INDIAN INSTITUTE OF TECHNOLOGY BOMBAY
Department of Civil Engineering
Powai, Mumbai - 400 076 (India)

Phone: (+91-22) - 2576 7346, 2572 2545
Fax: (+91-22) - 2572 3480, 2576 7302
Email: rsjangid@civil.iitb.ac.in

Dr. R.S. Jangid
Professor

Ref. No.: **DRD/CE/RSJ-169/24-25**

August 4, 2025

STRUCTURAL STABILTY CERTIFICATE/REPORT

PLAN SHOWING THE REVISED AND ADDITIONAL CONSTRUCTION OF HIGH RISE GROUP DEVELOPMENT CONSISTING OF 6 RESIDENTIAL, CUM COMMERCIAL TOWERS WITH COMBINED & EXTENDED DOUBLE BASEMENT FLOORS; 3RD BASEMENT FLOOR PART (FOR PUMP ROOM) + TOWER 01: GROUND FLOOR + 15 FLOORS WITH 56 DWELLING UNITS & SHOPS, HEALTH CARE, SUPERMARKET, DAYCARE UNITS @ 1st & 2nd FLOOR LVL (WITH HEIGHT 52.70m), TOWER 02 & 03:- GROUND FLOOR+ 16 FLOORS WITH 156 DWELLING UNITS & PARTY *I* MULTIPURPOSE HALL. INDOOR GAMES, MINI THEATRE, ASSOCIATION ROOM, YOGA ROOM & HEALTH CLUB (WITH HEIGHT 53.55m) + TOWER 04:- GROUND FLOOR + 16 FLOORS WITH 263 DWELLING UNITS (WITH HEIGHT 53.55m) + TOWER 05:- GROUND FLOOR + 16 FLOORS WITH 229 DWELLING UNITS (WITH HEIGHT 53.55m) + TOWER 06:- GROUND FLOOR + 16 FLOORS WITH 98 DWELLING UNITS & BUSINESS CENTER (WITH HEIGHT 52.70m) TOTALLY 802 DWELLING UNITS ABUTTING MOUNT-POONAMALLEE ROAD, COMPRISED IN S.NO.115/16 & 117 OF RAMAPURAM VILLAGE, MADURAVOYAL TALUK, ZONE-XI, DIVISION-154 AND S.NO.22/1, 23 OF MANAPAKKAM VILLAGE, ALANDUR TALUK, ZONE-XII, DIVISION- 157 WITHIN THE LIMITS OF GREATER CHENNAI CORPORATION.

The Residential Building referred to above is a framed structure with 2 Basement + Ground +16 Upper Floors. The Structural Design and Drawings for the building have been prepared by us conforming to the relevant Bureau of Indian Standards viz. IS 456:2000 for Plain and Reinforced Concrete, IS 875 (Part 11)-1987 for Imposed Loads and IS 1893:2002(Part 1) for seismic Force. The minimum grade of concrete is M25.

We certify that the building when constructed according to our Structural Designs and Drawings will be structurally safe against earthquakes and fit for occupation. The building will be sound and stable when used for the purpose which it is designed.

(R.S. Jangid)
Dr. R. S. JANGID
Professor
Department of Civil Engineering
I.I.T. Bombay, Powai, Mumbai-76

VASTECH
Consultants & Engineers LLP

STRUCTURAL DESIGN BASIS REPORT

PROPOSED RESIDENTIAL DEVELOPMENT FOR L&T REALTY PROPERTIES LIMITED AT CHENNAI

STRUCTURAL DESIGN BASIS REPORT

SUBMITTED BY

VASTECH CONSULTANTS & ENGINEERS LLP

4/5/24

Dr. R. S. JANGID
Professor
Department of Civil Engineering
I.I.T. Bombay, Powai, Mumbai-76

Vastech Consultants & Engineers LLP

VASTECH

SIGN OFF

Sr.No	Stake Holder's Role	Stake Holder's Name	Approved & Sign off	Sign off Date
1	Client	L&T REALTY PROPERTIES LIMITED		
2	Principle Architects	AEDAS PTE.LTD, SINGAPORE		
3	Project Architects	R CHAKKRAPANI AND SONS ARCHITECHS AND ENGINEERS CHENNAI-90		
4	Structural Consultant	VASTECH CONSULTANTS AND ENGINEERS LLP. PUNE -14		
5	SOIL CONSULTANTS	F.S. ENGINEERS PVT.LTD CHENNAI		

	PWD SUBMISSION	18-11-24
Revision No	Description	Date

STRUCTURAL DESIGN BASIS REPORT

CONTENTS

GENERAL PROJECT DETAILS

Structural Design Introduction:

The proposed structure is a residential project located at, Chennai India. In this brief report we are presenting the data and assumptions related to the structural design of the project, which has led to the conceptual design at this preliminary stage. The document attempts to record all inputs assumed in design and will form the basis for all future detailed structural work. The report most importantly clarifies the load criteria assumed in the design and it is therefore expected that all related consultants, including the architects, would go through the document and refer to it at every stage of detailed design. Recommendations or revisions on assumed parameters are requested at this stage.

Besides this the report will also form the outline of the design criteria and methods of both analysis and design to be adopted in this project with the aim of achieving a design that satisfies all sorts of seismic, and serviceability requirements.

1) PROJECT FEATURES

The proposed structure is a residential project which belongs to L&T REALTY PROPERTIES LIMITED, located at Chennai, India. The proposed building is having Basement-3 + Basement-2 + Basement- 1 + Ground floor +16 Floor (i.e., 20 no. of slabs). Project consist of 6 blocks i.e. block A, B, C, D, E, F along with connecting podium

2) FOUNDATION SYSTEM

The proposed project L and T Innovation Campus Residential (Chennai) the area explored has got top soil of 0.5M is uniform. The underlying layer comprises of clayey sand, sand and silty clay up to 11.50 to 15.0M followed by disintegrated rock with medium rock appearing at depths varying from 12.50 to 15.50M below ground level. Water table was met with at depths varying from 1.0 to 4.0M below ground level at the time of exploration. Water level could rise to ground level during rainy season. UDS samples were not collected since silty clay layer is highly expansive. For the proposed structure shallow foundations for 3 basement structure placed on DR / medium rock as per soil report SBC could be seem to over 10kg/cm2. Pile foundation is needed for structures without basement. The settlement of the shallow foundation would be within 25mm and for pile foundation would be within 12mm. Over excavation in the foundation trenches should be refilled by concrete according to SBC adopted. Suggested excavation procedure should be adopted while undertaking the construction.

EXCAVATION PROCEDURE -

1) The excavation could be done by normal excavators.

2) Dewatering should be done by bore well system sine well point dewatering may not be effective due to the presence of silty clay layer.

3) The side protection can be done by diaphragm wall seated in the medium rock layer.

Special considerations as per codes are as follows-

1. The percentage of Imposed Load to be considered in Seismic Weight Calculation is 25% when the imposed load is up to & including 3 Kn/m2 & it is 50% when the imposed load is above 3 Kn/m2. [IS1893 (Part1), Table No.10, Clause 7.3.3, Page No.20].

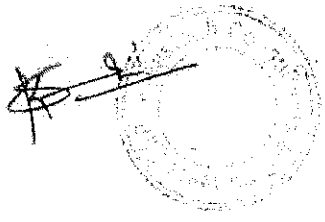
2. For the earthquake forces, the allowable bearing pressure in soils increased by 50% for footings resting on Rock /Hard soil. [IS1893 (Part1), Clause 6.4.2.1, Page No. 9].

3. For Wind Forces, the allowable bearing pressure in soils increased by 25% for footings as per IS 875 : 2015 (Part 3) Provisions.

4) Minimum 1.1% base shear shall be considered for Zone III as per [IS1893 (Part1), Clause 7.2.2]

3) LIST OF REFERENCES

IS 456-2000 (Reaffirmed 2005)	Plain and reinforced concrete-code of practice
IS 875	Code of practice for design loads for buildings and structures
Part 1: 1987 (Reaffirmed 2003)	Dead loads- unit weights of building material and stored material
Part 2: 1987 (Reaffirmed 2003)	Imposed loads
Part 3: 2015	Wind loads
Part 4: 2015	Snow loads (other than earthquake)
Part 5: 2015	Special loads and combinations (other than earthquake)
IS1904-1986 (Reaffirmed 2006)	Code of practice for design & construction of foundations in soils
IS 1893: 2016	Criteria for earthquake resistant design of structures
IS 4326:2013	Code of practice for earthquake resistant design and construction of buildings
IS 13920: 2016	Code of practice for ductile detailing of reinforced concrete structures subjected to seismic forces
IS 1343	Code of practice for prestressed concrete (First Revision)
BS 8110 : 1997	Plain and reinforced concrete-code of practice (British standard)
ACI 318	Plain and reinforced concrete-code of practice (American standard)
CP65	Plain and reinforced concrete-code of practice (Singapore standard)
IS 800:2007	Code of practice for general construction in steel
Reynolds Handbook	
IS 3414	Code of practice for joints in the buildings
IS 3370	Code of practice for concrete structures for the storage of liquids
Part 1: 2009	General requirements
Part 2: 2009	Reinforced concrete structures
Part 3: 1967 (Reaffirmed 2008)	Prestressed concrete structures
Part 4: 1967 (Reaffirmed 2008)	Design tables
BS-8007	Code of practice for liquid retaining structures for crack width calculation
Soil Report	F.S. ENGINEERS PVT.LTD
IS1080-1985 (Reaffirmed 2002)	Code of practice for design & construction of Shallow foundations in soils.
IS1904-1986 (Reaffirmed 2006)	Code of practice for design & construction of foundation in soils: General Requirements.
IS 3764:1992 (Reaffirmed 2002)	Excavation work - Code for Safety
IS 2911 (Part 1/Sec 2) : 2010	Code of practice for design and construction of pile foundation (Bored Cast In-situ Concrete Piles)
IS 1786-2008	High strength Deform steel bars and wires for concrete reinforcement



4) Material, Workmanship, Inspection and Testing:

- The proposed RCC structure will consists of concrete and steel reinforcement as the two main materials used for construction of the structure.

4.1 Concrete:

The concrete shall be in grades designated as per Table 2 IS 456-2000.
Recommended grades for the different members are as follows:

Raft , Pile & Pile Cap	M30
Columns	M40
R.C.C Beams/Slabs	M30
Water Tanks	M30
Retaining Walls	M30
Lift & Shear Walls	M40 AND M30
Lean Concrete	M15
Plum Concrete	65:35

As per IS 456-2000 clause no 5.3.2, 8.2.4.1, 9.1.2, Table no 5 we considered sever exposure for substructure & moderate exposure conditions for super structure. Maximum size of metal is 20mm

Ordinary Portland Cement of grade 53 or higher confirming to IS 8112 and IS 12269 will be used for concrete.

Minimum grade of concrete = M30/M25

Any other structural member will be in general designed in M25.

Design mix shall be OPC with Crushed sand, Crushed aggregate, Mineral Admixture (Fly-ash or GGBS) and Chemical Admixture. Minimum cementitious content (Cement plus mineral admixture) shall be as per IS 456 table no.5.

4.2 Reinforcement:

The reinforcement shall be high strength deformed steel bars with yield strength of 500D N/mm^2 conforming to IS 1786-2008. Elongation should be min 16%.

4.3 Durability of concrete

The structure is located in Chennai, where the climatic conditions are considered as moderate. Concrete grade of submerged structural elements will be a minimum of M25. Nominal covers shall not be less than 20mm from a durability point of view.

The cover to the various structural elements is to be as follows,

Elements	Simply Supported Elements Nominal Cover in mm	Continuous Elements Nominal Cover in mm
Slabs	35	25
Beams	40	30
Columns	40	40
Shear walls	30	30
Footings/ Raft/ Pile Caps	50	50
Retaining Walls	Outside 50	Inside 30
Piles	75	75

4.4 PT Strand

The P.T strands will be 15.24mm /12.7mm HTS low relaxation of ultimate stress capacity 1850N/mm^2.

H.T. Strand Specification:

Nominal Diameter	12.7mm /15.24mm
Nominal Area	98.7sq.mm./141sq.mm.
Nominal Weight	0.775kg/m /1.15kg/m
Min Ultimate Strength	183.6 kN./ 262.26 kN.
Modulus of Elasticity	195 kN/sq.mm
Relaxation, low	Max 2.5% relaxation losses at load of at 70% MBS after 1000h
Identification	Metal Tag for each coil
Certificates	Mill Certificate for each
Product Type	Un-oiled
Strand quality in Accordance with	IS 14268

General Assumptions for PT slab and Beam design

1) Strength design of prestressed member for flexure and axial loads shall be based on assumptions given in clause 18.3 (Chapter 18) ACI-318.

2) Design moment strength of flexural members shall be computed by the strength design method of the code ACI-318.

3) Prestressed flexural members shall be classified as Class U, Class T or Class C based on extreme fiber stress (Ft) in tension in precompressed tensile zone calculated at service loads.

4) Serviceability Design Requirements are as per Clause 18.3 - ACI 318.

5) Deflection of prestressed flexural members shall be calculated in accordance with Clause 18.3.5-ACI 318.

6) Permissible tensile stresses in flexural member are as per Class-U (Table 18.3.3-ACI-318)./ Tpe 2 (IS 1343:2012).

7) Permissible stresses in prestressing steel shall not exceed the following:-

a) Due to prestressing steel jacking force---0.94 Fpy (specified yield strength of prestressing steel in psi) but not greater than the lesser of 0.80(Fpu specified tensile strength of prestressing steel)and the maximum value recommended by the manufacturer of prestressing steel or anchorage devices.

b) Immediate after prestress transfer -----0.82Fpy but not greater than 0.74 Fpu (specified tensile strength of prestressing steel).

8) Minimum Bonded reinforcement shall be provided in all prestressed flexural members is as per clause 18.9-ACI 318.

9) Prestressing strands shall be of Low relaxation type conforming to IS: 14268-1995. Ducts shall be of Galvanized steel

and are flat ducts. While designing PT elements all design criteria has to be satisfy considering bonded system & should be design for Class -II. PT Elements shall be designed for critical load combinations in terms of all loading aspects.

10) Minimum average effective prestress of 125 psi on the slab section tributary to the tendon or tendon group.

11) Required elongation shall be determined from average load-elongation curves for the prestressing steel used. Generally 7% tolerance in prestressing steel force determined by gauge pressure and elongation measurements for post tension construction.

4.5 Structural Steel

Structural steel of minimum grade Fy 250N/mm^2 other requirements conforming to IS 800:2007 shall be used appropriately.

4.6 Aggregates

The sizes of coarse aggregates conform to IS 383. Nominal maximum size of coarse aggregate would be 20 mm, suitably graded as per the requirement of mix design. The fine aggregates conform to the specifications of IS 515.

4.7 Water

Mixing Water shall conform to IS 456: 2000.

4.8 Admixtures

Admixtures shall confirm to IS 456, IS 9103, IS 3812, and other relevant codes.

4.9 Couplers

Mechanical couplers capable of providing 125 percent of the design strength of joined bars\shall be used for splicing of reinforcement bars above 20mm dia.

4.10 Construction Joint

Construction joints and shrinkage strips will be planned with the contractor and only be used in locations pre-approved by consultants.

General guidelines: -

1) No construction joint is allowed in the sunken portion.

2) Preferred at L/3 from support.

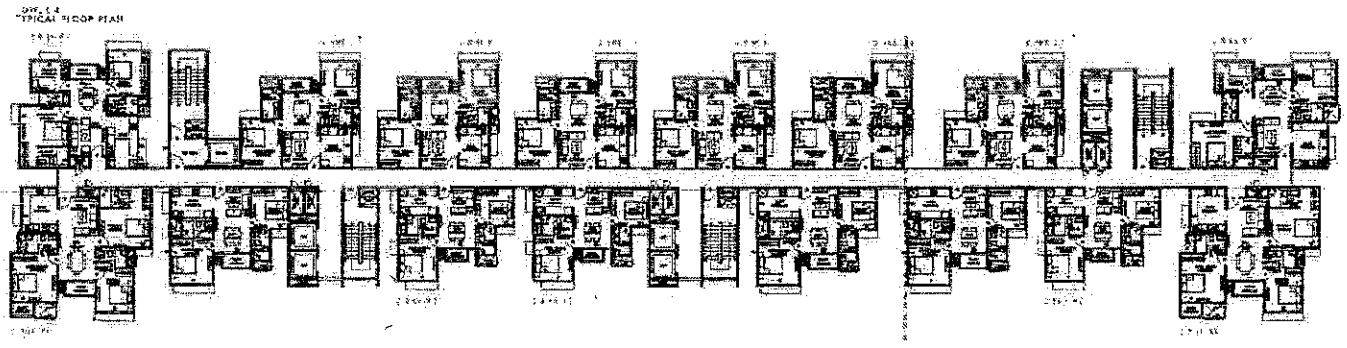
3) Construction joint shall be placed at accessible locations for maintenance purpose.

4) Joints are common source of weakness; therefore, it is desirable to avoid or at least minimize them.

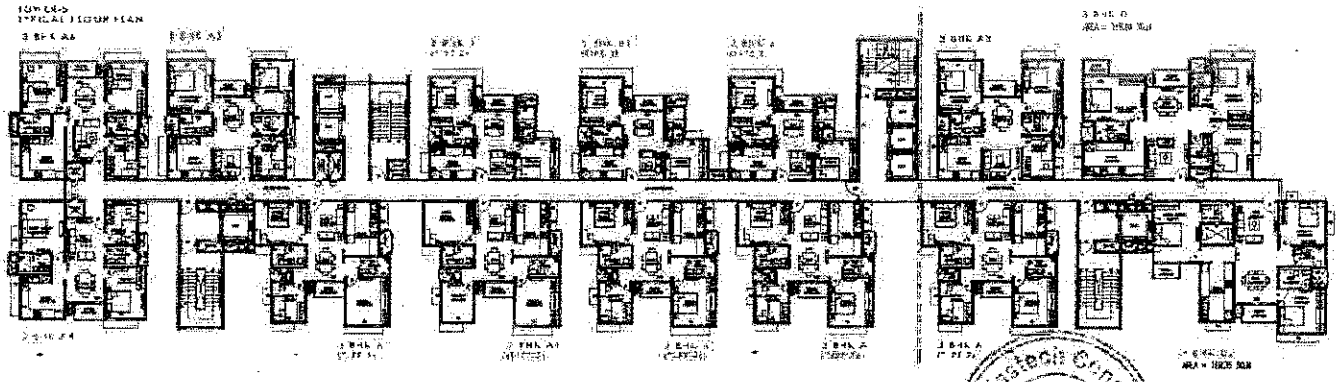
4.11 Expansion Joint

- We are proposing the main towers no 4 and 5 with expansion gap/joint above podium level. The basement is buried under the ground & the podium slab is covered with filling. For the temperature analysis 10^0C variations are considered.

Tower - 4



Tower- 5



5) General design considerations:

5.1 Method of Design

The aim of design is the achievement of an acceptable probability that structures being designed will perform satisfactorily during their intended life. With an appropriate degree of safety, they should sustain all the loads and deformations of normal construction and use and have adequate durability and adequate resistance to the effects of earthquake, wind as well as fire.

Structures and structural elements will be designed by Limit State Method. Due consideration will have given to the accepted theories, experience and modern philosophy of design.

Retaining wall will be designed to resist backfill loads along with soil conditions as per design requirement. Saturated soil density is 20 kN/m^3. The angle of shear resistance is assumed to be 30°. The water pressure due to the static water between the soil and the wall is also considered in design.

5.2 Loads and Forces

* In structural design, account is taken of the dead, imposed and wind loads and forces such as those caused by earthquake etc. where applicable.

Dead Loads

The dead loads are calculated on the basis of unit weights of materials given in IS 875 (Part 1). The data provided by consultant and other service consultants will be used for the specific materials/equipment's. The wall considered are light weight block walls & wall thickness as per architectural drawings.

Unless otherwise specified the unit weight of materials will be used as follows.

Reinforced Concrete	25 kN/cum
Plain concrete	24 kN/cum
Brickwork	20 kN/cum
Concrete block work	24 kN/cum
Siporex Blocks	7.5 kN/cum
Stone cladding	25 kN/cum
Soil dry	16 kN/cum
Soil wet (If Garden load with roots)	18 kN/cum
Floor finishes	10 kN/cum
Glass	23.5kN/cum
Structural Steel	78.5kN/cum
Water	9.81kN/cum

Block work is considered as a light weight block having density not more than 10 Kn/M3. Peripheral non-structural walls are proposed hence density for the same will be taken as 25kN/cum

Load Combinations considered:

1. 1.5 DL+ 1.5 LL
2. 1.2DL + 1.2 LL ± 1.2WX
3. 1.2DL + 1.2 LL ± 1.2WY
4. 0.9DL ± 1.5 WX
5. 0.9DL ± 1.5 WY
6. 1.5 DL± 1.5 WX
7. 1.5 DL± 1.5 WY
8. 1.2DL + 1.2 LL ± 1.2SX
9. 1.2DL + 1.2 LL ± 1.2SY
10. 0.9DL± 1.5 SX
11. 0.9DL± 1.5 SY
12. 1.5 DL± 1.5 SX
13. 1.5 DL± 1.5 SY
14. 1.2 DL+1.2TL
15. 1.2DL+1.2LL+1.2TL

16 1.2DL+1.2LL +1.2WX+1.2TL

17 1.2DL+1.2LL +1.2WY+1.2TL

18 1.2DL+1.2LL +1.2SX+1.2TL

19 1.2DL+1.2LL +1.2SY+1.2TL

Following **Service load combinations** will be considered for the analysis of the structure.

1. DL+ LL
2. DL + 0.8 LL ± 0.8WX
3. DL + 0.8 LL ± 0.8WY
4. DL ± WX
5. DL ± WY
6. DL + 0.8 LL ± 0.8SX
7. DL + 0.8 LL ± 0.8SY
8. DL± SX
9. DL± SY

Software's for the analysis & design:

a. Plan win & Framwin.
b. E-TABS
c. Adapt / SAFE
d. Prokon
e. Excel program sheets

Vastech Consultants & Engineers LLP

MATHEMATICAL MODELLING

MASS MODELLING

For calculation of seismic mass,

For live load up to and equal to 3 kN /m^2 – W = DL + 0.25 LL

For live load above 3 kN /m^2 – W = DL + 0.5 LL

Where,

DL = Dead load

LL = Live load

STIFFNESS MODELLING

Following stiffness modifies will be considered for unfactored condition

property	I22	I33	M11	M22	M12	F11	F22	F12	Torsion
RCC element									
Beam line element	0.7	0.7	-	-	-	-	-	-	0.001(except for cantilever)
shell-slab element			0.35	0.35	0.35	0.35	0.35	0.35	
column-line element	0.9	0.9	-	-	-	-	-	-	
shear wall	-	-	0.9	0.9	0.9	0.9	0.9	0.9	

Following stiffness modifiers will be considered for design load condition

property	I22	I33	M11	M22	M12	F11	F22	F12	Torsion
RCC element									
Beam line element	0.35	0.35	-	-	-	-	-	-	0.001(except for cantilever)
shell-slab element			0.25	0.25	0.25	0.25	0.25	0.25	-
column-line element	0.7	0.7							
shear wall	-	-	0.7	0.7	0.7	0.7	0.7	0.7	

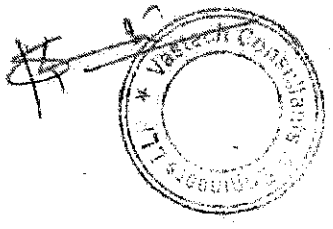
Deflection Check

The permissible deflection shall be as per IS 1893, IS 456, IS 800 and IS 875 (Part 3). The permissible storey drift shall be limited to 0.004 times the storey height under the design actions as per IS 1893. The permissible vertical deflection of structural steel elements shall be L/300 (where L – Span of the beams) and shall be checked for point loads as per clause 3.1 of IS 875 part 2. For conctere structural elements, the permissible vertical deflection shall be as per IS 456.

STATIC ANAYSIS

Static load cases which will be considered are listed below

Load cases	Linear Factors
Dead Load	1
Live load	1
EQX	1
EQY	1
WX	1
WY	1
TEMP	1



6) Details:

* 6.1.a Imposed Load

Imposed loads are assumed in accordance with IS 875 part 2, as follows.

The table listed below is a summary of these loads.

Floor BASEMENT-1,2,3

Sr.No	Area Description	Floor Finish	Services	Live Load	Super Imposed Dead Load	Remark / Comments
		Kn/Sq.m	Kn/Sq.m	Kn/Sq.m	Kn/Sq.m	Kn/Sq.m
1	Parking	2.0	0.5	2.5	0.0	Surface parking provided
2	HVAC pannel room	2.0	0.5	0.0	7.5	
3	Staircase	1.1	0.0	3.0	2.0	
4	Ramp	2.0	0.0	5.0	0.0	
5	Pump Room	2.0	0.5	0.0	7.5	
6	Toilets	0.0	0.0	2.0	2.1	Light weight filling (100mm sunk)
7	Common Lobby Area	2.0	0.5	3.0	0.0	
8	Driveway	2.0	0.5	3.0	0.0	
9	Other rooms	1.1	0.0	2.0	0.0	

Floor GROUND FLOOR

Sr.No	Area Description	Floor Finish	Services	Live Load	Super Imposed Dead Load	Remark / Comments
		Kn/Sq.m	Kn/Sq.m	Kn/Sq.m	Kn/Sq.m	Kn/Sq.m
1	Rooms	1.1	0.0	2.0	0.0	
2	kitchen	1.1	0.0	2.0	0.0	
3	Common Lobby Area	1.1	0.0	3.0	0.0	
4	Staircase	1.1	0.0	3.0	2.0	
5	UPS Room	1.1	0.0	0.0	5.0	
6	Electrical Room	1.1	0.0	0.0	5.0	
7	Ramp	2.0	0.0	5.0	0.0	
8	Toilets	0.0	0.0	2.0	2.1	Light weight filling (100mm sunk)
9	Balcony	0.0	0.0	3.0	2.6	Light weight filling (150mm sunk)
10	Driveway	0.0	0.5	5.0	8.5	Soil filling(0.4x20=8) Fire tendon load of 20to be considered while designing slabs and beams
11	NTA	0.0	0.0	3.0/2.5	6.0	Light weight filling(0.6x10=6)
						Landscape filling(0.6x18=10.8)

Floor TYPICAL FLOOR

Sr.No	Area Description	Floor Finish	Services	Live Load	Super Imposed Dead Load	Remark / Comments
		Kn/Sq.m	Kn/Sq.m	Kn/Sq.m	Kn/Sq.m	Kn/Sq.m
1	Rooms	1.1	0.0	2.0	0.0	
2	kitchen	1.1	0.0	2.0	0.0	
3	Common Lobby Area	1.1	0.0	3.0	0.0	
4	Staircase	1.1	0.0	3.0	2.0	
5	Toilets	0.0	0.0	2.0	2.1	Light weight filling (100mm sunk)
6	Balcony	0.0	0.0	3.0	2.6	Light weight filling (150mm sunk)

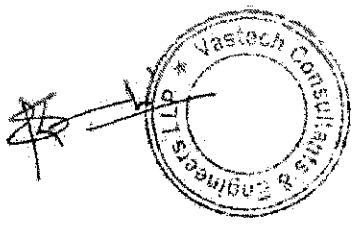
Floor Terrace Floor

Sr.No	Area Description	Floor Finish	Services	Live Load	Super Imposed Dead Load	Remark / Comments
		Kn/Sq.m	Kn/Sq.m	Kn/Sq.m	Kn/Sq.m	Kn/Sq.m
1	Terrace Area	0	0.0	1.5	3.0	(150 mm THK. Waterproofing)
2	Staircase	1.1	0.0	3.0	2.0	

Floor OHT & LMR

Sr.No	Area Description	Floor Finish	Services	Live Load	Super Imposed Dead Load	Remark / Comments
		Kn/Sq.m	Kn/Sq.m	Kn/Sq.m	Kn/Sq.m	Kn/Sq.m
1	LMR BOTTOM	0.0	0.0	2.0	15	[Machine Load]
2	OHT BOTTOM	0.0	0.0	15.0	1.5	(Asumed 1.5m Water Depth)*
3	OHT TOP	0.0	0.0	1.5	3.0	(150 mm THK. Waterproofing)

* Load may vary as per MEP drawing



6.1.b Analysis Approach

6.1.b (i) Structural Geometry:

The building structure consists of 20 slabs. The Slabs with their description, levels, heights & approximate areas are given in the table below.

Tower 4,5,6 Floor	Level	Height
	m	m
Head Room	56.7	4
Terrace	52.7	3.05
16th	49.65	3.05
15th	46.6	3.05
14th	43.55	3.05
13th	40.5	3.05
12th	37.45	3.05
11th	34.4	3.05
10th	31.35	3.05
9th	28.3	3.05
8th	25.25	3.05
7th	22.2	3.05
6th	19.15	3.05
5th	16.1	3.05
4th	13.05	3.05
3rd	10	3.05
2nd	6.95	3.05
1st	3.9	3.05
Ground Floor	0.85	3.05
B1	-4	4.85
B2	-7.9	3.9
B3	-13.44	5.54
Total		**73.19**

6.1.b (ii) Structural Frames:

The proposed building is RCC space frame structure, with columns and shear walls forming vertical components. RC Slab - Beam is proposed for the typical floor system. After taking into considerations the feasibility of particular system, clear height available for particular floor, mobility of the services below slab, cost estimation, provision of openings in the slab, approval of architects and other consultants, final framing system will be arrived at.

Podium Area: - PT banded beam-slab structural system proposed with RCC columns. Tower and Non-tower area is having separate vertical system. Non-Tower area is below ground level where wind and seismic forces will not be predominant.

6.1c Seismic Analysis:

6.1c (i) General Principles and design criteria

The structure is located in the seismic zone III. The design lateral force will be calculated as per the method described in the following paragraphs. The structure is primarily column /shear wall and beam-slab framing system although due considerations will be given to the major suggestions/clauses from IS13920, the basic frame is assumed to be as Building with ductile RC Structural walls, as per Table 9.

6.1c (ii) Design Spectrum

Seismic Analysis (Initial analysis for preliminary column sizing)

The design Horizontal seismic coefficient for a structure

$A_h = \frac{Z\ I\ Sa}{2\ R\ g}$ IS 1893-2016 Clause 6.4.2

Where,

Z = Zone factor 0.16 for Zone III Table 3

I = Importance Factor (1.2) Table 8

R = Response reduction factor

4 For Building with ductile RC Structural walls Table 9

Sa/g = Average Response acceleration coefficient Clause 6.4.2

$T = \frac{0.075\ h^{0.75}}{\sqrt{A_w}} \geq \frac{0.09h}{\sqrt{d}}$ For RC structural wall with SMRF building Clause 7.6.2

Where,

T = Fundamental natural period.

h = Height of the building.

A_w = Total effective area of the walls in first Storey of the building.

D =Base dimension of the building at the plinth level along the considered direction of earthquake shaking.

Damping value of 5% is considered. Clause 7.2.4

Design Seismic Base shear

$V_b = A_h W$

Where,

A_h = Design horizontal acceleration coefficient.

W = Seismic weight

Story Drift ≤ 0.004 Story Height.

Damping value of 5% can be considered.

Model analysis / Space frame analysis of the structure shall be carried out using Response Spectrum method.

6.1d Wind load analysis:

$Vz = Vb \times k_1 \times k_2 \times k_3 \times k_4$

Where,

Vz = Design Wind Pressure at Any Height Z in m/sec

Vb = Basic Wind Speed = 50 m/sec

K_1 = probability Factor =1

(As per IS: 875 (Part III) Clause 6.3.1, Table1)

K_2 = Terrain, Height and structure size Factor

(Assuming terrain category 3, As per IS: 875 (Part III) Clause 6.3.2)

K_3 = Topography Factor =1

(As per IS: 875 (Part III) Clause 6.3.3)

K_4 = importance Factor for cyclonic region =1

(As per IS: 875 (Part III)-2015 Clause 6.3.4)

$P_z = 0.6 \times Vz^2$

Design of life span = 50 years.

(As per IS: 875 (Part III)-1987 Table 1, Clause 5.3.1).

Pd = Kd.Ka.Kc.Pz

Where,

Kd = wind directionality factor = 1.0

Ka = area averaging factor = 0.8 and

Kc = combination factor = 0.9 (see 7.3.3.13)

(As per IS: 875 (Part III)-2015 Clause 7.2).

Wind force due to Gust effect

Necessary calculations for the Gust effect due to wind shall be calculated as per IS 875 (part 3)-2015

7. Conclusion

7.1 Other loads:

Any other loads like those of services; storage etc. will be obtained from time to time from the relevant consultants and incorporated. The top slab of the lift shaft will be designed for lift loads as obtained from the manufacturer.

7.2 Option Studies:

For the framing of the different floors, option studies will be provided along the project wherever options are possible. The cost effect of each option will be estimated for a decision making purposes.

7.3Column locations:

The location of the columns will be retained as per conceptual drawings received. Although additional columns and shear walls will be added wherever required. Final orientation of the columns and their sizing will be decided after discussion with the architects and mutually agreed upon. The frame model will be developed after this process. Any changes with regards to column sizes or locations requested would have to be studied on a case to case basis with possible effects on other columns.

This DBR attempts to briefly cover all design related methods and assumptions at this stage of the project. As the project progresses certain revisions to the DBR might be warranted and such timely revisions of this report will be promptly provided by us.

7.4Design methodology:

In addition to all assumptions mentioned in the document, each and every part of the structure will be designed taking in to consideration, the structural safety, economy and durability of the structural elements without compromising the architectural beauty.

7.5 Value Engineering Exercise:

Value Engineering shall be carried out to optimize the material consumption appropriately.

8. DETAILING REQUIREMENTS:

a) Shear walls and lateral load resisting vertical elements will be detailed for ductility as per IS-13920:2016.
b) Non lateral gravity columns will be detailed as non-ductile.
c) All lateral resisting framed beams will be detailed for ductility as per IS- 13920:2016.
d) Non framed beams will be detailed as non-ductile.

Dr. R. S. JANGID
Professor
Department of Civil Engineering
I.I.T. Bombay, Powai, Mumbai-76

Vastech Consultants & Engineers LLP