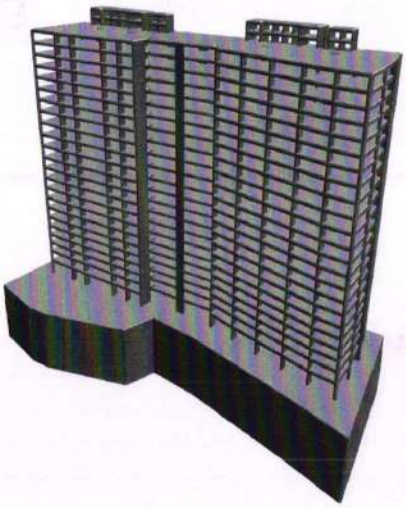
STRUCTURAL DESIGN BASIS REPORT

PROPOSED COMMERCIAL PROJECT BY PALAK GROUP
AHMEDABAD, GUJARAT



DATE	REV.NO	CHECKED BY	REVISION DETAILS
22-09-2023	R0	NARENDRA PATEL	

HNBS

Table of Contents

1. INTRODUCTION

The project consists of high-rise building by **PALAK GROUP, of 78.485m (Approx.)** height above the Ground Level (Stilt floor), having **4-Storey Basement + Ground floor + 22 Commercial Floors + Terrace.**

The involvement of the structural design team has provided a challenge in accommodating the architectural form that has developed to an advanced stage with little structural input. As a result, some elements of the architecture may need to be reviewed by architect to fit in the requirements.

From our understanding, the following schemes have been worked out considering the **premium tower** and the flexibility given to the end user. This flexibility is obtained by proposed **Beam-slab with shear wall structural system** for super structure & flat slab with shear wall with periphery beam-column system for sub- structure or Beam-Slab with Shear Wall System, as basements that will eliminate all internal beams& appropriate for the services too. Looking to the Client's requirement/Demand **Beam-Slab with Conventional RC System have been considered for Sub-Structure.**

The Structure is analysed with all the relevant code of practice as per Indian Standard codal provision & considering the appropriate safety parameters some of the international code of practice will also be due marked where Indian codes are silent or step back.

2. FOREWORD

This report forms the basis of the structural design process, by way of familiarizing with the requirements of the project. This report aims at formulating the design parameters that the structural consultant has adopted in developing the structural analysis, design and detailing work of the building, which will be compatible with the architectural theme, satisfy the functional needs, adhering to other applicable building norms & Indian Standards provisions to achieve safe, stable, strong & earth-quake/wind resistant structure, which is economical also.

This report covers the minimum design requirement to establish the untitled design basis that will form the overall design philosophy to be adopted in the structural design of the proposed building.
The design will aim to achieve,

- Structural And Functional Integrity
- Desirable Structural Performance Under Characteristic Service & Design Loads
- Resistance To Loads Due To Natural Phenomena i.e. Wind And Earthquakes
- Structural Durability And Maintainability

- Structural Safety, Performance During Fire And Fire Safety Measures
- Compatible With All The Relevant Codes Of Practice

PROJECT NAME	**PALAK COMMERCIAL**
LOCATION	**AHMEDABAD, GUJARAT**
CLIENT	**PALAK GROUP**
ARCHITECT	**MANSI SHAH ARCHITECTS**
STRUCTURAL ENGINEER	**HNBS ASSOCIATES**

3. PROJECT DESCRIPTION

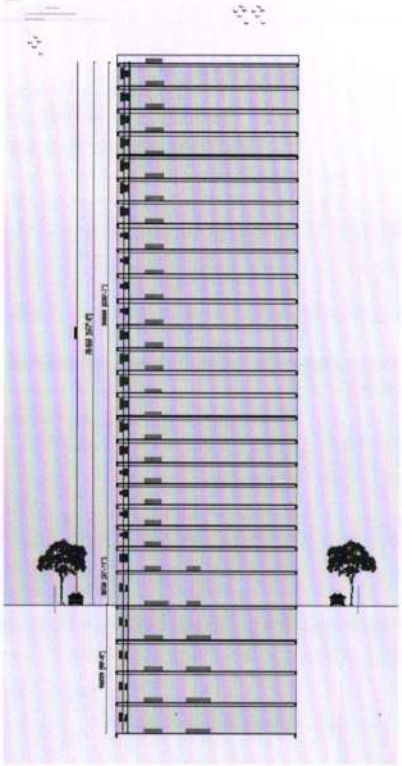
The project comprises of high rise building By **PALAK GROUP, of 78.485m (Approx.)** high above the Ground Level (Stilt floor), having **4-Storey Basement + Ground floor + 22 Commercial Floors + Terrace.**

ITEAM NO.	
BUILDING DIMENSION (X DIR. X Y DIR.)	28.36m X 101.55m
BUILDING HEIGHT (h)	78.485 m

***Height Is Considered From - (Plinth Level To Terrace Level)**

BASEMENT AREAS	**4-Storey Basement Area Has Been Proposed To Cater For Parking Requirements. The Floor Height Of Basement-4,3 & 2 is 4.5m & Basement-1 is 5.0m**
GROUND AREAS	**Ground Floor Area Partially Consists of Parking. The Floor Height Is 5.0m.**
TYPICAL AREA	**1ST Floor Height 3.5m, 2nd to 5th Floor Height 3.040m, 6th to 11th Floor Height 3.325m,12th to 15th Floor Height 3.650m,16th to Terrace Floor Height 3.325m.**

HNBS



TYPICAL FLOOR HEIGHT OF TOWERS

HNBS

4. STRUCTURAL SYSTEM DESCRIPTION

A. GENERAL

The structural scheme of the building will be of cast in situ reinforced concrete (RC). The structure consists of cast in situ RCC shear walls, columns, beams and slabs.

B. VERTICAL LOAD PATH

The vertical gravity loads are carried by the RC slab - beam system and transferred to the load bearing structural RCC walls and columns. The floor slabs are supported by the beams and eventually byRC shear walls and columns in the tower areas.

The complete load bearing RC structure is going directly down to the ground floor level and further to the foundation and will bring all the vertical loads down to the foundation. The load bearing structure is continuous from top to bottom and has no structural interruptions.

C. LATERAL LOAD PATH

The lateral load resisting system is formed by cast in - situ RC shear walls, columns with perimeter& internalbeams frames in x and y plan directions which are located inside the building in required configuration. The shear walls& Columns shall be designed and detailed **as per IS: 13920 - 2016 and are considered as ductile shear walls& Columns.**

The RC slab - beams provides continuity and connection with the shear walls and columns which are able to transfer in-plane shear forces as well as overturning moments to the lateral load resisting system. The slab behaves as a rigid floor diaphragm as the in plane stiffness is much high, **however to address the actual in plane distortion the diaphragms are model as semi-rigid configuration using Membrane or Shell-Thin formulation.**
Due to the large stiffness of the shear walls they are resisting almost all the lateral forces in addition of gravity loads and therefore the total system as such shall be classified as a building with ductile shear walls. As per IS: 1893 - 2016 (PART-I) the Response Reduction factor of the lateral load resisting system of this building shall be taken as **R = 4.0 (Ductile Shear Walls).**

5. METEROLOGICAL CONDITIONS

The environmental conditions to which the structural elements are considered to be exposed to as per Clause 8.2.2.1 Table-3 of IS: 456 - 2000 are as follows:

EXPOSURECONDITION	ELEMENTS
MODERATE	SLABS, BEAMS& COLUMNS/WALLSABOVE GROUND
MODERATE	FOUNDATION & STRUCTURES BELOW GROUND

MILD: Exposure condition shall be explained as one where concrete surfaces are protected against weather or aggressive conditions, except those situated in coastal areas.

MODERATE: Exposure condition shall be explained as one where concrete surfaces are sheltered from severe rain or freezing whilst wet; concrete exposed to condensation and rain; concrete continuously under water; concrete in contact under non-aggressive soil; concrete surfaces sheltered from saturated salt in coastal areas.

6. FIRE RATING

A structural element is required to have fire resistance and should be designed to possess an appropriate degree of resistance to flame penetration; heat transmission and failure.

The fire rating considered for various structural elements are as follows,

STRUCTURAL ELEMENT	FIRE RESISTANCE
LOAD BEARING WALLS	2 Hours
COLUMNS & BEAMS	2 Hours
FLOOR SLABS	1.5 Hours
STAIRCASE WALLS & LIFT WALLS	2 Hours
SHEAR WALLS	2 Hours

Minimum dimensions for fire resistance of reinforced concrete members in accordance as per Clause 21.2, Figure-1 of IS: 456 - 2000 are as follows,

STRUCTURAL ELEMENTS	MINIMUM DIMESIONS	
	1.5 Hrs.	2.0 Hrs.
BEAM WIDTH	200 mm	200 mm
FLOOR THICKNESS	110 mm	125 mm
COLUMN: FULLY EXPOSED	250 mm	300 mm
COLUMN: 50% EXPOSED	200 mm	200 mm
COLUMN: ONE FACE EXPOSED	140 mm	160 mm
WALL THICKNESS: (r/f- 0.4 %< P<1.0%)	140 mm	160 mm

Structural member sizes are decided conforming to the above mentioned requirements for fire resistance as per Indian Standard Code IS: 456 - 2000 and NBC 2016 Type-II requirement.

HNBS

7. NOMINAL COVER

Minimum values of nominal cover to outermost reinforcement of normal weight aggregate concrete, which should be provided to all reinforcement, depends on the exposure condition and fire rating considered. Cover to the reinforcement shall be in accordance with IS: 456 - 2000 corresponding to MODERATE exposure conditions for the superstructure and MODERATE exposure conditions for the substructure and to satisfy the specified fire rating.

The nominal cover to meet specified period of fire resistance as per Table16A, Clause 21.4 of IS: 456 – 2000& NBC 2016 are as follows,

STRUCTURALELEMENT	EXPOSURECONDITION		FIRE RESISTANCE	
	MILD	MODERATE	1.5Hours	2.0Hours
BEAMS (Simply Supported)	20mm	30mm	--	*40mm*
BEAMS (Continuous)	20mm	30mm	--	*30mm*
FLOORS (Simply Supported)	20mm	*30mm*	25mm	--
FLOORS (Continuous)	20mm	*30mm*	20mm	--
COLUMNS	40mm	40mm	--	*40mm*
WALLS	20mm	30mm	--	*30mm*
FOUNDATION	50 mm	*75mm*	--	--

*Cover to the Shear Wall will be considered as 40mm to maintain same typology for Construction Activity.

In case of slabs, formainreinforcementupto12mmdiameterbar for moderate exposure the nominal cover may be reduced by 5mm. Unless specified otherwise, actual concrete cover should not deviate from the required nominal cover by ±10mm.

8. MATERIAL GRADES

The preliminary minimum grade of concrete to be used depends on the exposure conditions to which the structural elements are subjected to. The final concrete grade for each element will be confirmed once the concept/schematic stage framing layout & analysis shall be conclude.

STRUCTURAL ELEMENT	CONCRETE GRADE
FOUNDATION	M35
RETAINING WALL	M35
COLUMNS & SHEAR WALLS	M55/M50 (REDUCTION IF REQUIRED)
SLABS	M40
BEAMS	M40

MODERATE: Exposure condition shall be explained as one where concrete surfaces are sheltered from severe rain or freezing whilst wet; concrete exposed to condensation and rain; concrete continuously under water; concrete in contact under non-aggressive soil; concrete surfaces sheltered from saturated salt in coastal areas.

6. FIRE RATING

A structural element is required to have fire resistance and should be designed to possess an appropriate degree of resistance to flame penetration; heat transmission and failure.

The fire rating considered for various structural elements are as follows,

STRUCTURAL ELEMENT	FIRE RESISTANCE
LOAD BEARING WALLS	2 Hours
COLUMNS & BEAMS	2 Hours
FLOOR SLABS	1.5 Hours
STAIRCASE WALLS & LIFT WALLS	2 Hours
SHEAR WALLS	2 Hours

Minimum dimensions for fire resistance of reinforced concrete members in accordance as per Clause 21.2, Figure-1 of IS: 456 - 2000 are as follows,

STRUCTURAL ELEMENTS	MINIMUM DIMESIONS	
	1.5 Hrs.	2.0 Hrs.
BEAM WIDTH	200 mm	200 mm
FLOOR THICKNESS	110 mm	125 mm
COLUMN: FULLY EXPOSED	250 mm	300 mm
COLUMN: 50% EXPOSED	200 mm	200 mm
COLUMN: ONE FACE EXPOSED	140 mm	160 mm
WALL THICKNESS: (r/f- 0.4 %< P<1.0%)	140 mm	160 mm

Structural member sizes are decided conforming to the above mentioned requirements for fire resistance as per Indian Standard Code IS: 456 - 2000 and NBC 2016 Type-II requirement.

HNBS

7. NOMINAL COVER

Minimum values of nominal cover to outermost reinforcement of normal weight aggregate concrete, which should be provided to all reinforcement, depends on the exposure condition and fire rating considered. Cover to the reinforcement shall be in accordance with IS: 456 - 2000 corresponding to MODERATE exposure conditions for the superstructure and MODERATE exposure conditions for the substructure and to satisfy the specified fire rating.

The nominal cover to meet specified period of fire resistance as per Table16A, Clause 21.4 of IS: 456 – 2000& NBC 2016 are as follows,

STRUCTURALELEMENT	EXPOSURECONDITION		FIRE RESISTANCE	
	MILD	MODERATE	1.5Hours	2.0Hours
BEAMS (Simply Supported)	20mm	30mm	--	*40mm*
BEAMS (Continuous)	20mm	30mm	--	*30mm*
FLOORS (Simply Supported)	20mm	*30mm*	25mm	--
FLOORS (Continuous)	20mm	*30mm*	20mm	--
COLUMNS	40mm	40mm	--	*40mm*
WALLS	20mm	30mm	--	*30mm*
FOUNDATION	50 mm	*75mm*	--	--

*Cover to the Shear Wall will be considered as 40mm to maintain same typology for Construction Activity.

In case of slabs, formainreinforcementupto12mmdiameterbar for moderate exposure the nominal cover may be reduced by 5mm. Unless specified otherwise, actual concrete cover should not deviate from the required nominal cover by ±10mm.

8. MATERIAL GRADES

The preliminary minimum grade of concrete to be used depends on the exposure conditions to which the structural elements are subjected to. The final concrete grade for each element will be confirmed once the concept/schematic stage framing layout & analysis shall be conclude.

STRUCTURAL ELEMENT	CONCRETE GRADE
FOUNDATION	M35
RETAINING WALL	M35
COLUMNS & SHEAR WALLS	M55/M50 (REDUCTION IF REQUIRED)
SLABS	M40
BEAMS	M40

All reinforcing steel to be used shall be of Grade Fe500D or Fe550 with Minimum Yield strength of Fy = 500 N/mm^2 and tensile strength not less than Fu = 545 N/mm^2 having elongation of more than 14.5% and conforming to IS: 1786 – 2008.

9. GEOTECHNICAL PARAMETERS

The Geotechnical Investigation has been carried out by M K SOIL TESTING LABORATORY PRIVATE LIMITED, Report No. MK/30/03-2023 and the report has been submitted to us.

Based on this report: -

- We are considering the Gross SBC for the raft as Avg.**400kN/m^2** as recommended on Appendix-1 for Avg.75 mm to 100 mm settlement, for Tower.
- The ground water table has been observed at Approx. 12.8m depth below ground level.
- The modulus of sub-grade reaction is consideredfrom geo-technical report.

The Foundation System for the Towers have been proposed as Raft Foundation with Uniform Thickness and Localized thickening where required. For Non-Tower Area/Columns/Walls, Isolated Slopes/Pad Footings have been proposed.

Soil Retention System have been considered as Diaphragm Walls at all Sides which have been design by specialized Consultant (By Other).

10. ANALYTICAL/DESIGN APPROACH

A.NUMERICAL MODEL

- A comprehensive 3-dimensional finite element analysis of the superstructure shall be carried out with ETABS software tool using ultimate version 2019 or latest edition.
- For foundation depending upon geotechnical criteria, a series of combined footing and raft foundation shall be proposed below tower columns/walls and isolated footing for the columns in non-tower area. Finite Element Analysis for same shall be carried out in SAFE 2016 or latest edition software tool.
- Buildings shall be assessed for a combination of gravity and lateral loads, and detailed appropriately
- For the design of various structural elements like foundations, columns, beams, slab etc. in - house developed spreadsheets& Programs will be used wherever applicable.

B. APPROACH FOR STRUCTURAL ANALYSIS

After preliminary sizing of various structural members, a computer model of the structure is generated for carrying out computer analysis to analyse the effects of vertical and lateral loads that are likely to be imposed on the structure.

HNBS

HNBS ASSOCIATES LLP AHMEDABAD

FEM computer software ETABS will be used for the structural analysis of the building. Geometrical dimensions, member properties and member-node connectivity are modelled in the FEM computer program and the following structural analysis will be performed:

- Equivalent Linear Static Analysis (ELF Procedure)
- Second-Order-Delta Analysis (Elastic Softening Analysis)
- Modal Analysis (Inherent Dynamic Configuration of Structure)
- Linear Dynamic Analysis (Response Spectrum Analysis)

The seismic analysis shall account for torsion effects, including accidental torsion. The accidental torsion has been taken into account by applying eccentricity to all the floor diaphragms in x-direction and y-direction with eccentricity ratio of 0.05. As the diaphragm have been considered as Semi-rigid, the eccentricity ratio will be considered at every nodes on the analytical model itself.

C. APPROACH FOR FLOOR ANALYSIS

Several configurations like flat plate, flat slab, slabs supported by beams etc. have been investigated and a brief synopsis of the results were presented. The best option is considered to be the option that is closest to delivering the architectural intent whilst enabling a rational structural solution. **Conventional Floor system, i.e: slab supported by beams have been considered.**

D. APPROACH TO ADRESS BACK STAY ANALYSIS (TOWERS CONNECTED WITH A COMMON PODIUM)

Backstay transfers the forces from lateral load-resisting elements in the tower to additional structural elements provided within the podium and the basement, typically through one or more floor diaphragms. Lateral load resistance in the podium levels with assured force transfer path through floor diaphragms at these levels, helps the tall building to resist lateral overturning forces. This component of overturning resistance, referred as the backstay effect (also called shear reversal).

Buildings have more than two towers; and extended basements, hence the Back Stay path shall be designed considering the following:

- Such buildings shall be modelled as separate towers only and the Separate Model representing the podium shall be considered with the Lateral Load Application from the Separate Tower Models. Designed of the Podiums/back Stay Path will be considered based on the same.
- The estimation of natural period (for calculation of base shear) shall be based on individual building model
- In the integral modelling which representing podiums only and back stay path, directional effects for all worst possibilities (that is, tower shaking in the same and in the opposite directions) should be considered in the design load combinations; and
- Equivalent static seismic forces will be used, provided they are scaled to match base overturning moments obtained from response spectrum analysis.

Minimum thickness and reinforcement requirement as per IS: 16700 will be supersedes over and above design results for back-stay diaphragm design. As per IS:16700-2017, Backstay diaphragm floor shall be at least 150 mm thick, and shall have two curtains of vertical and horizontal reinforcements (in plan view) of amount not less than 0.25 percent of cross- section area in each direction at first Connecting Level.

E. DESIGN PHILOSOPHY

Design of the RCC Commercial structure shall be carried out by limit state method conforming to IS: 456-2000. Design of all the structural elements of the Commercial complex shall be based on its three-dimensional (3D) analysis results. Individual member section of this space (3D) frame structure shall be designed for the section forces generated under various load combinations.

Main Reinforcement provided in design of member will be of grade Fe500D or Fe550 (with minimum yield strength=500 N/mm^2) and Shear Reinforcement will be of grade Fe415 for Shear Walls Design Only (with minimum yield strength = 415N/mm^2) as per IS: 1786-2008.

For RC slab, IS: 456 - 2000 (limit state method) would be used for the long term deflection check and design.

Ductile detailing norms will be adopted to make the building earthquake resistant in accordance with the relevant Indian Standard Codes. Since the building is in **Zone III**, the recommendations of IS: 13920–2016 shall be applicable.

F. STIFFNESS MODIFIERS

For Ultimate Limit State: (ULS)

STRUCTURAL ELEMENT	MODIFIERS	EQUIVALENT STIFFNESS MODIFIER (SOFTWARE APPLICATION)
Slabs	0.25 Ig	M11 = M22 = M12 = 0.25
Beams	0.35 Ig	I22 = I33 = J = 0.35
Coupling Beams	0.35 Ig	I22 = I33 = J = 0.35 (As Frame Element)
Columns	0.70 Ig	I22 = I33 = J = 0.70
Shear Wall	0.70 Ig	F11 = F22 = F12 = M11 = M22 = M12 = 0.70
Coupling Beams	0.70 Ig	F11 = F22 = F12 = M11 = M22 = M12 = 0.70 (As Area Element)

For Serviceability Limit State: (SLS)

STRUCTURAL ELEMENT	MODIFIERS	EQUIVALENT STIFFNESS MODIFIER (SOFTWARE APPLICATION)
Slabs	0.35 Ig	M11 = M22 = M12 = 0.35
Beams	0.70 Ig	I22 = I33 = J = 0.70
Coupling Beams	0.70 Ig	I22 = I33 = J = 0.70 (As Frame Element)
Columns	0.90 Ig	I22 = I33 = J = 0.90
Shear Wall	0.90 Ig	F11 = F22 = F12 = M11 = M22 = M12 = 0.90
Coupling Beams	0.90 Ig	F11 = F22 = F12 = M11 = M22 = M12 = 0.90 (As Area Element)

Where, Ig - Gross Moment of Inertia, *Reference: IS-16700, ATC-72, LATBSDC-2020

11. LOADING PARAMETERS

A. UNIT WEIGHTS

SR. NO.	DESCRIPTION	UNIT WEIGHT
1.	PLAIN CEMENT CONCRETE	= 24.0 kN/m^3
2.	REINFORCED CEMENT CONCRETE	= 25.0 kN/m^3
3.	STRUCTURAL STEEL	= 78.5 kN/m^3
4.	SAND BASE AAC BLOCKS (MASONARY WORK)	= 6.5 kN/m^3
5.	WATER	= 10.0 kN/m^3
6.	FLOOR FINISH	= 18.0 kN/m^3
7.	WATER PROOFING	= 20.0 kN/m^3
8.	PLASTER FINISH	= 20.0 kN/m^3
9.	SOIL FILLING	= 18.0 kN/m^3

Fire Tender Load on Ground Floor (As per NBC 2016/AUDA)* *= 16kN/m^2
Bifurcated as 12.0 kN/m^2 for fire fighter loading and 4.0 kN/m^2 as Live Load to supress the presence of loading at ground floor level.

Calculation for Weight of MasonryWalls: -

Unit Weight for AAC Block Masonry	= 6.5 kN/m^3
Unit Weight for plaster finish **(12mm thick on each face)**	= 20.0 kN/m^3
Typical Line Load Calculation for walls **(100mm thk. wall)**	**= (3.65-0.600) x 0.100 x 6.5 + (2 x 0.012 x 3.650 x 20) = 3.73 kN/m**

WALL LOADING AT DEFFERENT FLOOR LEVELS

Typical Floor-OUTER WALL **(12mm Inside& 24mm Out Side Plaster)**	**= (3.65-0.600) x 0.100 x 6.5 + (3 x 0.012 x 3.330 x 20) = 4.61kN/m**

HNBS

HNBS ASSOCIATES LLP AHMEDABAD

B. LOADS ON DIFFERENT UNITS OF STRUCUTRE

Item No.	Item Description	SELF WEIGHT OF SLAB (kN/m^2)	SDL (FLOOR FINISH) (kN/m^2)	LIVE (kN/m^2)	CAR (kN/m^2)	MACHINE (kN/m^2)
1.	TYPICAL COMMERCIAL FLOOR	= 25.0 X SLAB THICKNESS	FLOOR FINISHES (65mm THICK) = 1.2 kN/m^2 SERVICES & CEILING = 0.3 kN/m^2 Total SDL = **1.5 kN/m^2**	4.0	-	-
2.	PARKING AREA (BASEMENTS LEVEL)	= 25.0 X SLAB THICKNESS	FLOOR FINISHES (75mm THICK) = 1.5 kN/m^2 SERVICES & CEILING = 0.3 kN/m^2 Total SDL = **1.8 kN/m^2**	-	5.0	-
3.	PARKING AREA (GROUND LEVEL)	= 25.0 X SLAB THICKNESS	FLOOR FINISHES (120mm THICK) = 2.2 kN/m^2 SERVICES & CEILING = 0.3 kN/m^2 Total SDL = **2.5 kN/m^2**	4.0	-	-
4.	FOYER / PASSAGE / LOBBY	= 25.0 X SLAB THICKNESS	FLOOR FINISHES (65mm THICK) = 1.2 kN/m^2 SERVICES & CEILING = 0.3 kN/m^2 Total SDL = **1.5 kN/m^2**	3.0	-	-
5.	LIFT MACHINE ROOM	= 25.0 X SLAB THICKNESS	FLOOR FINISHES (120mm THICK) = 2.2 kN/m^2 SERVICES & CEILING = 0.3 kN/m^2 Total SDL = **2.5 kN/m^2**	1.0	-	10.0
6.	BALCONY (150mm Sunk)	= 25.0 X SLAB THICKNESS	WATER PROOFING – (0.010x25)+(0.065x18)+(**0.075**x 6.5) = 1.9kN/m^2 SERVICES & CEILING = 0.3 kN/m^2 Total SDL ≈ **2.2 kN/m^2**	3.0	-	-
7.	STAIRCASE	= 25.0 X SLAB THICKNESS	SELF WEIGHT OF STEPS = 2.0 kN/m^2 FLOOR FINISHES (55mm THICK) = 2.0 kN/m^2 SERVICES & CEILING = 0.3 kN/m^2 Total SDL ≈ **4.3 kN/m^2**	3.0	-	-
8.	CHAJJAS & PROJECTIONS	= 25.0 X SLAB THICKNESS	Total SDL ≈ **1.5 kN/m^2**	1.0	-	-
9.	RAMPS	= 25.0 X SLAB THICKNESS	FLOOR FINISH (75mm THICK) = 1.35 kN/m^2 Total SDL ≈ **1.5 kN/m^2**	-	3.0	-

HNBS

HNBS ASSOCIATES LLP AHMEDABAD

10.	SHOPS & COMMERCIAL (IF ANY*)	= 25.0 X SLAB THICKNESS	FLOOR FINISHES (65mm THICK) = 1.2 kN/m^2 SERVICES & CEILING = 0.3 kN/m^2 Total SDL = **1.5 kN/m^2**	4.0	-	-
12.	NON-TOWER AREA (GROUND FLOOR)	= 25.0 X SLAB THICKNESS	FLOOR FINISH/SOIL FILLING (350mm THICK) = 6.3 kN/m^2 SERVICES & CEILING = 0.3 kN/m^2 Total SDL ≈ **6.6 kN/m^2**	-	4.0	-
13.	NON-TOWER AREA (GARDEN/LANDSCAPE AREA)	= 25.0 X SLAB THICKNESS	SOIL FILLING (600mm THICK) = 12.6 kN/m^2 SERVICES & CEILING = 0.3 kN/m^2 Total SDL ≈ **13.0 kN/m^2**	3.0	-	-
14.	WATER TANK	= 25.0 X SLAB THICKNESS	WATER PROOFING (125mm THICK) = 2.5 kN/m^2 Total SDL ≈ **2.5 kN/m^2**	0.5	-	-

12. SEISMIC LOADS AS PER IS: 1893 - 2016 (PART-I)

The proposed development is located at **Ahmedabad**, Gujarat. As per Figure 1 of IS: 1893 - 2016 (Part-1), **Ahmedabad falls under Zone III, (Z=0.16)**

SR. NO.	DESCRIPTION	TOWER
1.	BUILDING DIMENSION (X-DIRECTION)	28.36 m
2.	BUILDING DIMENSION (Y-DIRECTION)	101.55 m
3.	HEIGHT OF BUILDING (GR TO TERRACE)	78.485m
4.	IMPORTANCE FACTOR (I) (TABLE-8)	1.2
5.	RESPONSE REDUCTION FACTOR (R) (TABLE-9)	4.0
6.	SOIL TYPE (TABLE-4)	I (HARD SOIL)
7.	Bare Frame - $T = 0.075\ h^{0.75}$	1.98sec
8.	*Masonry Infill* - $T = \frac{0.09\ h}{\sqrt{d}}$,	Tx = 1.33sec Ty = 0.70 sec

HNBS

9.	*RC Shear Wall* - $T = \frac{0.075\ h^{0.75}}{\sqrt{A_w}}$, *where* $A_w = \sum_{i=1}^{n}\left[A_{wi}\left\{0.2 + \left(\frac{L_{wi}}{h}\right)^2\right\}\right]$	Tx = 0.07 sec Ty = 1.70 sec
	TIME PERIOD CONSIDERED FOR DESIGN OF STRUCTURE	Tx = 1.33 sec Ty = 1.70 sec

13. WIND LOADS AS PER IS: 875 – 2015 (PART – III)

SR. NO.	DESCRIPTION	TOWER A
1.	BUILDING DIMENSION (X-DIRECTION)	28.36 m
2.	BUILDING DIMENSION (Y-DIRECTION)	101.55 m
3.	HEIGHT OF BUILDING (GR TO TERRACE)	78.485m
4.	BASIC WIND SPEED (CL 6.2 & ANNEX-A)	39 m/s
5.	TERRAIN CATEGORY (CL 6.3.2.1)	3
6.	PROBABILITY FACTOR (K1) (TABLE-1)	1.0
7.	TOPOGRAPHY FACTOR (K3) (CL 6.3.3 & ANNEX-C)	1.0
8.	IMPORTANCE FACTOR (K4) (CL 6.3.4)	1.0
9.	DRAG FORCE-COEFFECIENT IN X-DIRECTION (CFx) (CL 7.4.2 & FIG-4)	1.25
10.	DRAG FORCE-COEFFECIENT IN X-DIRECTION (CFy) (CL 7.4.2 & FIG-4)	1.08

HNBS

For Linear Dynamic Wind Analysis, as per clause 7.1 of IS: 875 (Part-III) -2015,Building and closed structures with a height to minimum lateral dimension ratio of more than about 5.0Building and closed structures whose natural frequency in the first mode is less than 1.0Hz. Any building or structure which does not satisfy either of the above two criteria shall be examined for dynamic effects of wind.

14. TEMPERATURE LOADS (THERMAL LOADS)

Temperature variation produces stresses in the structure, as it expands and contracts with the gain and loss of thermal energy. In the structures, with large geometrical dimensions, the effect of temperature may be important in the behaviour and final design. Due to cyclic deformation– between day time and nights, and between winter and summer the effect on the durability of structure and the supported finishes may be significant to produce fatigue.

The structure will be analysed for the following temperature variation condition.Podium, roof and other similar exposed slabs to the sunlight shall be checked for the uniform seasonal temperature variation +/-20.0 degrees, based on a maximum temperature of 45.0 degrees and a minimum temperature of 25.0 degrees, in accordance with as per clause 2.0 of IS: 875 - 1987 (Part 5).

15. CRACK WIDTH (FOR WATER RETAINING STRUCTURES)

Indian code IS: 3370-2009 shall be applicable (Design of concrete structures for retaining aqueous liquids) with control on crack width. The crack width will be restricted to 0.2 mm.

16. LOAD CASES & COMBINATIONS

STATIC LOAD CASES

LOAD PATTERN	LOAD TYPE
DEAD	DEAD LOAD
SDL	SUPER DEAD LOAD
LIVE/BLL	REDUCEABLE LIVE LOAD
WATER	SUPER DEAD LOAD
MACHINE	SUPER DEAD LOAD
WALL	WALL/LINE LOAD
CAR	LIVE LOAD