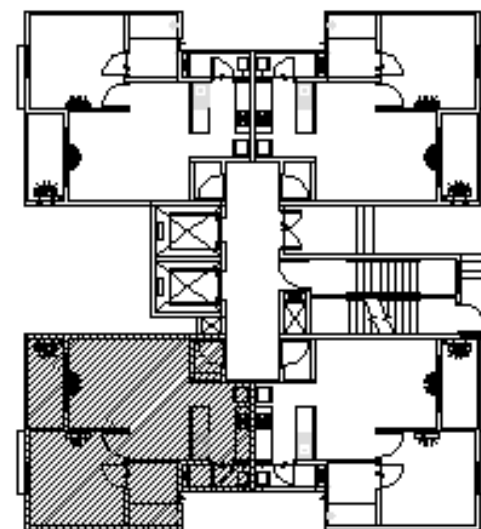
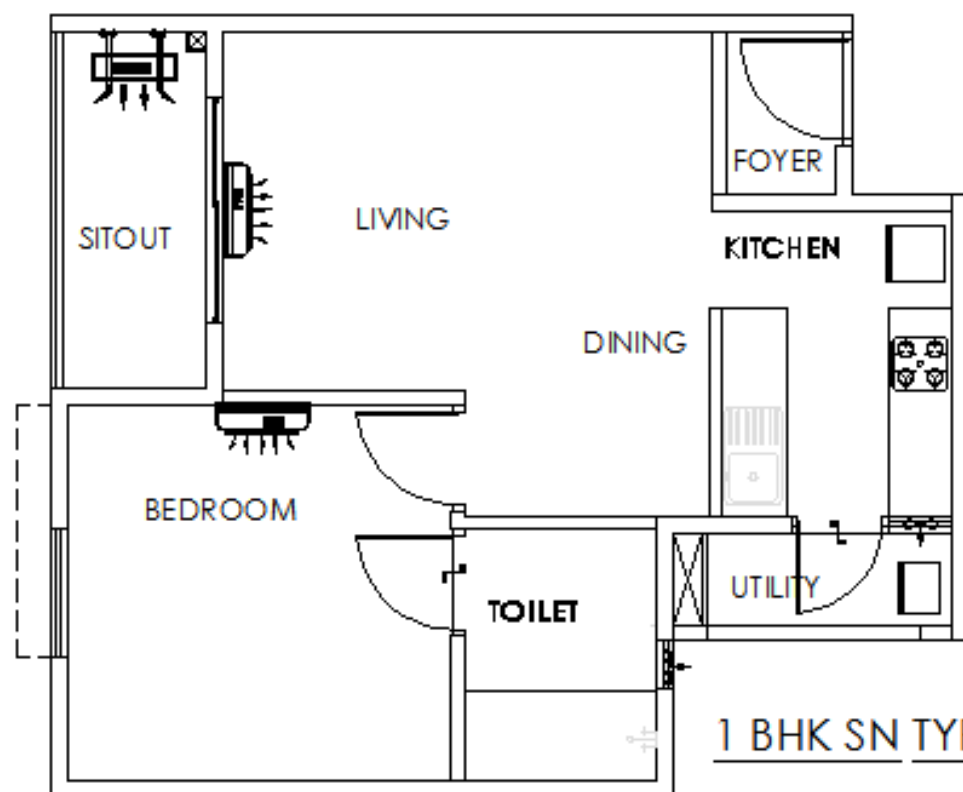


PHASING PLAN

Architectural Floor Plan– 1.5 BHK

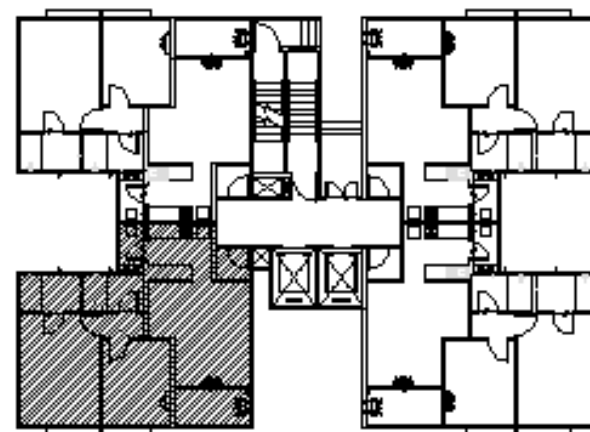
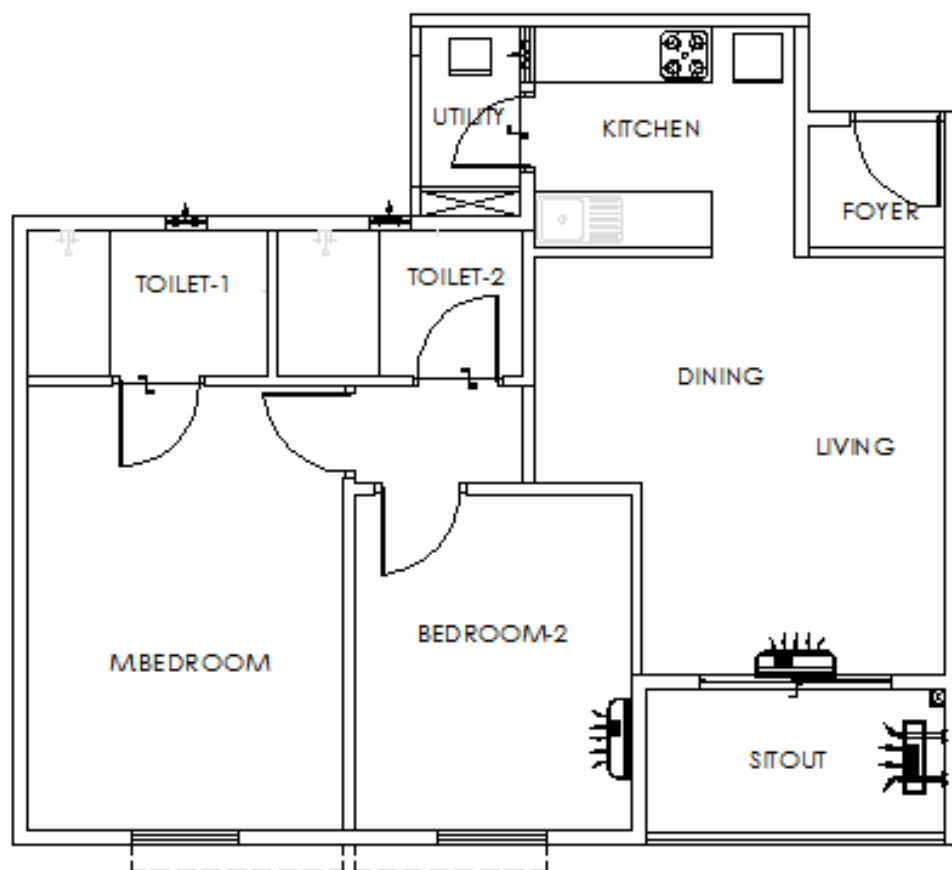


Architectural Floor Plan– 1 BHK–SN



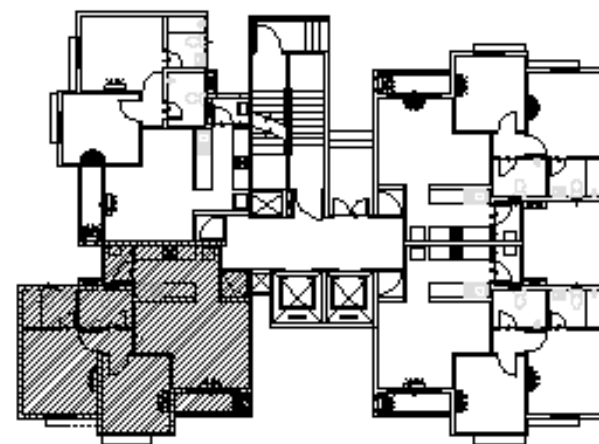
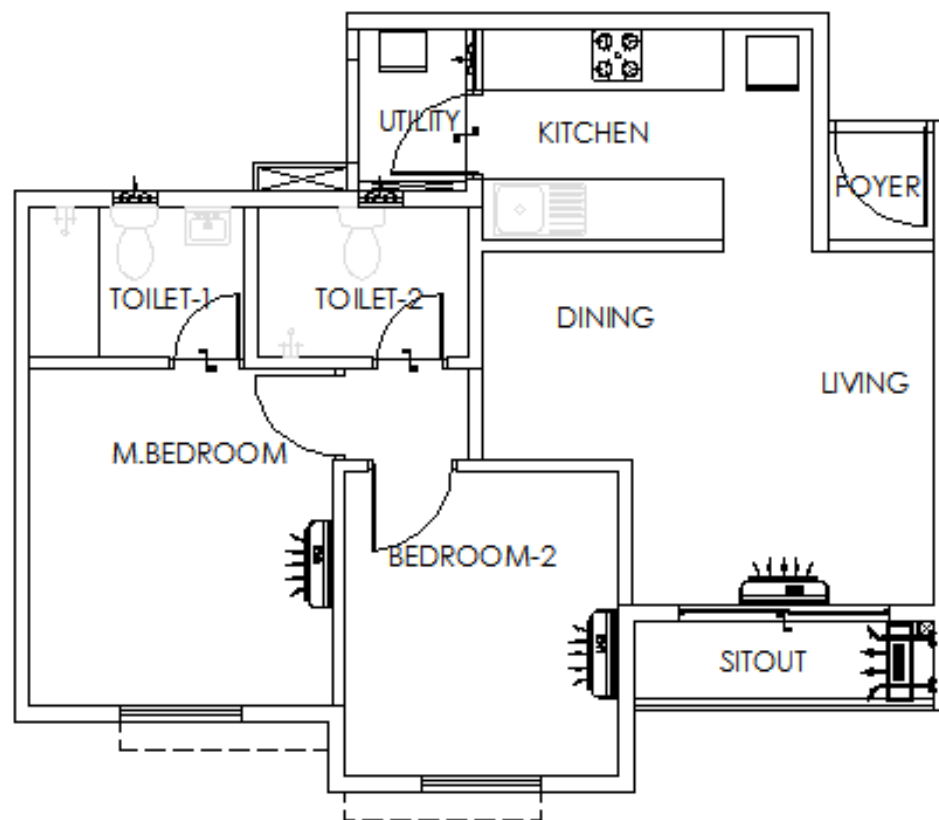
1 BHK SN TYPICAL PLAN

Architectural Floor Plan– 2BHK–SN



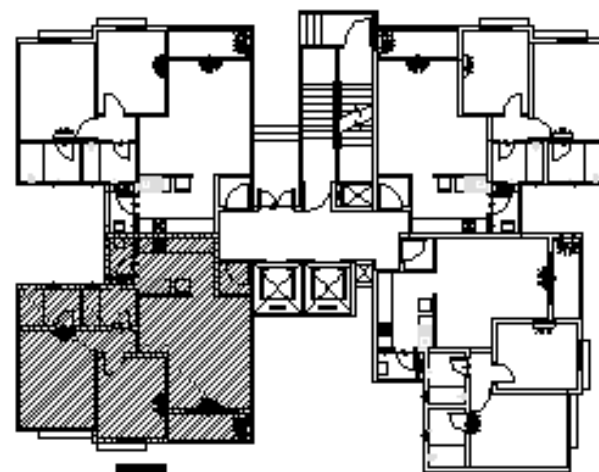
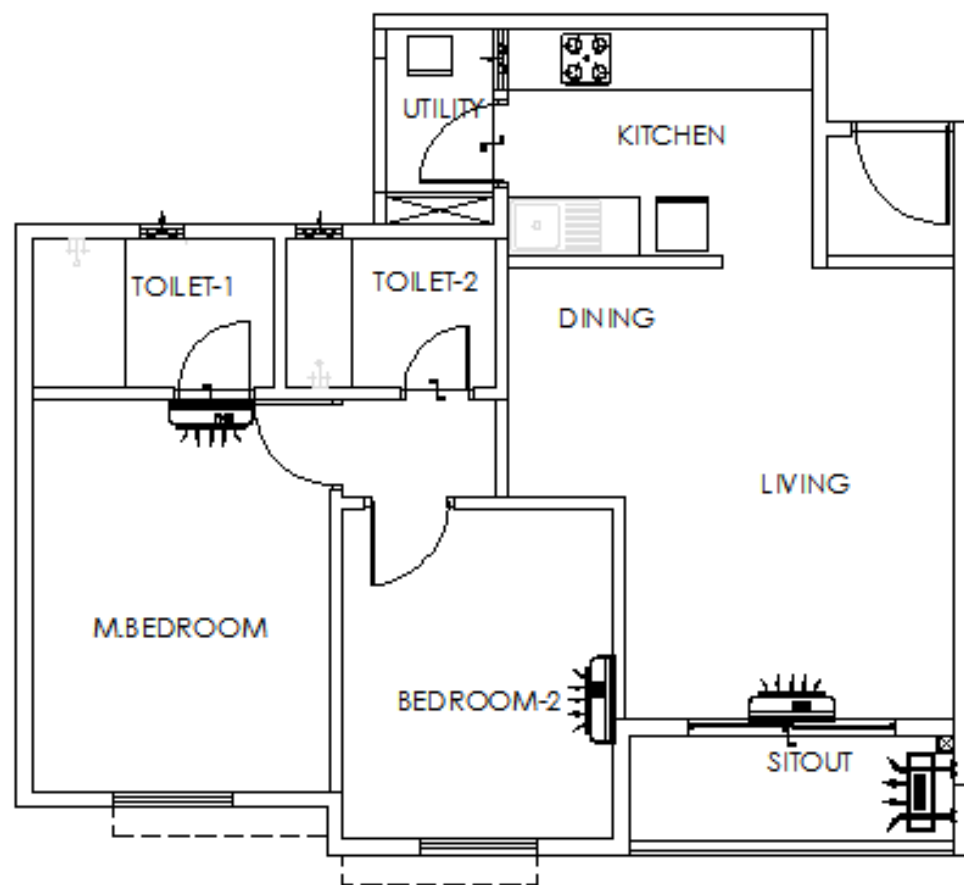
2 BHK SN TYPICAL PLAN

Architectural Floor Plan- 2BHK-SMALL



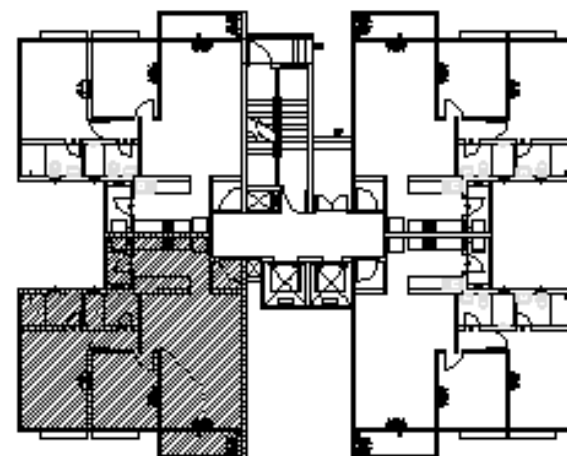
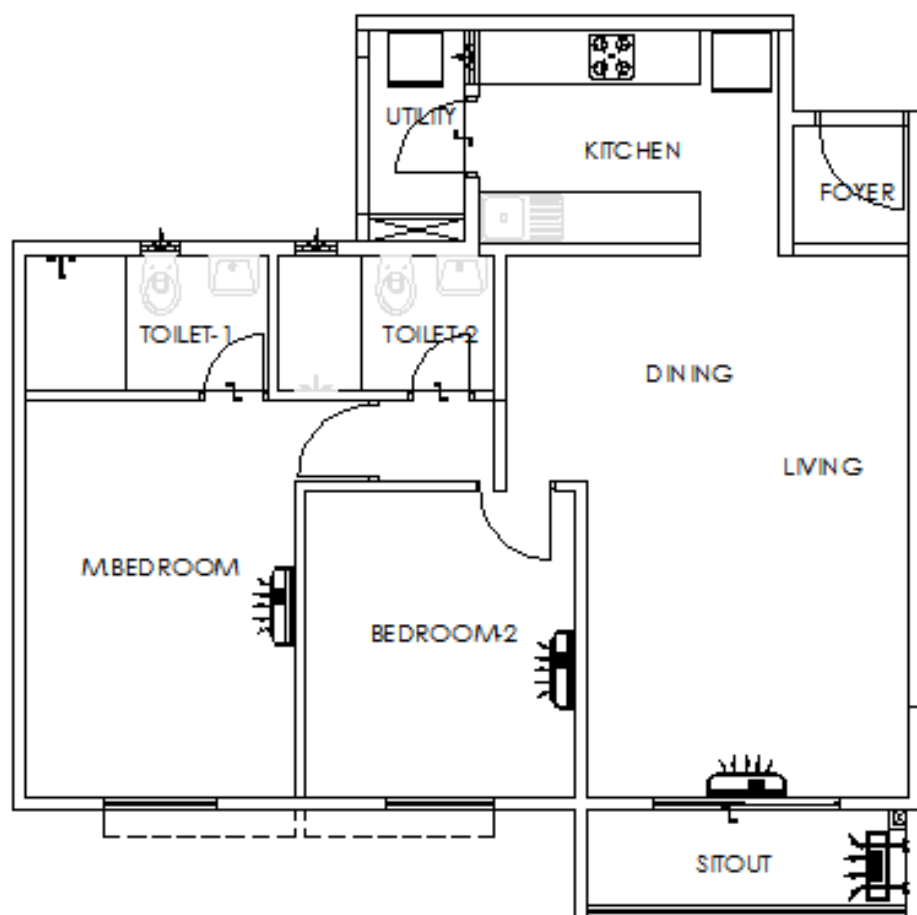
2 BHK SMALL TYPICAL PLAN

Architectural Floor Plan– 2BHK–MID



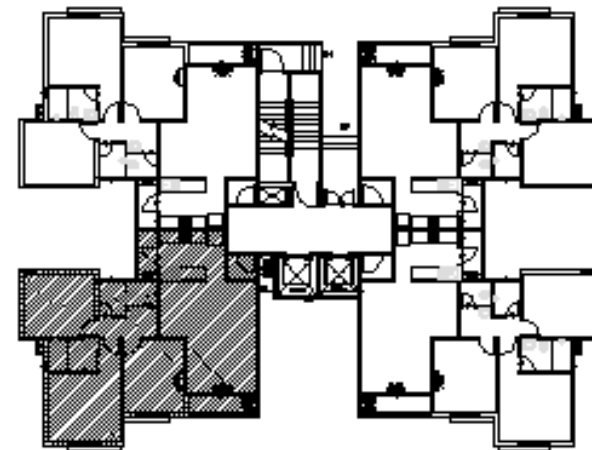
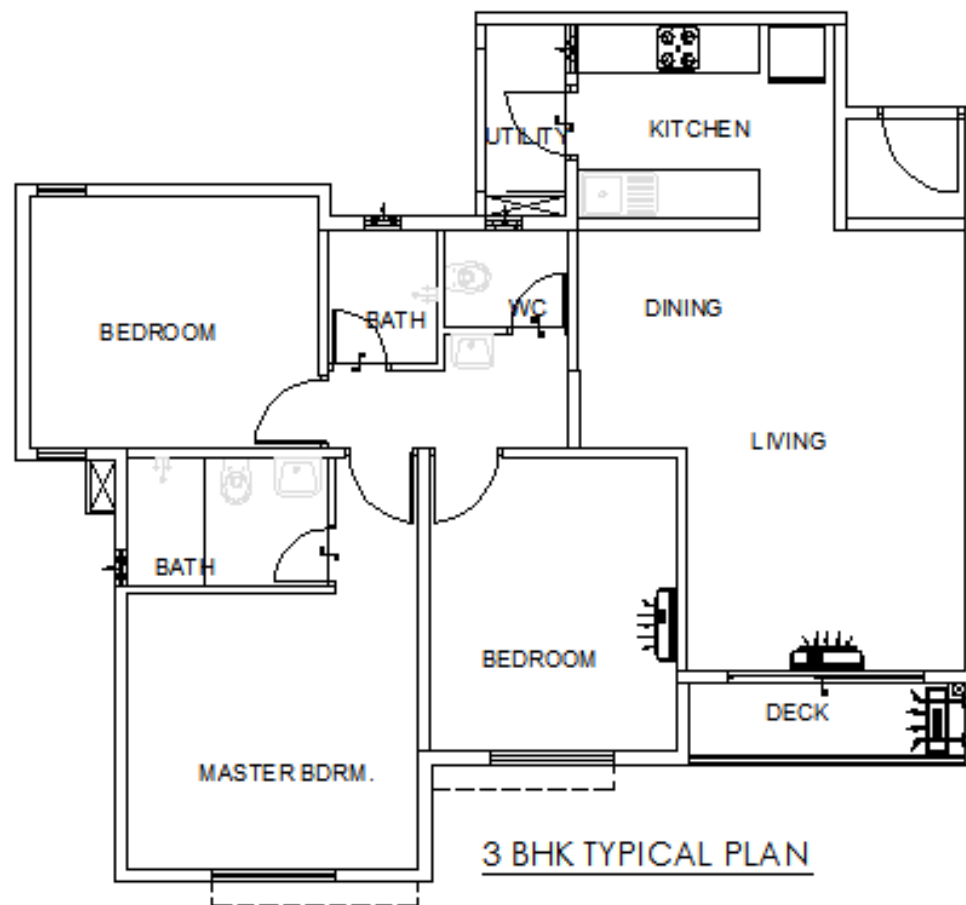
2 BHK MID TYPICAL PLAN

Architectural Floor Plan– 2BHK–LARGE



2 BHK LARGE TYPICAL PLAN

Architectural Floor Plan– 3BHK



Structural Design

Structural Design – Criterion

- ▶ Reinforced Concrete Members as per IS 456:2000
- ▶ Pre-stressed Hollow core slabs as class 2 members as per IS 1343:1980
- ▶ Structural Steel members as per IS 800:1984
- ▶ Connections of Precast Elements as per IS 11447:1985
- ▶ Precast Building Design as per IS 15916 : 2010
- ▶ Erection of Precast Concrete Elements as per IS 15917: 2010

Structural Design – Loads

- ▶ The Dead Loads are calculated based on unit weights as per IS 875–1
 - Floor finish = 1.0 kN/sqm
 - Partition Wall = 0.5 kN/sqm
 - Services = 0.25 kN/sqm
- ▶ The live loads are calculated as per IS 875–II
 - Residential Rooms = 2.0 kN/sqm
 - Stairs, Lobbies & Balcony = 3 kN/sqm
- ▶ The Wind Loads are calculated based on IS 875 part3 (For Bengaluru Region– $V_b = 33$ m/s, 50 Year return period, Terrain Category 2, Structure size class A)
- ▶ The Seismic Forces are calculated based on IS 1893 part 1:2002 (For Bengaluru Region – Zone II, $Z=0.10$, $R = 3$,
▶ $I = 1.0$, Medium Strata, 5% damping)

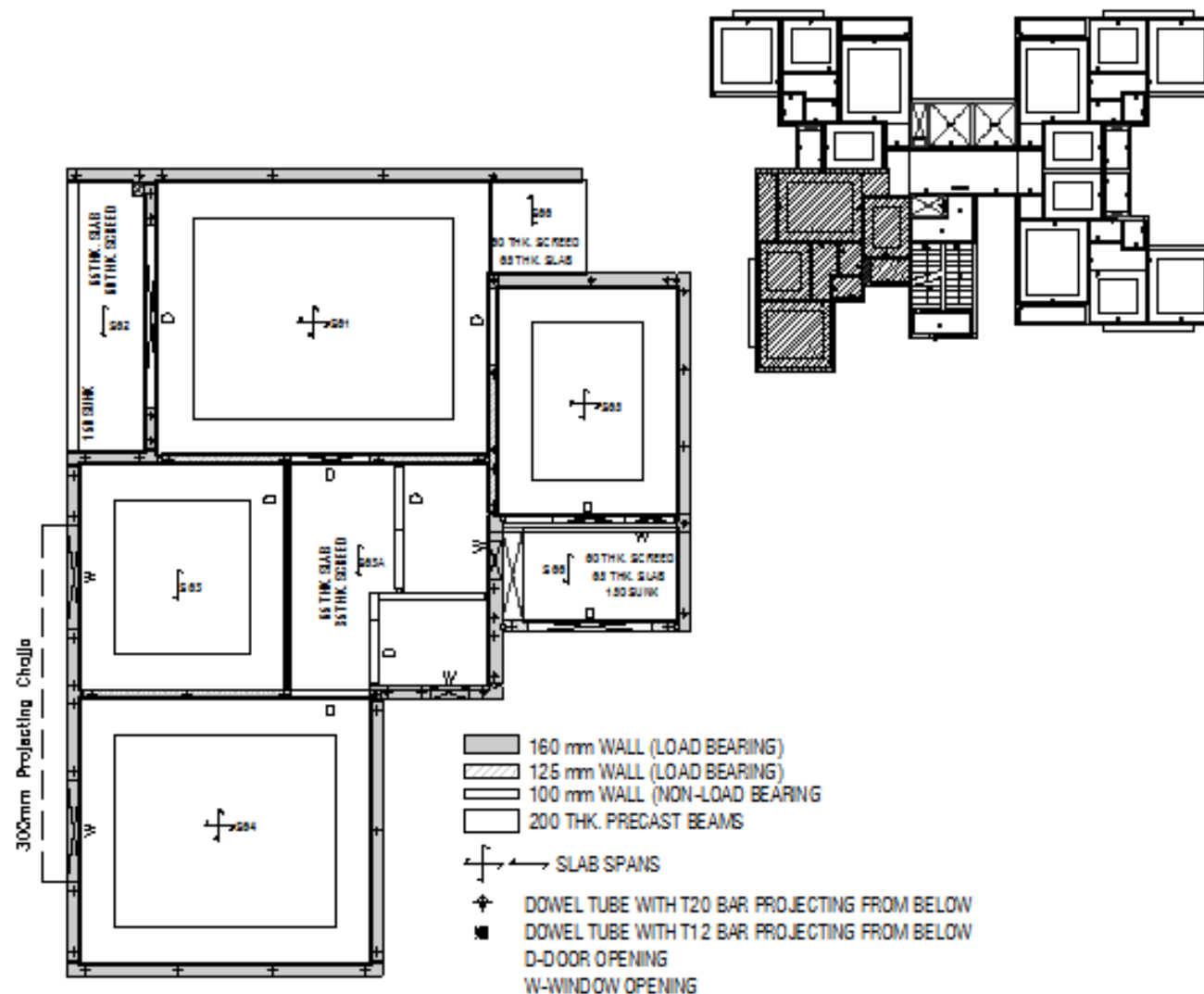
Structural Design – Serviceability

- ▶ The Final Deflection due to full Service load shall not exceed $L/250$
- ▶ The Deflection before applying finishes shall not exceed $L/350$
- ▶ The Lateral sway due to wind loads shall not exceed $H/500$
- ▶ The storey drift at any floor shall not exceed 0.004 times the storey height under design seismic force (working)
- ▶ The secondary effects (P-Delta analysis) should be considered if Q as defined in E-2 of IS 456 exceeds 0.04

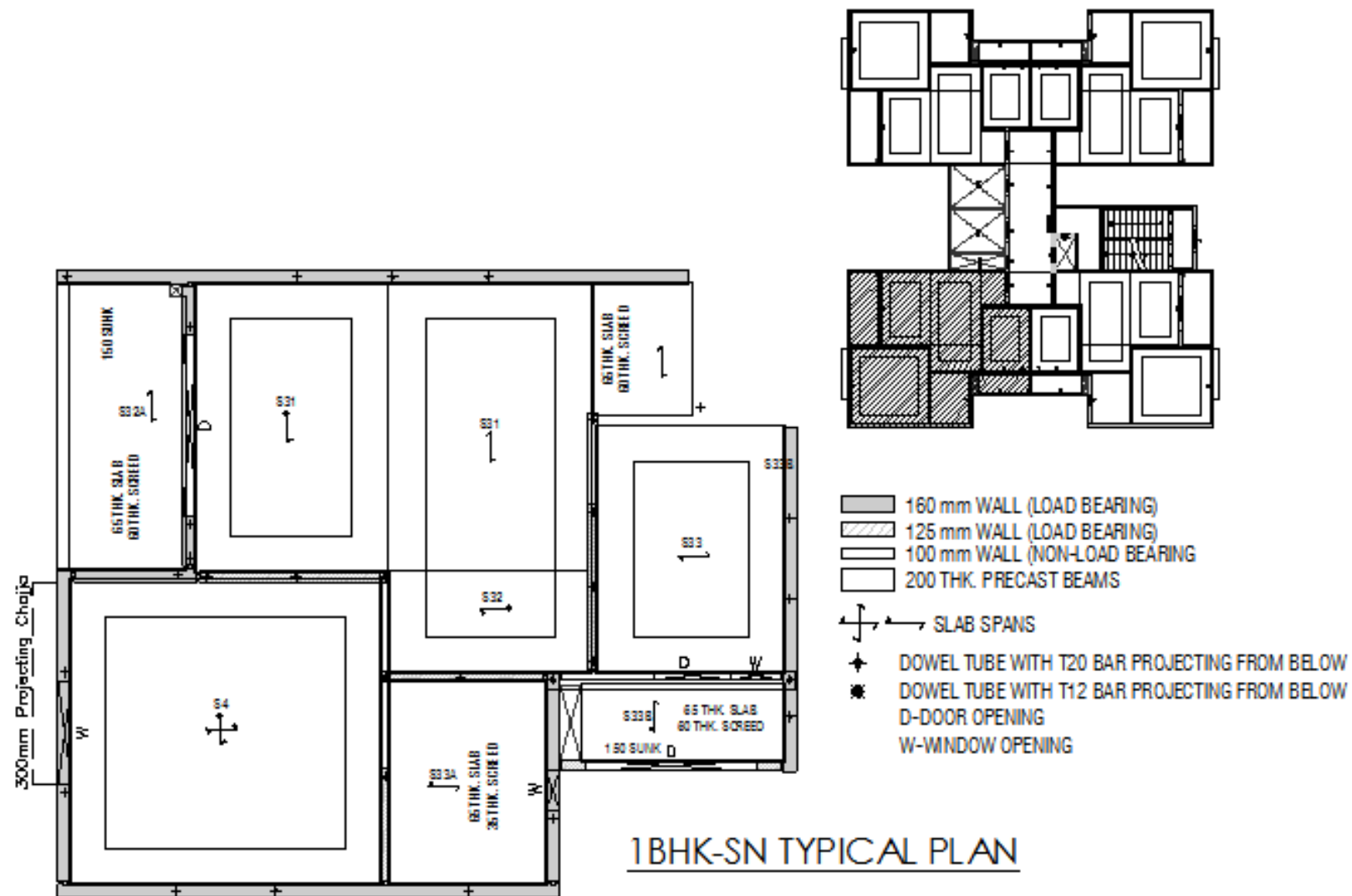
Structural System Proposed

Structure Type	Structure Description
Sub Structure (Framed)	In Situ (Foundation, Column-Beams)
Super Structure (Framed)	Precast Load Bearing walls
External and dividing Walls (Load bearing) 160mm Thk.	Precast Solid Walls
Internal Walls (Load bearing) 125mm Thk.	Precast Solid Walls
Partition Walls (Non-Load bearing) 100mm Thk.	Precast Solid Walls
Floor Slab 125mm Thk.	Precast Notched slab (room size)

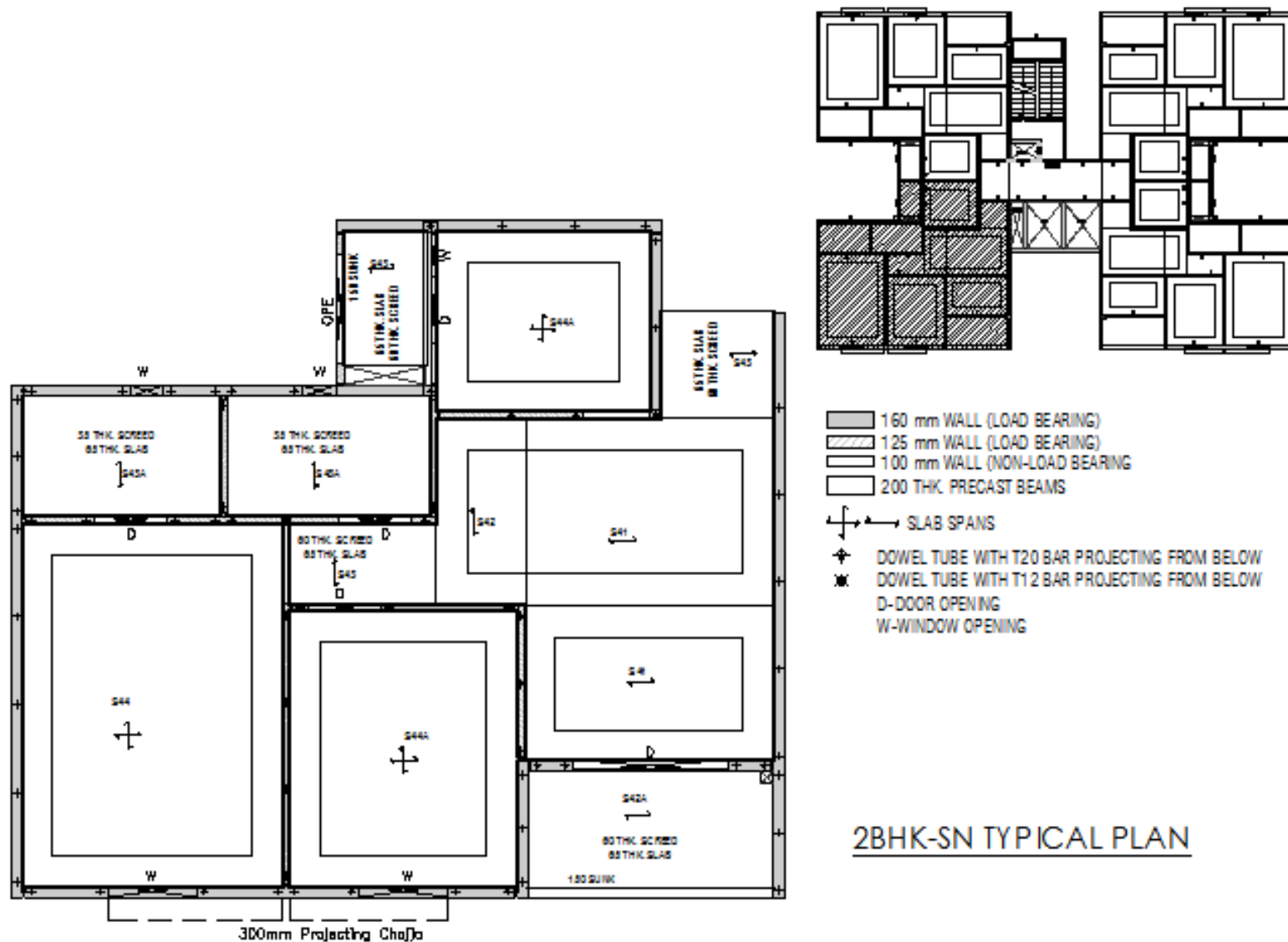
Structural Framing Plan– 1.5BHK



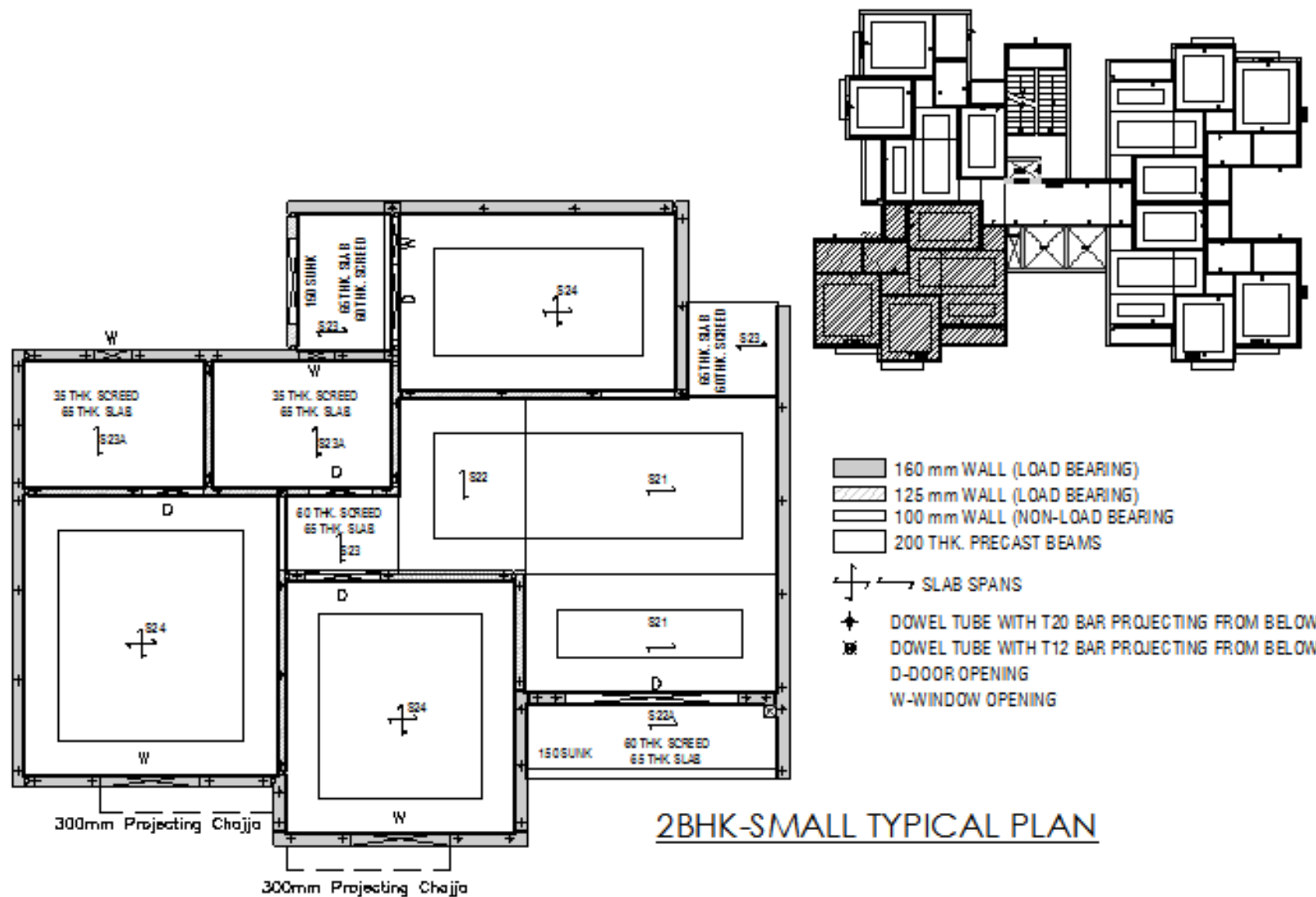
Structural Framing Plan– 1 BHK–SN



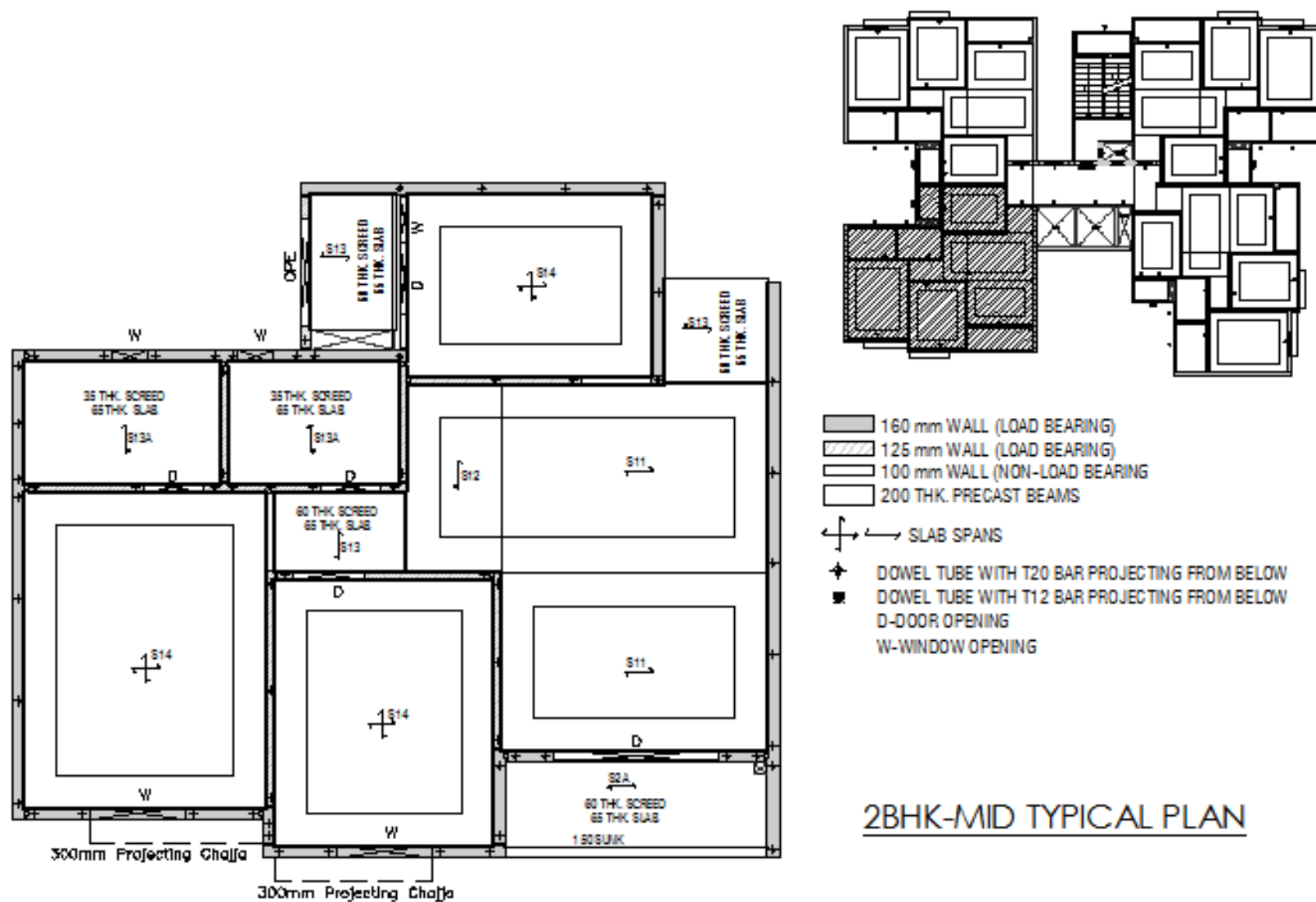
Structural Framing Plan– 2BHK–SN



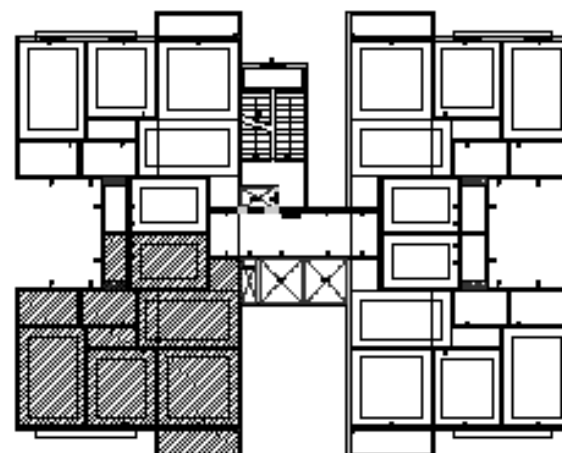
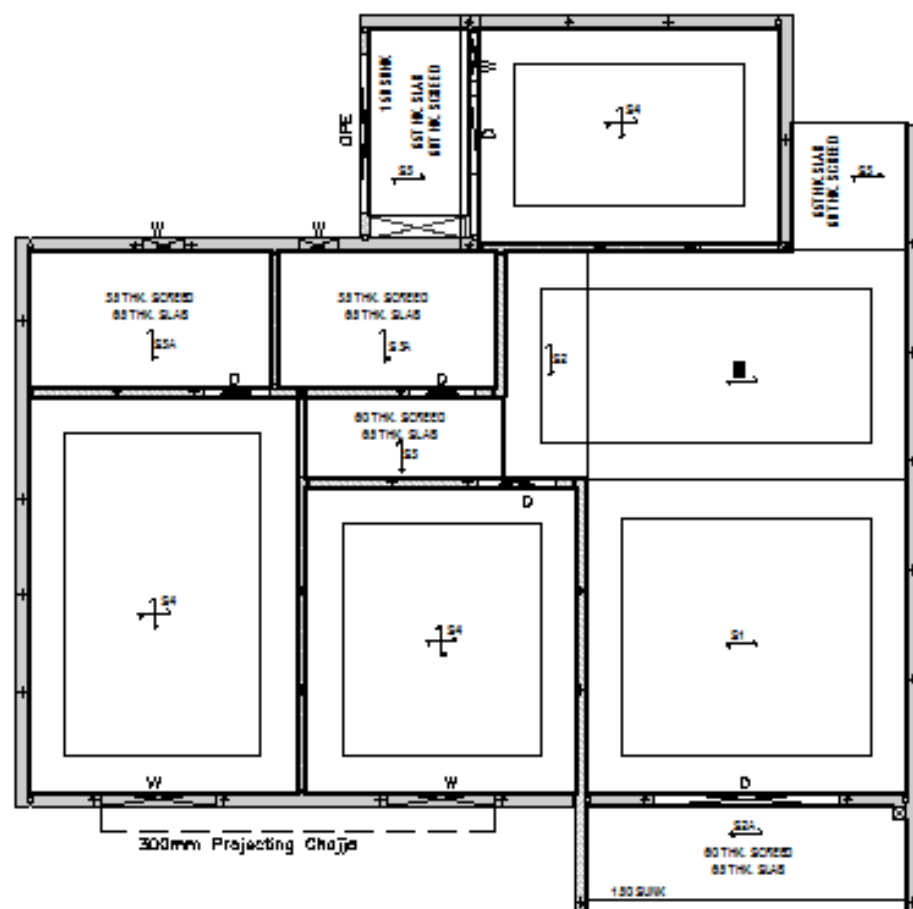
Structural Framing Plan- 2BHK-SMALL



Structural Framing Plan– 2BHK–MID



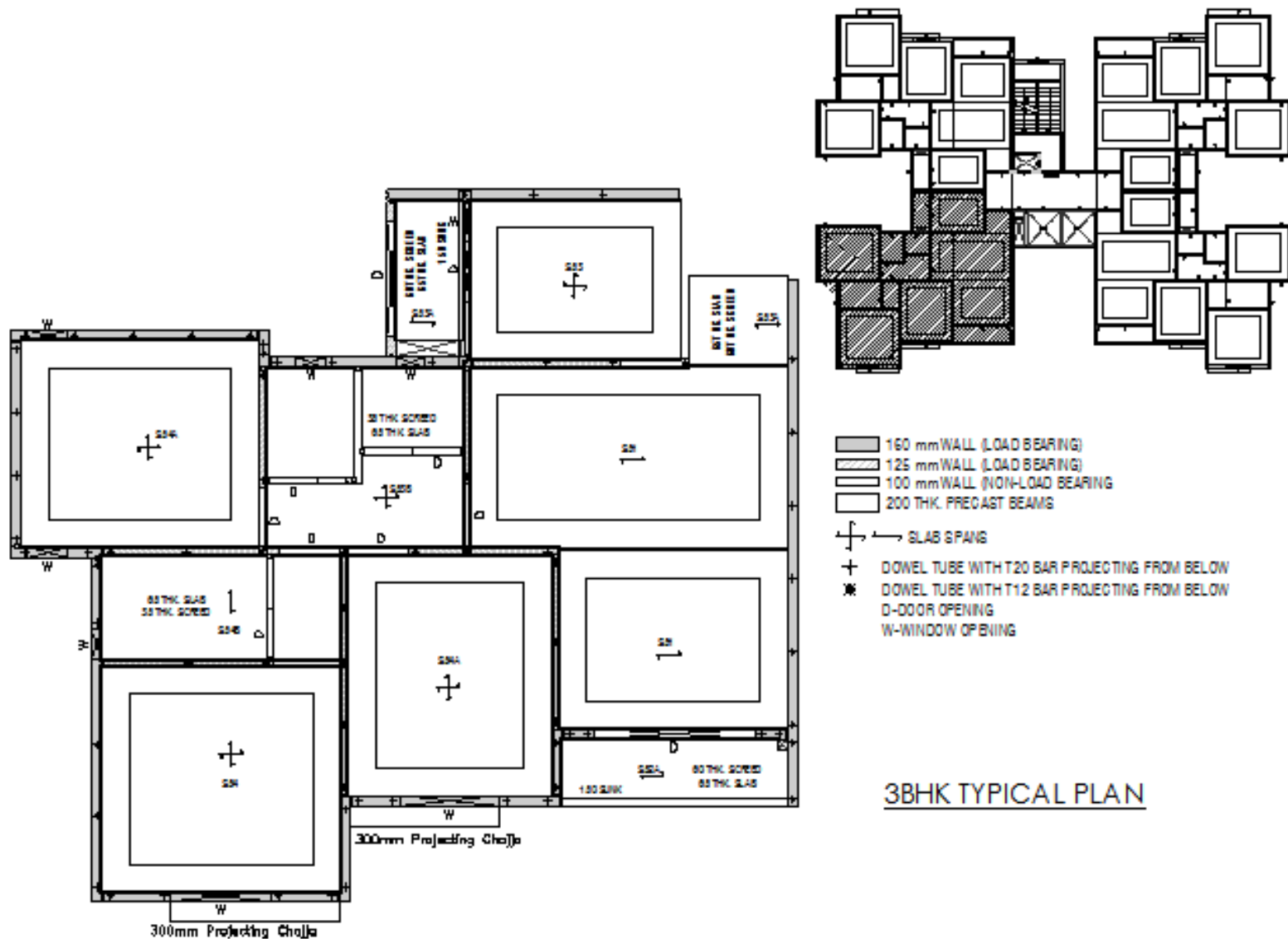
Structural Framing Plan- 2BHK-LARGE

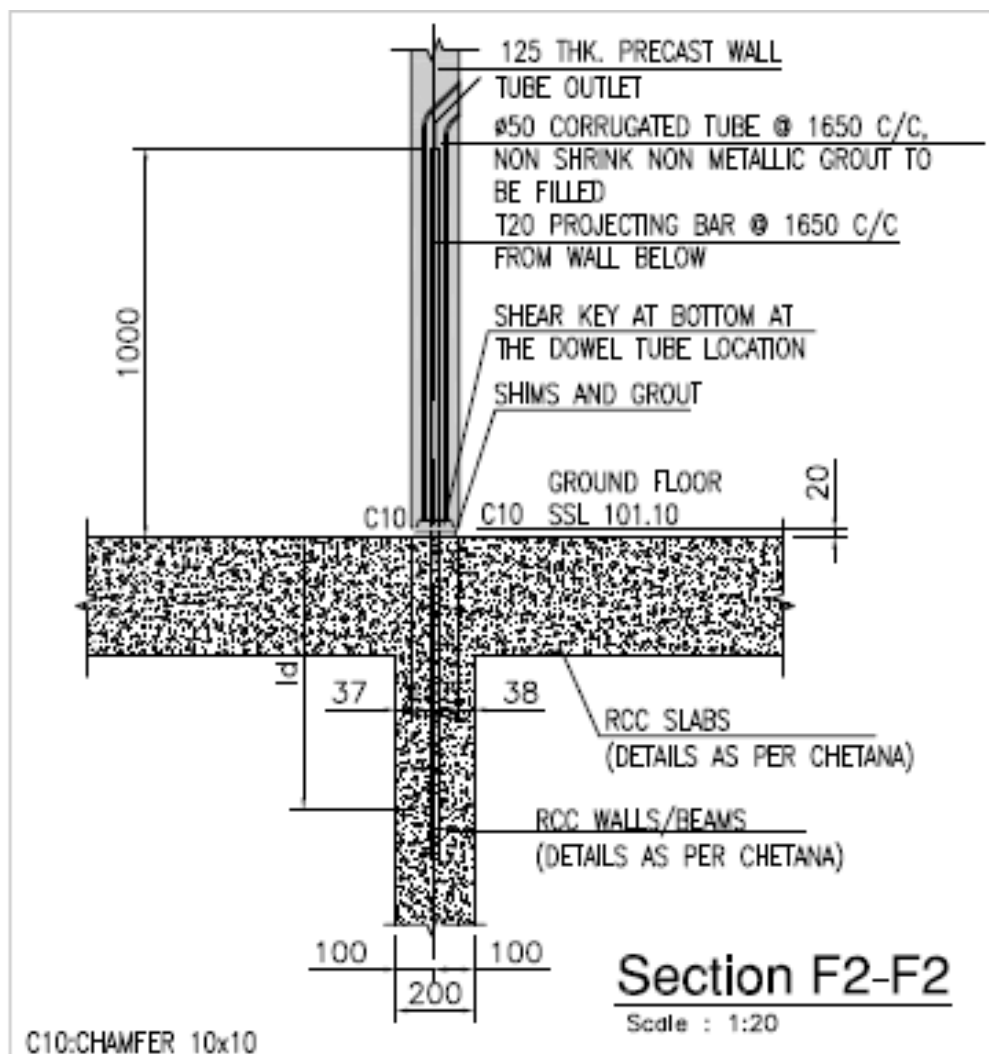


- 160 mm WALL (LOAD BEARING)
- 125 mm WALL (LOAD BEARING)
- 100 mm WALL (NON-LOAD BEARING)
- 200 THK. PRECAST BEAMS
- SLAB SPANS
- DOWEL TUBE WITH T20 BAR PROJECTING FROM BELOW
- DOWEL TUBE WITH T12 BAR PROJECTING FROM BELOW
- D-DOOR OPENING
- W-WINDOW OPENING

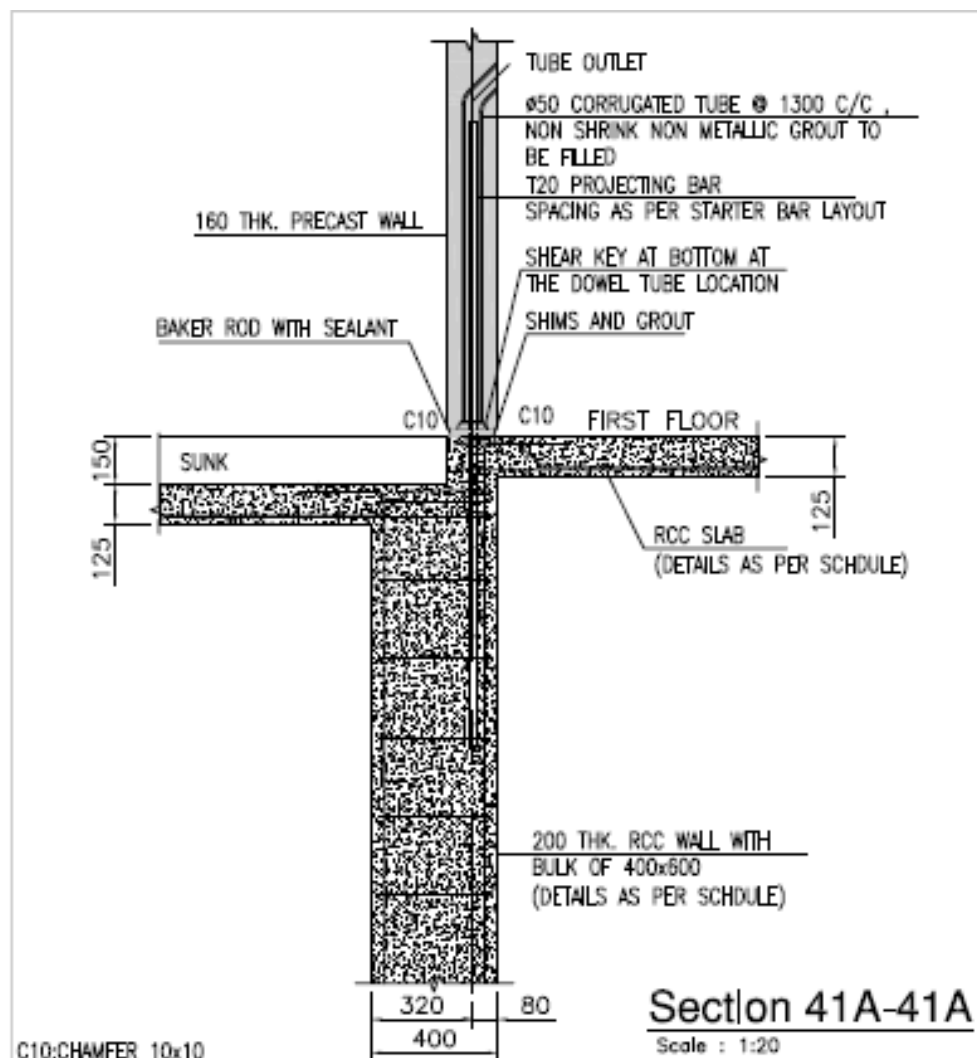
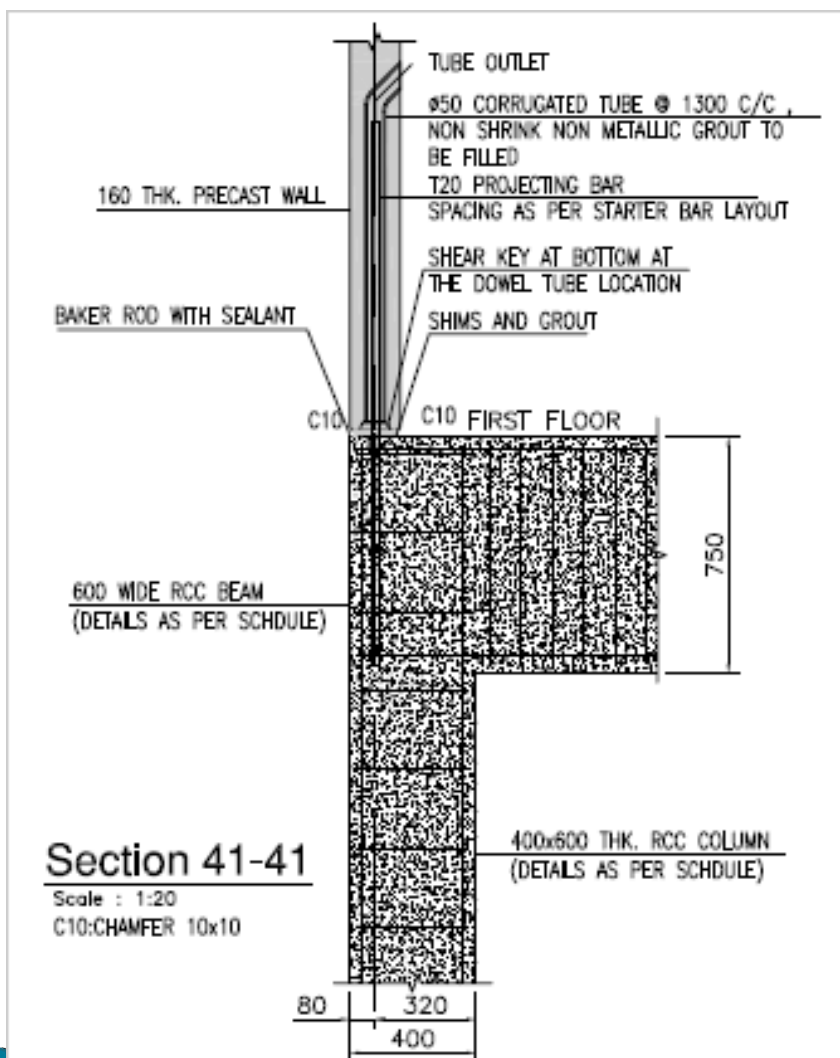
2BHK-LARGE TYPICAL PLAN

Structural Framing Plan- 3BHK

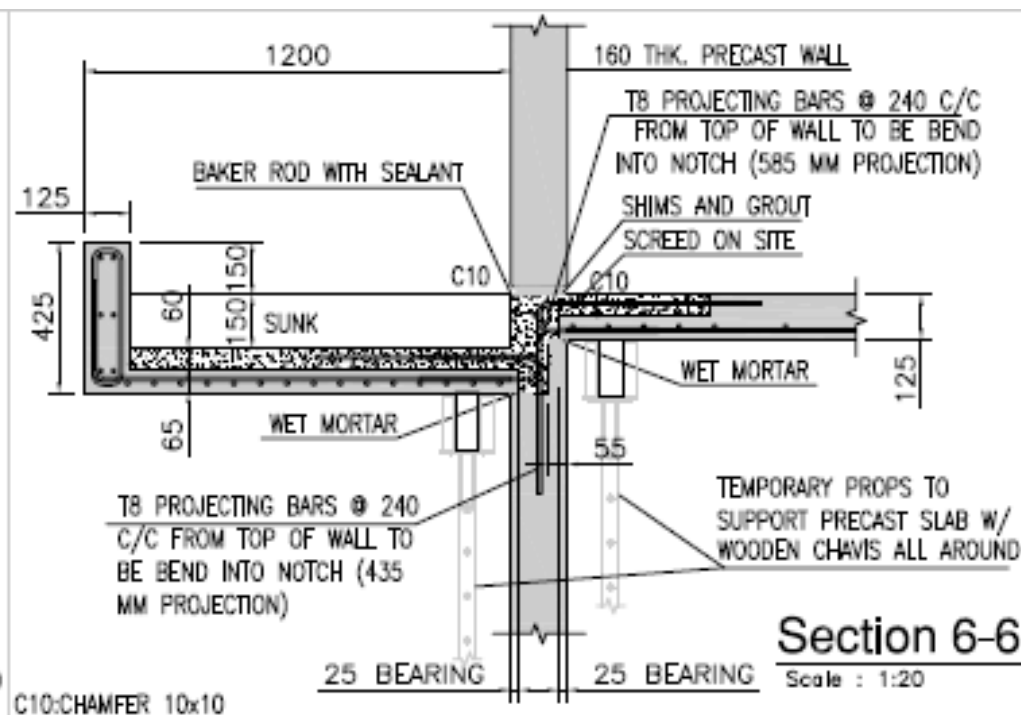
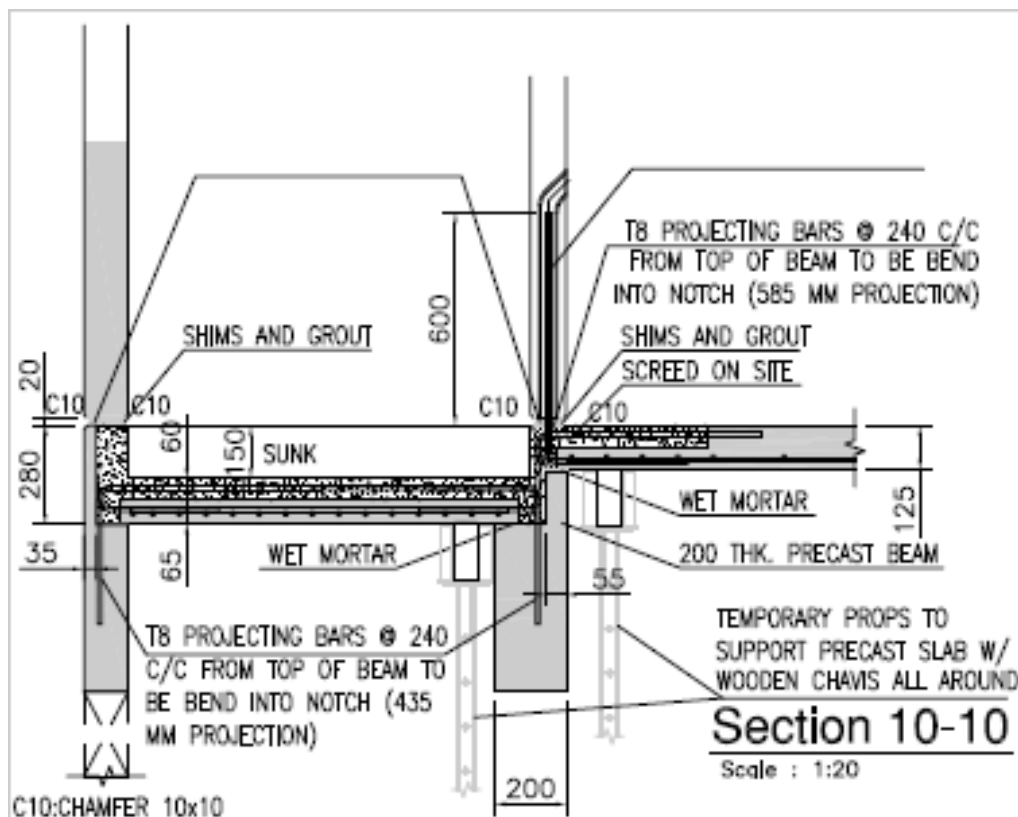




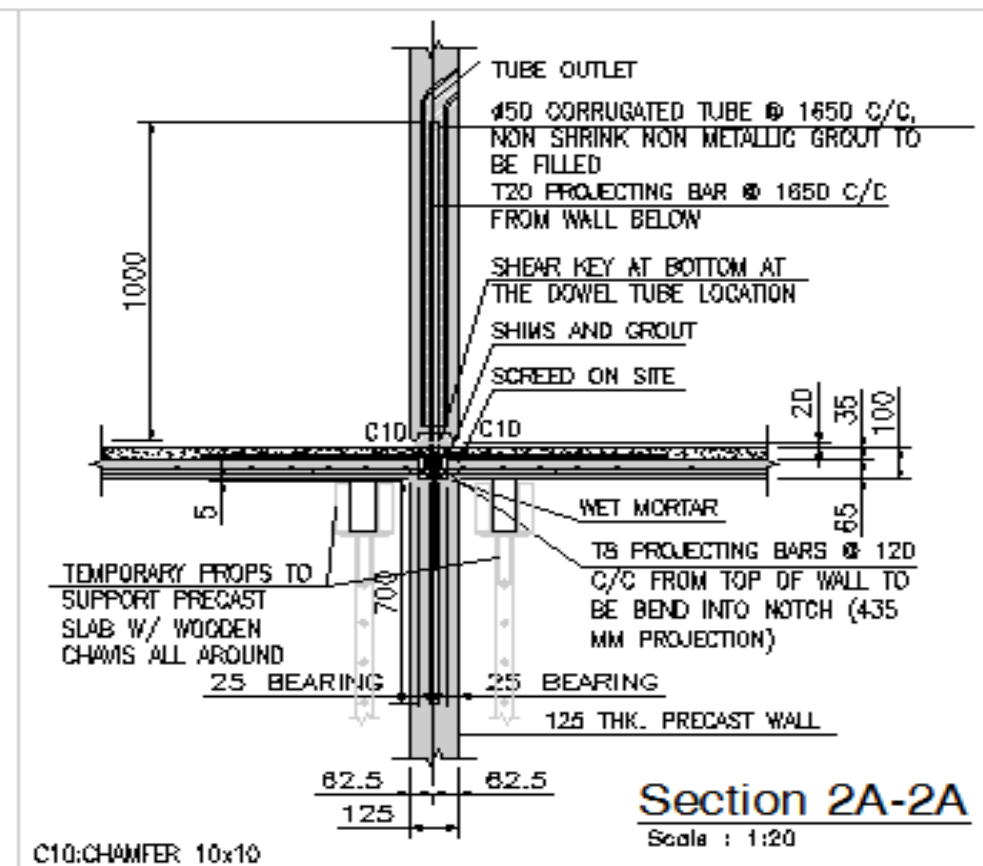
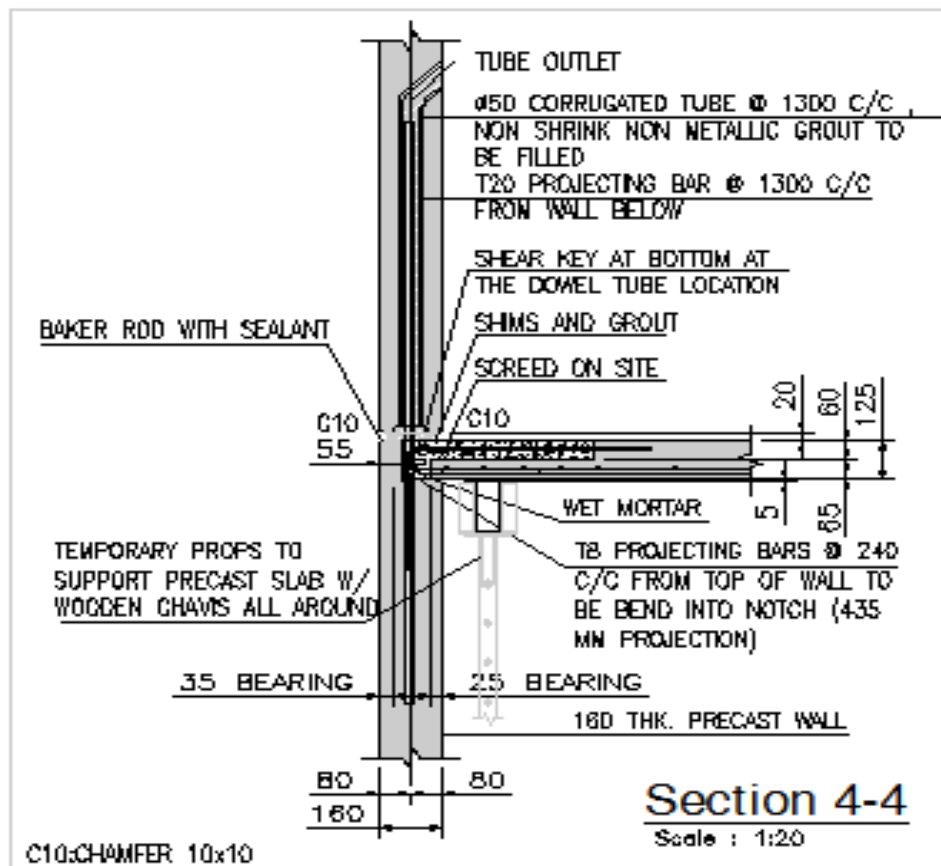
Structural Connections – In-situ at first floor to precast at upper floor



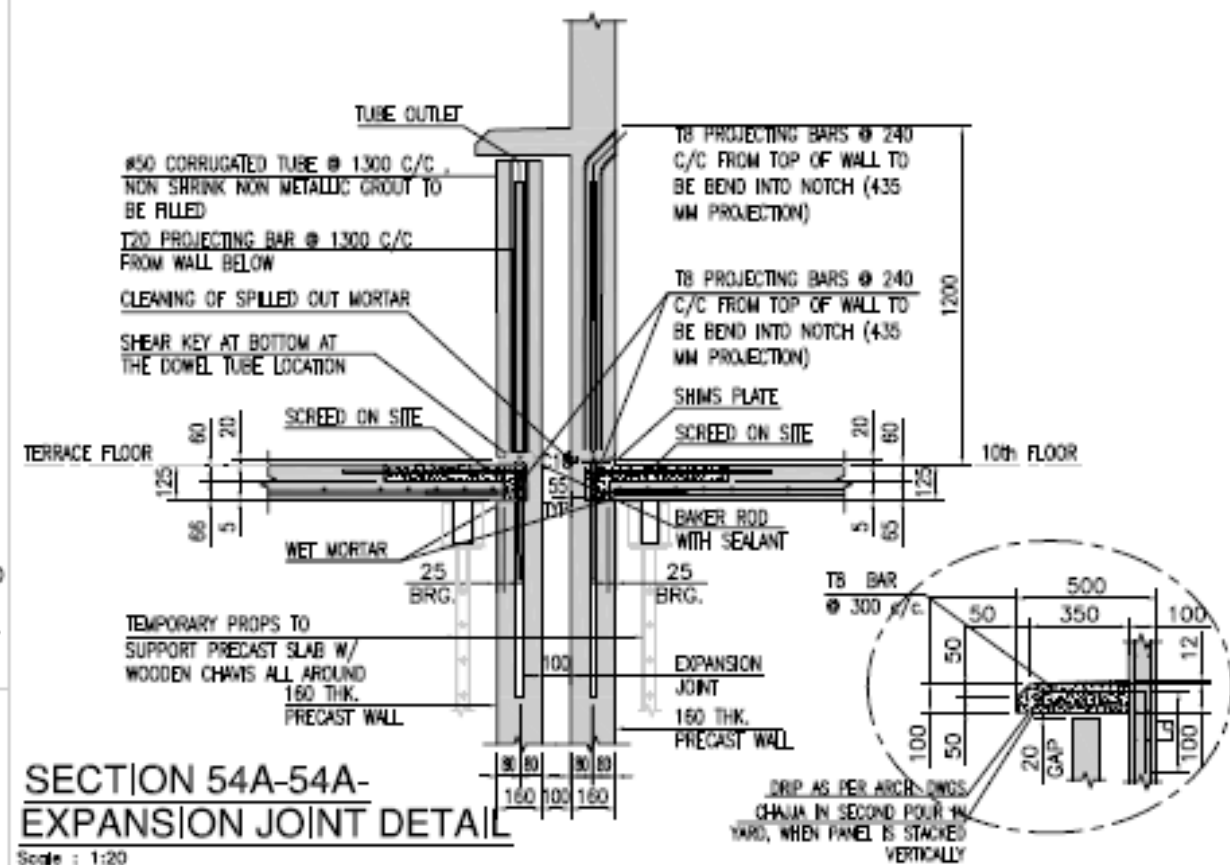
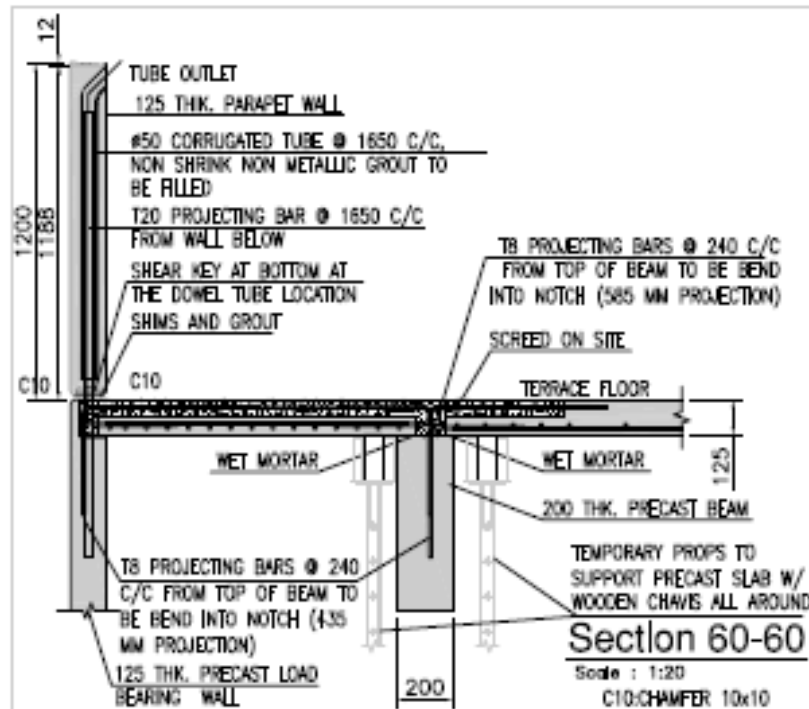
Structural Connections – Typical section for sunken slab



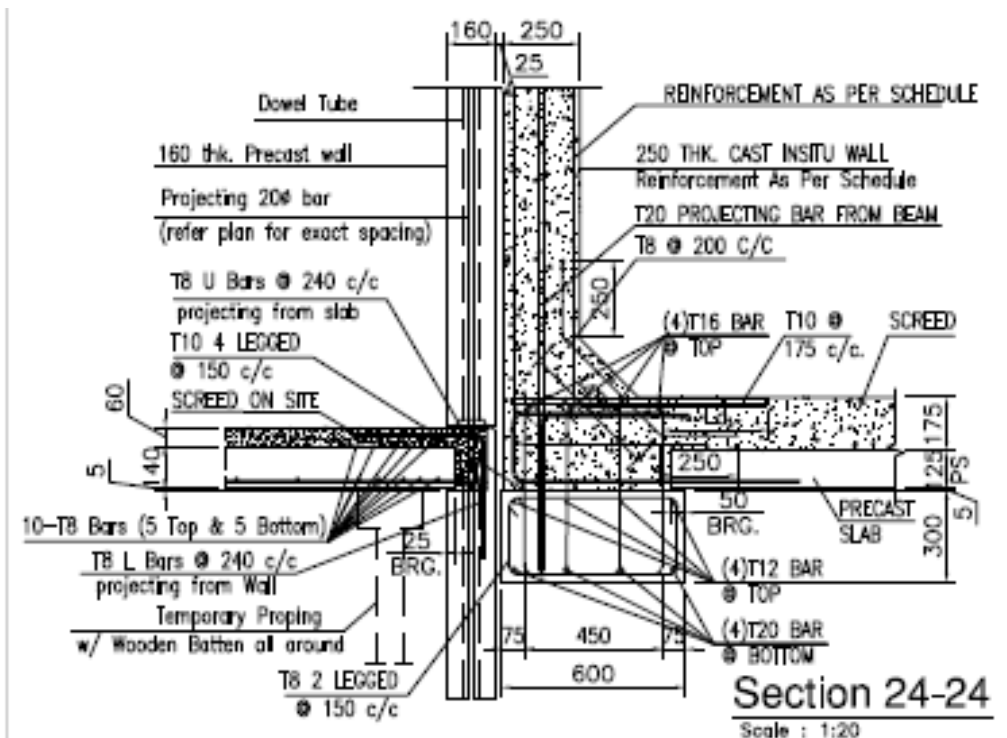
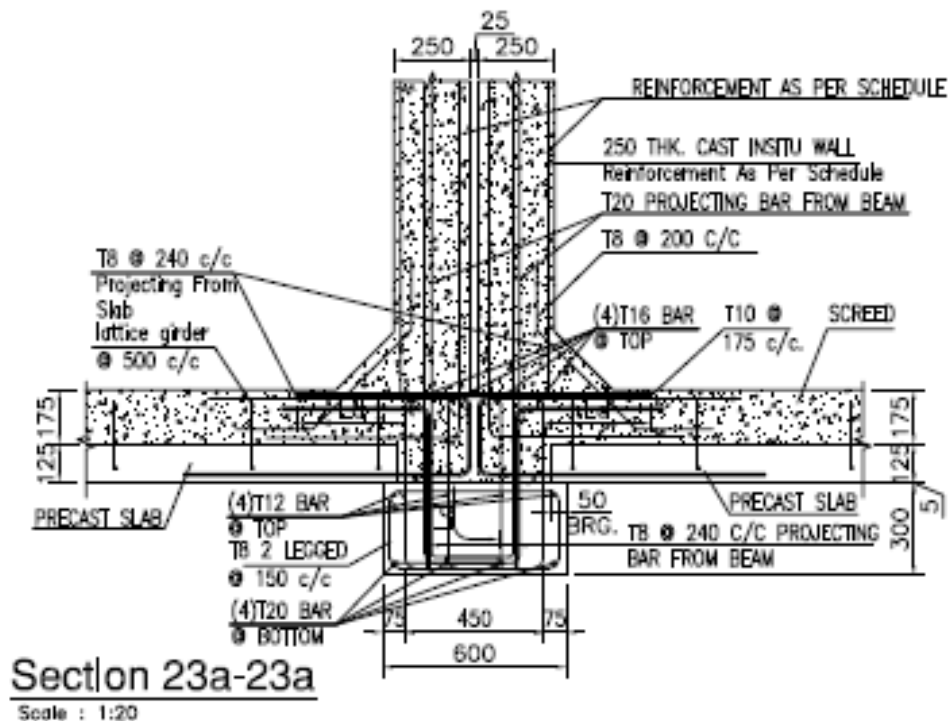
Structural Connections – Typical section for precast wall to wall



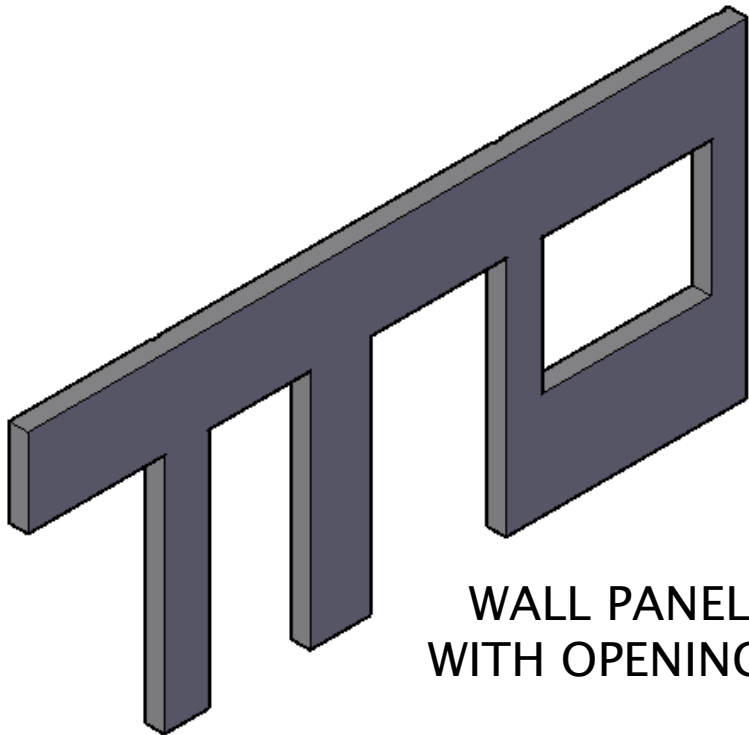
Structural Connections – At Terrace parapet level



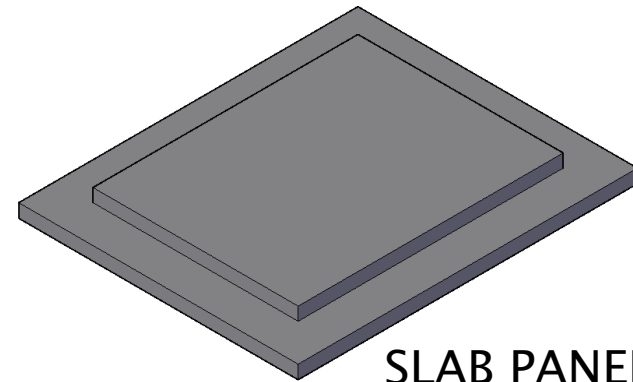
Structural Connections – At LMR level



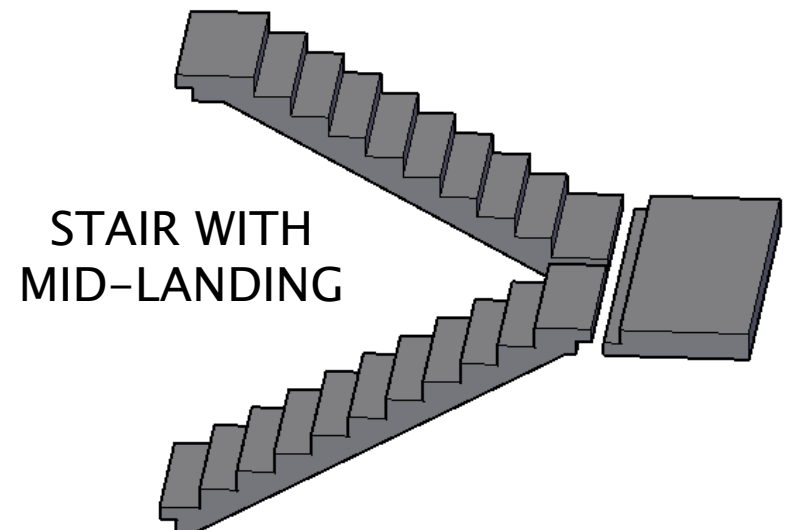
Typical Precast Elements



WALL PANEL
WITH OPENINGS



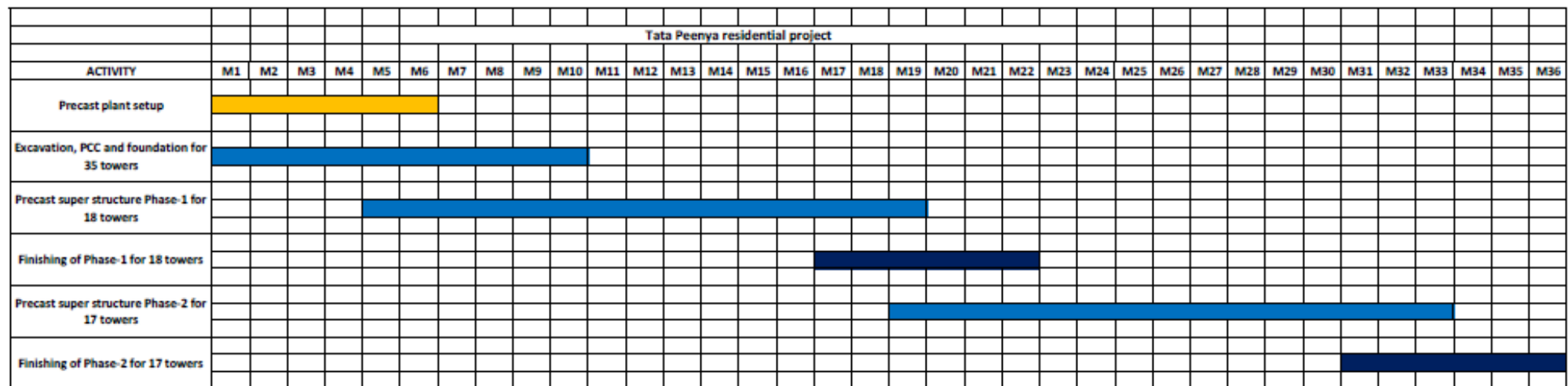
SLAB PANEL
WITH NOTCH



STAIR WITH
MID-LANDING

Project Planning

Overall Time line: (36 months completion)



M= Month

Precast structure BOQ: For 35 towers (7 typologies) Built up area = 1657107 sq.ft.

Description	Concrete in m3	Steel in Kg/m3	Total Steel in tons
160 mm Wall	34606	70	2422
125 mm Wall	11083	65	720
100 mm Wall	826	55	45
Precast Slab	15400	85	1309
Precast Beams	448	120	54
Precast Stairs	1062	60	64
Precast Landings	730	130	95
Screed	5450	0	0
OHWT	315	150	47
Columns at ground floor	205	200	41
Walls at ground floor	240	80	19
Beams at ground floor	200	150	30
Total	70565		4847
Ratio / sq.ft.	0.043 cum/sft		2.92 kg/sft

Precast Elements Abstract: For 35 towers

Elements	1.5 BHK	1-BHK-SN	2-BHK-SN	2-BHK-SMALL	2-BHK-MID	2-BHK-LARGE	3-BHK
Wall Panel/floor	103	90	110	106	109	106	138
Precast Slab/floor	38	42	64	55	54	54	46
Precast Stair case/floor	2	2	2	2	2	2	2
Precast Beams/floor	3	2	2	3	3	2	2
No of elements per floor	146	136	168	166	168	164	188
No. of typical floors	69	13	35	129	121	73	39
Total No. of elements	10074	1766	5880	21414	20328	11972	7332

Planning – Production

Elements are produced every day considering 375 working days for Production for Phase-1

Type of Block	Wall	Slab	Beam	Staircase	Total
1. 5 BHK	7107	2622	207	138	10074
2 BHK-S	13674	7095	387	258	21414
2 BHK-M	1635	810	45	30	2520
2 BHK-L	1590	810	30	30	2460
1 BHK-SN	1170	546	26	26	1768
2 BHK-SN	1430	702	26	26	2184
Total to produced	26606	12585	721	508	40420
Elements to produced every day	71	34	2	2	109

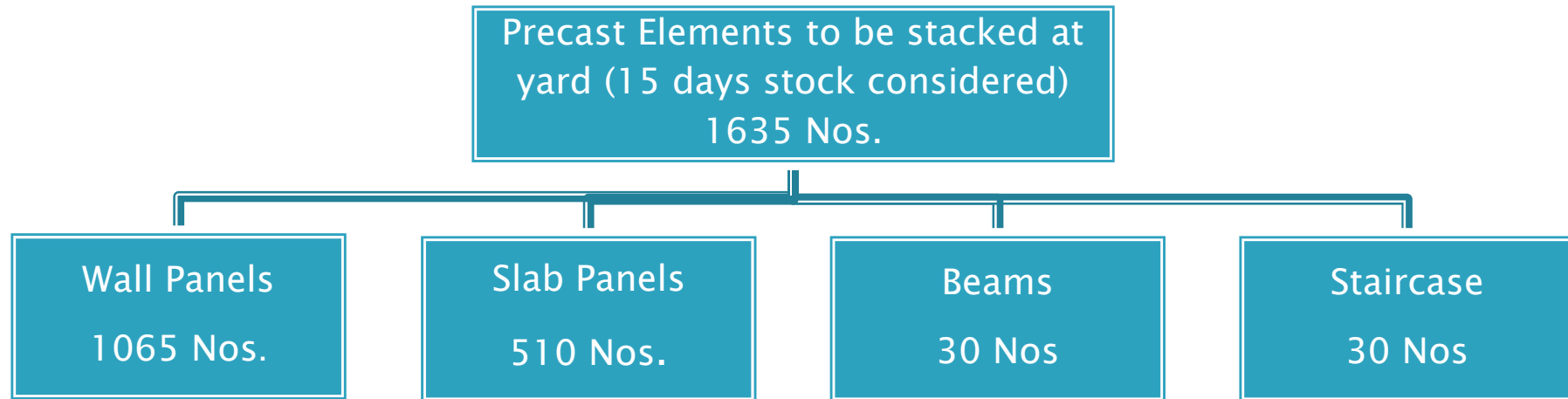
Planning – Production

Elements are produced every day considering 375 working days for Production for Phase-2

Type of Block	Wall	Slab	Beam	Staircase	Total
2 BHK-M	11554	5724	318	212	17808
2 BHK-L	6148	3132	116	116	9512
3 BHK	5382	1794	78	78	7332
2 BHK-SN	2420	1188	44	78	3696
Total to produced	25504	11838	656	450	38348
Elements to produced every day	68	32	2	2	104

Planning – Stacking

Manufactured elements were stacked after de-molding / cured. The Stock yard was planned for 15 days stock.



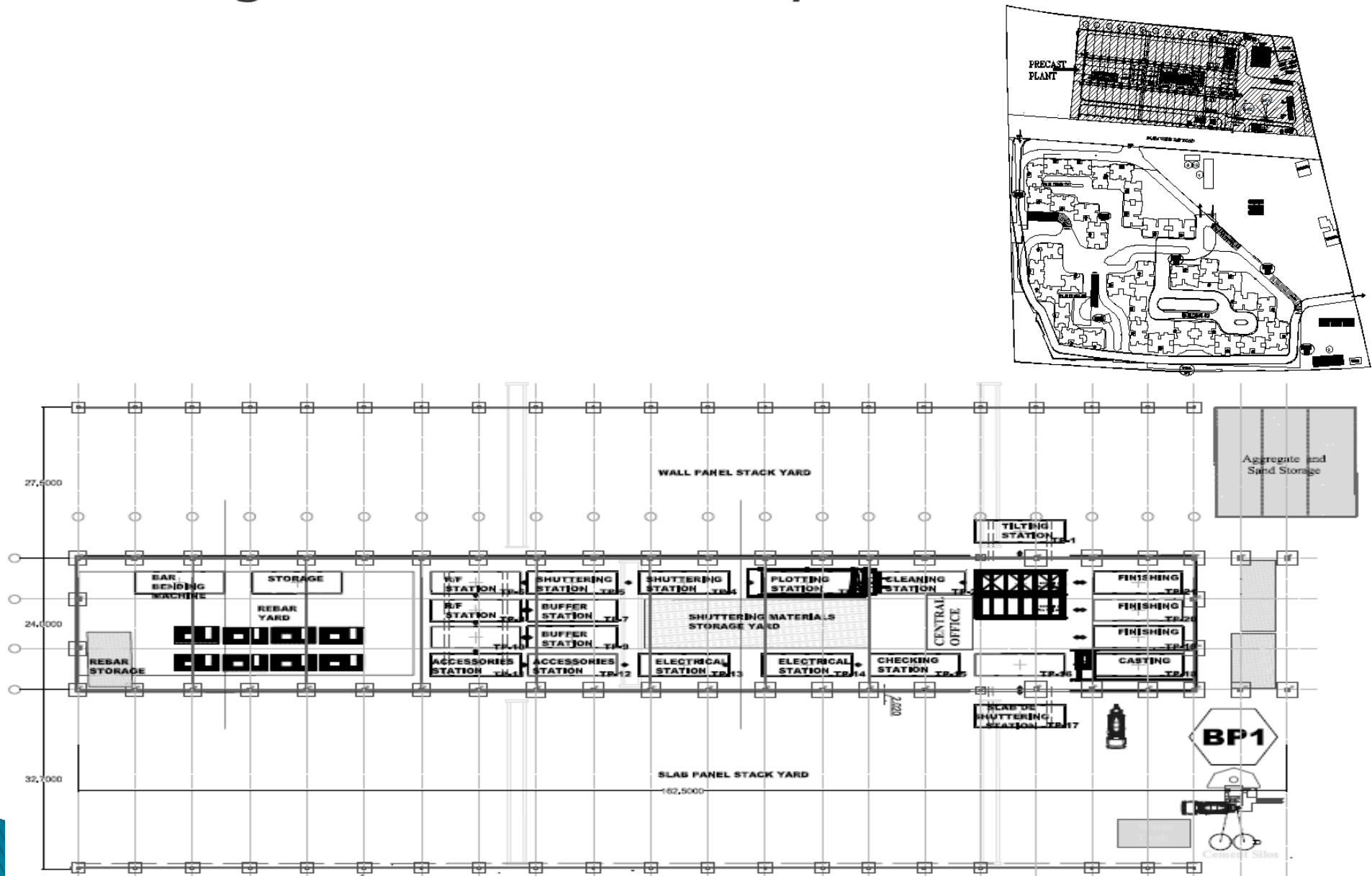
Planning – Precast Plant Set-up

- ▶ Carousel System (30 Pallets 12.0 x 4.0m) with Curing Chamber (For manufacturing 960 sq.m. of walls + slabs each day in one shift, considering 67% efficiency of pallet).
- ▶ Bar bending Machines (1no.) (For 10 T per day of bar cutting & bending)
- ▶ Vertical Stair Mould – 1 no for 2 flights per day.
- ▶ Batching Plant (1 shaft mixer) with concrete transfer system by transit mixer (For 123 Cu.m. per day per shift)
- ▶ Cement Silo, Aggregate storage beans, Platform etc.
- ▶ PEB shed for Plant & Facilities. (4000 sqm)
- ▶ EOT cranes in shed (10T capacity 2 Nos. maximum weight of element 5 T.)
- ▶ Gantry in Stock Yard (10T capacity 4 Nos.)
- ▶ Diesel Generator
- ▶ Transformer(1000 KVA)
- ▶ Forklift (5 ton) & Misc. Machinery
- ▶ Central Testing Laboratory for testing of concrete & steel.

Planning – Precast Plant Set-up



Planning – Precast Plant Layout



Planning – Transportation

- ▶ On an average 84 elements are transported to the site. The same is facilitated by using 7 no. of trailers (25T) considering 4 trips per day per trailer. (on an average basis 3 elements will be loaded for each trip)



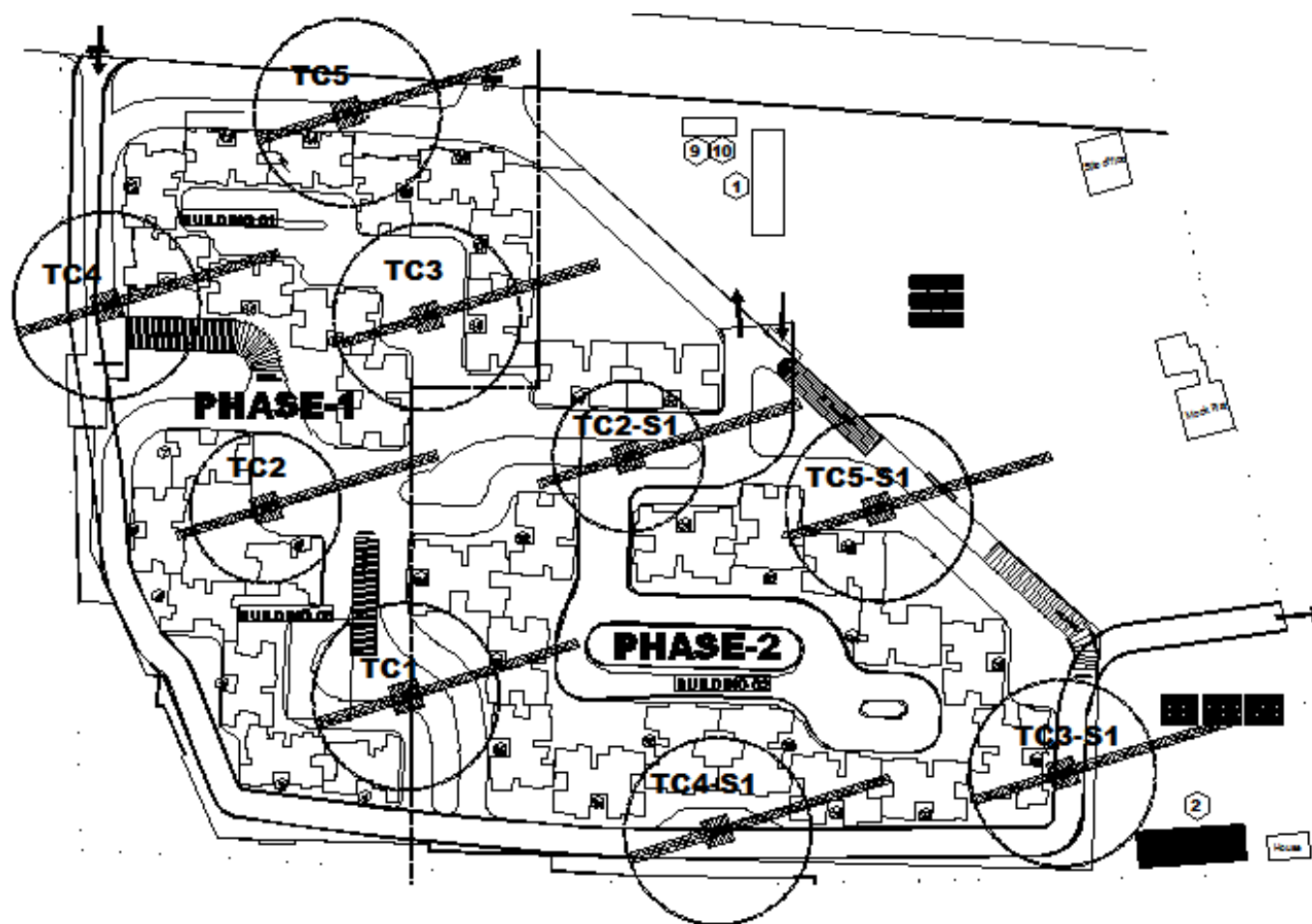
Planning – Erection

- ▶ On an average 84 elements are erected on site. The same is facilitated by using 5 Nos. cranes for Phase-1 and 4 Nos. for Phase-2 Considering 20 minutes per element. (24 elements per day per crane)



Planning – Erection

- Project completed by using 5 Nos. 10T capacity cranes at tip for Phase-1 and 4 Nos. for Phase-2



Project Execution

Project Execution: Cast in situ works

Substructure works for All Sites were taken up in a phased manner as per construction schedule. Major sub structure works are excavation, Anti termite treatment, RCC foundation.



Project Execution: Setting up Precast Plant

Precast yard for casting of precast elements were set up at the 40 Acres of Land provided by the Tata housing



Project Execution: Casting of Precast Walls

Precast Walls are cast on pallets of carousel system.



Project Execution: Casting of Precast Slabs

Precast slabs are cast on pallets of carousel system



Project Execution: Stacking of Precast Elements

Precast Elements are stored in the stockyard till their time of erection



WALL PANELS
STACKING



SLAB PANELS
STACKING

Project Execution: Stacking of Precast Elements

Precast Elements are stored in the stockyard till their time of erection



STAIRCASE
STACKING



BEAMS
STACKING

Project Execution: Transportation of Precast Elements

Precast Elements from Yard to Site shall be transported using trailers', which are loaded at yard by gantry.



SLAB
TRANSPORTATION



WALLS
TRANSPORTATION

Project Execution: Erection of Precast Walls

For wall panel, it is recommended to lift the wall panel in vertical position for installation so that Handling Stresses are minimized.



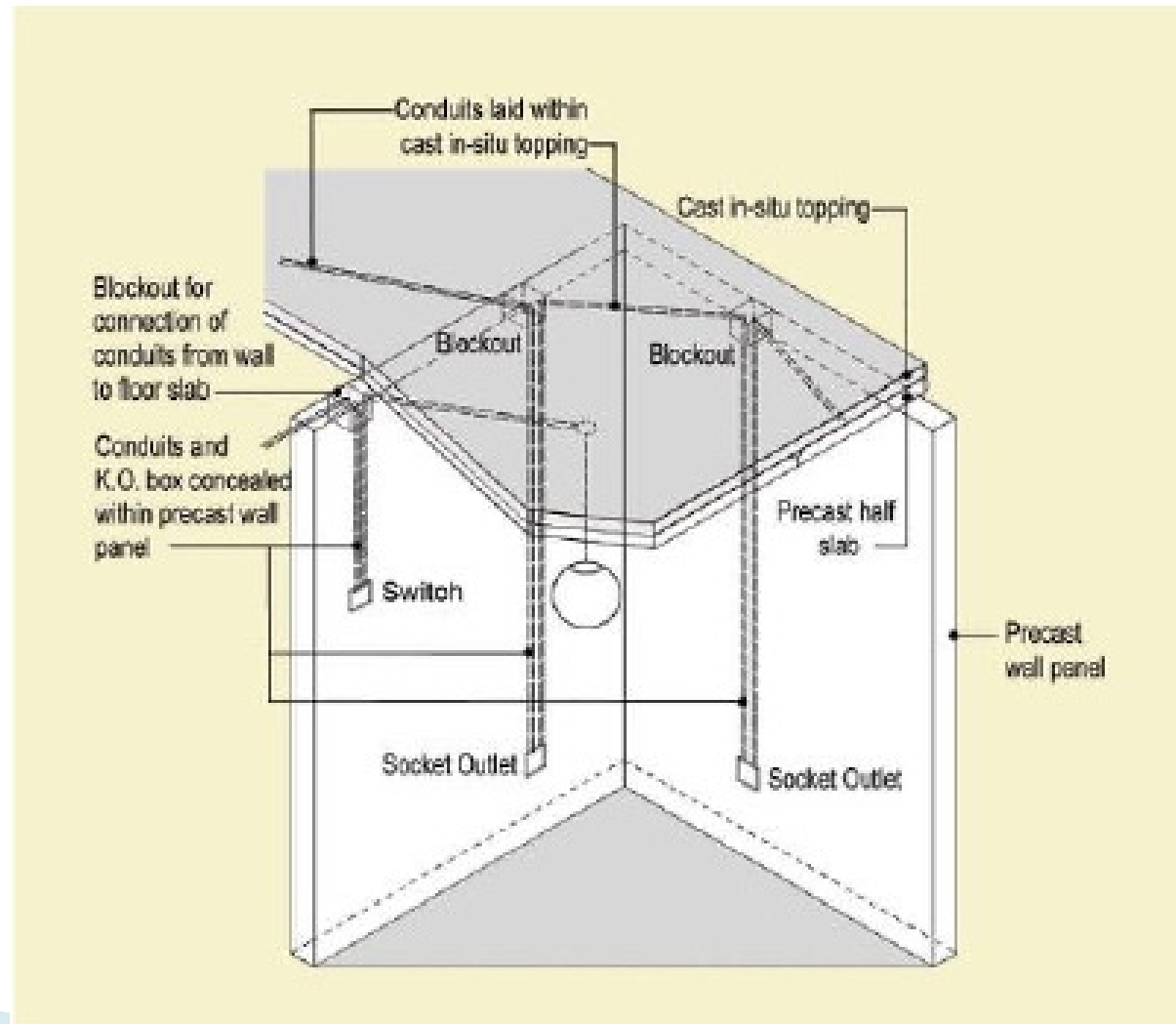
Project Execution: Erection of Precast Slabs

For slabs, it is recommended to lift the slabs in horizontal position for installation



Project Execution: MEP Services

Electrical conduits and plumbing work are concealed.



QA/ QC

Inspection of Precast Elements

- ▶ This finished precast concrete elements and works should be inspected to ensure they meet the design requirement and standards. There will be pre pour and post pour checklist during and after production, as well as stocking and transportation and also for erection including temporary supports.
- ▶ Quality assurance and control is achieved with good planning and management. Records are maintained for inspection and Test Plan, ITP which summarizes the projects inspection, acceptance criteria and frequency of inspection. Checklists for the in-process and final inspection of precast concrete elements are prepared to detail the checks required at critical stages.
- ▶ The produced & erected elements will be checked against tolerance parameters as per IS15916.

Production Tolerance for Precast Elements

Length :

+/- 0.1 percent subject to maximum of +5 / -10mm

Thickness / Cross sectional dimensions:

+/- 2mm up to 300mm wide.

+/- 3mm for greater than 300mm wide.

Straightness / bow:

+/- 5mm or 1 / 750 of length, which ever is greater.

Square-ness:

When considering the squareness of the corner, the longer of two adjacent sides being checked shall be taken as the base line

The shorter side shall not be out of square line for more than +2 / - 5mm.

Twist:

Any corner shall not be more than the tolerance given below from the plane containing the other corners:

+/- 1 / 1500 of dimensions or +/- 5mm which ever is less.

Flatness:

The maximum deviation from 1.5 m straight edge placed in any position on a nominal plane surface shall not exceed + / - 3mm.

Erection Tolerance for Precast Elements

Walls :

Length wise = + / - 10 mm.

Height wise = + / - 10 mm at bottom, + / - 2.5 mm at Top.

Width wise = + / - 5 mm.

Slabs / Stairs:

Length / width wise = + / - 5 mm.

Vertically = + / - 2.5 mm.



Completed Phase-1 , Structure.













Thank you

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