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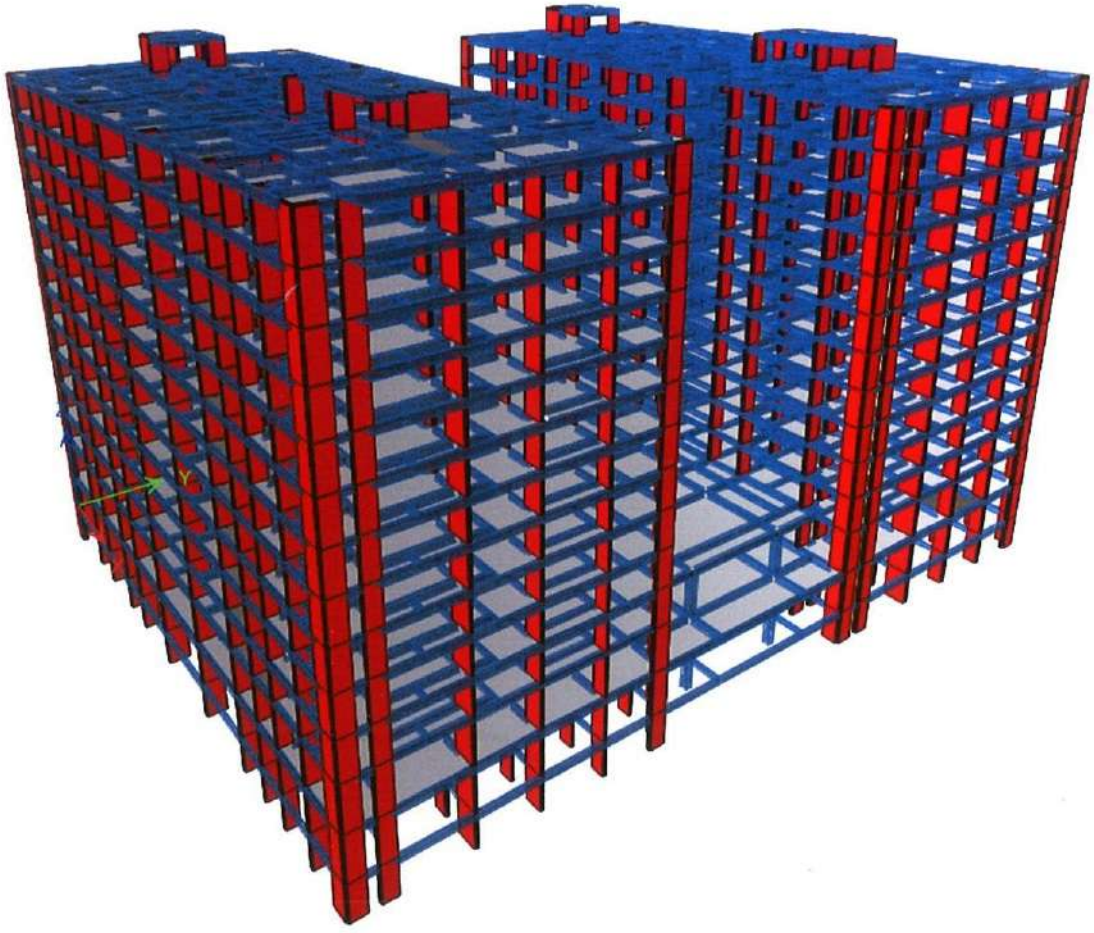
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STRUCTURAL DESIGN REPORT

OF RESIDENTIAL BUILDING (BASEMENT+STILT+11 UPPER FLOORS)

AT THANAKKANKULAM,MADURAI

MARCH-2026



STRUCTURAL CONSULTANT

C.KANNAN B.E., M.E (STRUCTURE)
INDIRA NAGAR, CHENNAI-20.

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FOREWORD

1.1.1 - Description of Project

M/s. Max Properties Private Limited, Madurai is developing a High rise residential building (Basement+Stilt+11 upper floors) at S.No:191/82A part, 1919/82B, 191/109 at Thanakkankulam Panchayat, Thiruparankundram Taluk, Madurai. This project is designed to provide a generous and comfortable habitat, complete with facilities that cater to a relaxed and convenient lifestyle. The project construction is carried out as RCC framed structure with Shear wall, RCC Beam and Slab system. The building is designed with accessibility in mind as well as earthquake-resistant construction to ensure the well-being of occupants.

1.1.2 – Objective of the Report

The objective of this report is to provide and furnish complete details related to Project and structural analysis and design considerations.

1.1.2 – Scope of the Report

The Structural Report covers the complete Structural Elements design considerations for analysis of lateralloads & gravity loads.

1.2 CODES, STANDARDS AND REFERENCES

Statutory Requirements:

The design of structural and other building services will comply with the following requirements:

- National Building Code The Building Regulations
- The Environmental Protection Act in liaison with the Environmental Agency.
- Fire prevention and detection in compliance with the local Fire Regulation.

DESIGN STANDARDS:

Specific applicable codes and standards will be identified and adopted in the design philosophies as appropriate to the structural elements. The latest editions of the Codes and Standards will be used indesigns. All design work shall be based on Indian Standards and Codes with latest revision, with amendments if any, as on date.

Loads:

IS: 875 -2015	-	Code of Practice for design loads (other than earthquake) for Buildings & structure (All parts)
IS: 1893-2016	-	Criteria for earthquake resistant design of structure

Foundations:

IS: 1080-1985(2016)	-	Code of Practice for design and construction of shallow foundations on soils(other than raft, ring and shell)
IS: 1904-1986(2015)	-	Code of Practice for design and construction of foundations in soils general requirement
IS: 2911-1980(2013)	-	Code of Practice for design and construction of pile foundations (All parts)
IS: 2950-1981(2013)	-	Code of Practice for design and construction of raft foundations
IS: 2974-1998(2013/2015)	-	Code of Practice for design and construction of machine Foundations(All parts)
IS: 8009-1976/1980(2013/2015)	-	Code of Practice for calculation of settlement of foundations (All parts)

RCC:

IS: 456 -2000(2016)	-	Code of Practice for plain and reinforced concrete
IS: 458 -1988	-	Specification for precast concrete pipes
IS: 3370-2009	-	Code of Practice for concrete structures for the storage of liquids:(All parts)
IS: 4326-2013	-	Code of Practice for earthquake resistant design and construction of building
IS: 5525-1969(2013)	-	Recommendation for detailing of reinforced concrete works
IS: 1786-2008	-	Code of Practice for design and construction of machine Foundations(All parts)
IS: 5525-1969(2013)	-	Specification for high strength deformed steel bars and wires for concrete reinforcement
IS: 1786-2008	-	Recommended guidelines for concrete mix design
IS: 10262-2009	-	Criteria for earthquake resistant design of structures (General provisions and building).
IS: 1893 (Part-1)-2016	-	Criteria for structural safety of Tall Concrete buildings
IS: 16700 – 2017	-	Ductile design and Detailing of Reinforced concrete structures subjected to Seismic forces – Code of practice
IS: 13920 – 2016	-	Ductile design and Detailing of Reinforced concrete structures subjected to Seismic forces – Code of practice
IS: 1343 – 1980	-	Code of practice for Prestressed concrete

Miscellaneous:

IS: 432(part 2)-1995	-	Specification for mild steel and medium tensile steel bars and hard-drawnsteel wire for concrete reinforcement
IS: 6313(part II)-2001	-	Standards for anti-termite treatment
IS: 1905-1998	-	Code of Practice for structural use of unreinforced masonry
IS: 3067-1995	-	Code of Practice for general design details and preparatory works for damp proofing and water proofing of buildings
SP: 6 -1998	-	Handbook for structural engineers (all parts)
SP: 7 -2005	-	National Building Code of India
SP: 16-1999	-	Design Aids for reinforced concrete to IS:456-1978
SP: 22-1982	-	Explanatory handbook on codes for earthquake engineering (IS:1982-1975and IS:4326-1976)
SP: 24-1983	-	Explanatory handbook on Indian Standard code of Practice for plain andreinforced concrete
SP: 34-1987	-	Handbook of concrete reinforcement and detailing (SCIP)

Material:

IS: 269 -2015	-	Specification for Ordinary, rapid hardening and low heat Portland cement'
.IS: 455 -1995	-	Specification for Portland blast furnace slag cement.
IS: 1489-1991	-	Specification for Portland pozzolana cement
IS: 4031-1991	-	Method of physical tests for Portland cement.
IS: 383 - 2016	-	Specification for coarse and fine aggregates from natural sources for concrete.
IS: 516 – 1999	-	Method of test for strength of concrete
IS: 1199-1999	-	Method of sampling and analysis of concrete.
IS: 1566-2000	-	Specification for plain hard drawn steel wire fabric for concrete reinforcement
IS: 4990-1998	-	Specification for plywood for concrete shuttering works.
IS: 2645-1999	-	Specification for integral cement water proofing compounds.

1.3 DESCRIPTION OF STRUCTURE

1.3.1 Building Description

The Development consists of the following:

a. Residential building floor covered with RCC roofing.

The usages of individual floors are as given below:

Floors	Details
Main Residential Building	Space living purpose

1.3.2 Structural Arrangement:

The Structural System for the residential buildings comprises of RCC column and beam and slab.

S.No.	Description	Details
1.	Column Grids	3.60 m x 2.10 m (Varies for some grids)
2.	Structural System	RCC Shear Wall & Column
3.	Slab Thickness RCC Slab	Min. 120mm (Varies on span)
4.	Foundation	Raft Foundation
5.	Column	As per design
6.	Beams	As per design

1.4 DESIGN APPROACH

1.4.1 – Design Life.

The design life of the building is assumed as 50 years. This requirement is applicable only for concrete works and not applicable to replaceable finishing materials, water proofing membrane and thermal insulations (if any). Hence periodic maintenance / refurbishment are required for all replaceable material for longer life.

1.4.2 – Material Properties.

Materials specified will conform to the latest edition of the relevant Indian Standard or other accepted standard. Specifications for materials will include sampling and testing as stipulated in the design standards. Detailed material specifications will be included in the Technical Specification.

Concrete:

All structural concrete shall have cube crushing strength of 40 N/sq.mm (M40) at 28 days.Plain cement concrete shall have cube crushing strength of 10 N/sq.mm (M10) at 28 days.

Concrete Mix:

Concrete Item	Grade
Raft Foundation	M30
Columns	M40
Slabs & Beams	M30

Reinforcement steel:

- All reinforcement shall confirm to IS: 1786 – 1985 having minimum yield strength of 500 N/sq.mm.Corrosion resistant steel is not required.

1.4.3 – Design loads

Dead loads:

Dead load shall include weight of all structural and Architectural components. Self-weight of the materials shall be calculated on the basis of unit weights given in IS: 875.

- Floor finish of 75 mm thickness : 75 kg/sqm
- Self-weight of Plain concrete : 2400 kg/cum (24 kN/cum)
- Self-weight of RCC : 2500 kg/cum (25 kN/cum)
- Aerocon block masonry : 700 kg/cum (7 kN/cum) [For walls]
  (With additional 15mm thick plastering on external surface and 12mm plastering on internal wallsurfaces)
- Soil (Dry) : 1800 kg/cum (18 kN/cum)
- Soil (Wet) : 2000 kg/cum (20 kN/cum)
- Water : 1000 kg/cum (10 kN/cum)
- Masonry with plastering : 2200 kg/cum (22 kN/cum)
- Wall loads : As per actuals

Live loads:

The superimposed loads shall be calculated in accordance with IS: 875(Part-2) based on Occupancy Classification. For multiple occupancies of use in the building shall be referred with the other appropriate comparable occupancy classification as per Table.1 of IS 875(Part-2)-1987.

Following live loads are considered while designing the structural elements apart from the dead loads asper codes.

Floor Live loads:

- Living Area : 200 kg/sqm (2.0 kN/sqm)
- Stairs : 300 kg/sqm (3.0 kN/sqm)
- Corridors / Balcony : 300 kg/sqm (3.0 kN/sqm)
- Toilets : 200 kg/sqm (2.0 kN/sqm)
- Terrace with Access : 200 kg/sqm (2.0 kN/sqm)
- Electrical rooms : 400 kg/sqm (4.0 kN/sqm)

Sunken Details:

- Toilet : 250 mm

Wind Loads

The Wind pressure shall be calculated in accordance with IS: 875 (Part-3):2015.Madurai has a high wind speed of 50m/s.

Basic Wind Speed V_b : 39 m/s

Risk Coefficient k_1 : 1.00 (k_1 corresponds to 50 years Mean Probable Design Life of Structure)

Terrain, height, structure size factor k_2 : To suit the height of the structure for terrain category 2

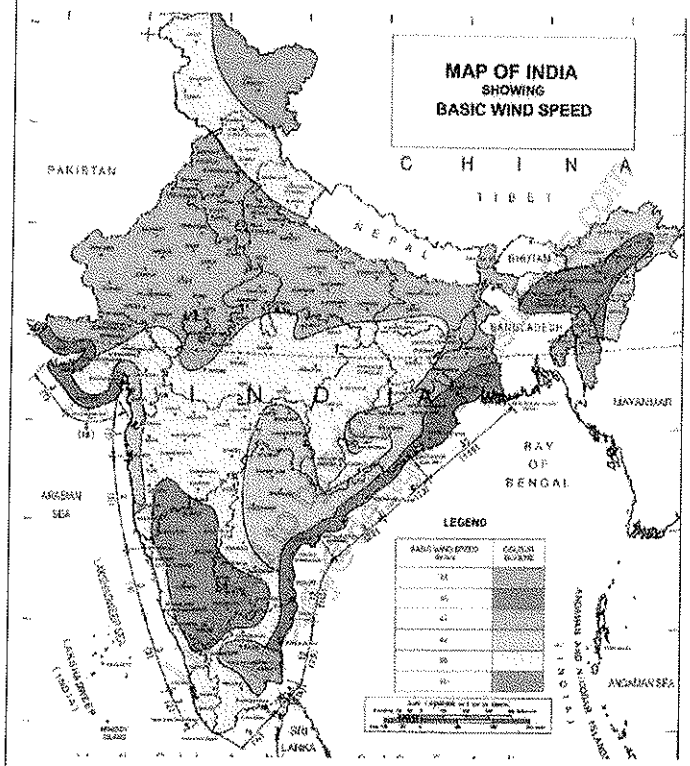
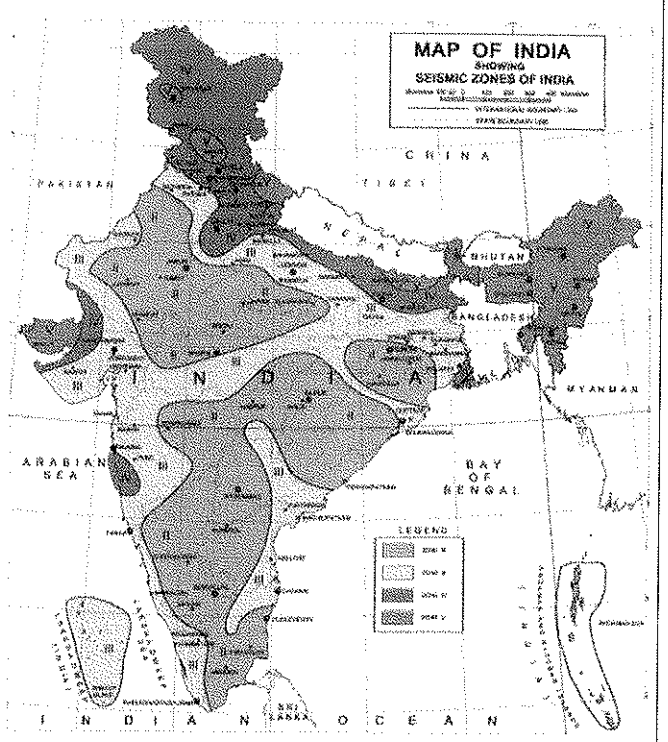
Topography factor k_3 : 1.0

Importance factor for cyclonic region k_4 : 1.00

The external and internal pressure co-efficient shall be as per respective clauses of IS: 875 (Part 3):2015 Design

Wind speed V_z : $V_b \times k_1 \times k_2 \times k_3 \times k_4$

Design Wind Pressure, P_z : $0.6V_z^2$

Map showing basic wind speed	Map showing seismic zones
	
Basic wind speed in m/s (based on 50-year return period)	Seismic zones of India

Seismic Forces:

Madurai falls under seismic zone III as per IS 1893-2016 (Part 1) (Sixth Revision) and has the following factors to be considered for designs. Ductile detailing is required. (Please refer attached map above)

Seismic Zone	: II
Seismic Zone factor, Z	: 0.1 (As per Table 3; IS: 1893-2016)
Design horizontal seismic coefficient (Ah)	: $(Z/2)*(S_a/g)*(I/R)$
I -Importance factor	: 1.2 (Ref Table 8; IS: 1893-2016)
Response reduction Factor	: 5
Soil type	: Type -I
Damping Ratio for RCC	: 5 %

Sa/g – Average response acceleration coefficient for soil sites as per Fig.2 of IS: 1893-2016 and it is arrivedbased on appropriate fundamental natural period of structure as per Cl 7.6.2 (b)

Design horizontal seismic coefficient (A_h)	: $(Z/2)*(S_a/g)*(I/R)$
	: $(0.1/2)*(1.2/5) * (S_a/g)$
A_h	: $0.012 * (S_a/g)$
Design seismic base shear, V_b	: $A_h * w$ where, w - seismic weight of building
Effect of infill panels	: Not considered in the analysis

Table No : 03

Seismic Zone Factor Z				
(Clause 6.4.2)				
Seismic Zone	**II**	**III**	**IV**	**V**
Seismic Intensity	Low	Moderate	Severe	Very Severe
Z	0.10	0.16	0.24	0.36

Temperature Loads:

The effect of temperature will be considered wherever applicable in accordance with relevant Indian Codes. Minimum & maximum temperatures considered are as shown in the table below. Same will be used for the analysis & design. The coefficient for thermal expansion and contraction will be in accordance with IS: 456 and IS: 800 for concrete and steel respectively.

Station Name	Month	Period	No. of Years	Mean Temperature in Degree C		Mean rainfall in mm
				Maximum	Minimum	
Chennai (Minambakkam)	January	1901-2000	100	28.8	20.4	35.3
Chennai (Minambakkam)	February	1901-2000	100	30.5	21.1	13.0
Chennai (Minambakkam)	March	1901-2000	100	32.6	23.0	14.5
Chennai (Minambakkam)	April	1901-2000	100	34.7	25.8	15.9
Chennai (Minambakkam)	May	1901-2000	100	37.4	27.6	42.4
Chennai (Minambakkam)	June	1901-2000	100	37.3	27.4	53.9
Chennai (Minambakkam)	July	1901-2000	100	35.3	26.1	99.6
Chennai (Minambakkam)	August	1901-2000	100	34.5	25.5	129.9
Chennai (Minambakkam)	September	1901-2000	100	33.9	25.2	123.5
Chennai (Minambakkam)	October	1901-2000	100	31.8	24.2	284.6
Chennai (Minambakkam)	November	1901-2000	100	29.4	22.6	353.0
Chennai (Minambakkam)	December	1901-2000	100	28.4	21.2	146.3

[Source: National Data Centre: ndc@imdpune.gov.in DGM (Sectt.): dgm.hq@imd.gov.in]

Considering the average **daily** maximum temperature as 34 degrees and minimum as 24 degrees, the variation in temperature for analysis is considered as **10 degrees**. [Source https://www.wunderground.com/history/airport/VOMM/2016/1/4/CustomHistory.html?dayend=5&monthend=2&yearend=2017&req_city=&req_state=&req_statename=&reqdb.zip=&reqdb.magic=&reqdb.wmo=]

Temperature and shrinkage effect:

Horizontal floor displacement due to differential temperatures and shrinkage is of importance in long concrete buildings. It can be taken care of by either providing expansion joints at an appropriate spacing or designing structural members for the additional moments caused by the temperature and shrinkage effects. Pour strips at suitable locations shall also be considered where required.

Exceptional Loads:

Loads due to the following catastrophe scenarios are not considered in the design:

- Exceptional loads due to terrorist attacks (Explosions)
- Accidental loads (Falling of aircraft on the building)
- Accidental collision of vehicles on the façade of the building

1.4.4 Durability Considerations:

Environmental conditions, Corrosion and Fire protection for concrete and structural steel

- Environment : Moderate
- Exposure conditions : Concrete surfaces exposed to moderate environment
- Minimum grade of Concrete : Moderate Exposure – M25

Table 5 Minimum Cement Content, Maximum Water-Cement Ratio and Minimum Grade of Concrete for Different Exposures with Normal Weight Aggregates of 20 mm Nominal Maximum Size

(Clauses 6.1.2, 8.2.4.1 *and* 9.1.2*)*

Sl No.	Exposure	Plain Concrete			Reinforced Concrete		
		Minimum Cement Content kg/m³	Maximum Free Water-Cement Ratio	Minimum Grade of Concrete	Minimum Cement Content kg/m³	Maximum Free Water-Cement Ratio	Minimum Grade of Concrete
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
i)	Mild	220	0.60	–	300	0.55	M 20
ii)	Moderate	240	0.60	M 15	300	0.50	M 25
iii)	Severe	250	0.50	M 20	320	0.45	M 30
iv)	Very severe	260	0.45	M 20	340	0.45	M 35
v)	Extreme	280	0.40	M 25	360	0.40	M 40

NOTES

1 Cement content prescribed in this table is irrespective of the grades of cement and it is inclusive of additions mentioned in 5.2. The additions such as fly ash or ground granulated blast furnace slag may be taken into account in the concrete composition with respect to the cement content and water-cement ratio if the suitability is established and as long as the maximum amounts taken into account do not exceed the limit of pozzolona and slag specified in IS 1489 (Part 1) and IS 455 respectively.

2 Minimum grade for plain concrete under mild exposure condition is not specified.

1.4.5 Fire Rating

Thickness of the structural elements as per table 15, 16 & 16A clause 26.4 of IS 456-2000.

Fire Resistance h	*Minimum Beam Width b*	*Rib Width of Slabs b_w*	*Minimum Thickness of Floors D*	*Column Dimension (b or D)*			*Minimum Wall Thickness*		
				Fully Exposed	50% Exposed	One Face Exposed	$p<0.4\%$	$0.4\% \le p \le 1\%$	$p>1\%$
	mm	mm	mm	mm	mm	mm	mm	mm	mm
0.5	200	125	75	150	125	100	150	100	100
1	200	125	95	200	160	120	150	120	100
1.5	200	125	110	250	200	140	175	140	100
2	200	125	125	300	200	160	–	160	100
3	240	150	150	400	300	200	–	200	150
4	280	175	170	450	350	240	–	240	180

NOTES

1 These minimum dimensions relate specifically to the covers given in Table 16A.

2 p is the percentage of steel reinforcement.

FIG. 1 MINIMUM DIMENSIONS OF REINFORCED CONCRETE MEMBERS FOR FIRE RESISTANCE

Nominal covers for 2 hr. fire resistance:

Nominal Cover						
Beams		Slabs		Ribs		Columns
Simply supported	Continuous	Simply supported	Continuous	Simply supported	Continuous	
mm	mm	mm	mm	mm	mm	mm
40	30	35	25	45	35	40

1.5 ANALYSIS METHODOLOGY:

This structure has a physical interface with almost all the disciplines like geotechnical works, MEP services,etc. The structure proposed is of cast in-situ concrete construction with columns suitably placed. The vertical loads including the dead and super imposed loads are transferred to the soil through columns and foundation. Foundations are sized with consideration to the safe bearing capacity of soil at the level of transfer of load recommended by specialist soil investigation consultants.

1.5.1 Assumptions:

- The structure is idealized as 3D space frame and analyzed using ETABS software package for both vertical and lateral loads.
- The structure is analyzed for specific loads like dead load, live load, wind, and seismic loads and forthe load combinations as given in the relevant codes.
- The foundation is represented in analysis model using fixed end conditions.

1.5.2 Mathematical model

Mass Modelling:

Mass Source as per IS: 1893_2016 is considered as follows.

Mass source = DL+SDL+ 0. 5LLWhere DL - Dead Load;

SDL – Super Imposed Dead Load;LL - Live Load

1.5.3 Static Analysis:

The following Static loads cases are considered in the analysis.

DL - Dead Load which includes self-weight of the structure.

SDL – Super Imposed Dead Load, including load due to finishes, wall Loads, Soil filling loads etc.

LL - Live Load

1.6 LOAD COMBINATIONS:

Load combinations Used for Strength, Serviceability are tabulated below:

Load Combination	Limit State of Collapse			Limit State of Serviceability		
	DL+SDL	*LL*	*WL/EL/TL*	*DL+SDL*	*LL*	*WL/EL/TL*
DL + LL	1.5	1.5	—	1	1	—
DL + WL	1.5 or 0.9*	—	1.5	1	—	1
DL + EL	1.5 or 0.9*	—	1.5	1	—	1
DL + TL	1.5	—	1.5	1	—	1
DL+LL+WL	1.2	1.2	1.2	1	0.8	0.8
DL+LL+EL	1.2	1.2	1.2	1	0.8	0.8
DL+LL+TL	1.2	1.2	1.2	1	1	1
DL+WL+TL	1.2	—	1.2	1	—	1
DL+EL+TL	1.2	—	1.2	1	—	1
DL+LL+EL+TL	1.2	1.2	1.2	1	1	1

Response spectrum combinations:

- 1.2[DL+LL+(SPECX+0.3 SPECY+0.3 SPECZ)]
- 1.2[DL+LL+(SPECY+0.3 SPECX+0.3 SPECZ)]
- 1.5[DL+(SPECX+0.3 SPECY+0.3 SPECZ)]
- 1.5[DL+(SPECY+0.3 SPECX+0.3 SPECZ)]
- 0.9DL+1.5(SPECX+0.3 SPECY+0.3 SPECZ)]
- 0.9DL+1.5(SPECY+0.3 SPECX+0.3 SPECZ)]

The various loads are combined in accordance with the stipulations in IS: 875 (Part 5)-1987; whichever combination produces the most unfavorable effect in the building foundation or structural member concerned may be adopted.

*This value is to be considered when stability against overturning and stress reversal is critical where DL/LL/WL/EL denotes,DL - Dead Load; LL - Live Load; TL - Temperature Load; WL - Wind Load;EL - Earthquake Load , SPEC- Response spectrum Wind load and earthquake loads are considered for both x & y directions. Whenever imposed load is combined with earthquake load, the appropriate part of imposed load as specified in IS: 1893-2016 / Clause 7.3.3 of seismic code will be used both for evaluating earthquake effect and for combined load effects usedin such combination. Serviceability loads combinations with suitable live load reduction factor as per IS: 875(Part-2) will be used for foundation design.

1.7 DESIGN METHODOLOGY:

- All R.C.C structures shall be designed according to the Limit State Method as specified in IS: 456 – 2000.
- Forces and moments from the 3D analysis output for the worst combinations are used for the design of the structure.
- The foundations are designed for critical load combination.
- The structure is analyzed for specific loads like dead load, live load, wind and seismic loads and for the load combinations as given in the relevant codes.
- The slab is analyzed as two-way and one way slabs.
- Design of special members like retaining wall, water tanks will be done in accordance with the relevant IS Codes.

1.8 ACCEPTANCE CRITERIA:

1.8.1 Deflection Limits:

For Reinforced concrete works:

- Limiting values of deflection (Short and Long term) as per clause 35.3 of IS: 456-2000 is followed in the design.
- Limiting value for long term deflection is considered as span/250 and for the long term deflection after erection of partitions & finishes is considered as span/350 or 20mm whichever less as per IS 456 – 2000.

1.8.2 Cracking Limits:

- Limiting values of crack width as per clause 35.3 of IS: 456-2000 is followed in the design.In general for slabs and beams, the crack width is limited to 0.3mm.
- For water retaining structures, crack width is limited to 0.2mm.

1.8.3 Soil data:

Foundations are designed based on Geo Technical investigation report and will dissipate all the vertical and horizontal loads safely to the soil below. The soil investigation report recommends mat foundation system.

1.9 DETAILING REQUIREMENTS:

RC walls, which are considered as lateral load resisting elements are detailed as ductile RC walls along with perimeter SMRFs (both columns and beams). Rest of the columns and beams are detailed as per normal detailing requirement. Detailing for all structural members shall be in accordance with IS: 456 & SP: 34.

IS 1893:2016 Auto Seismic Load Calculation

This calculation presents the automatically generated lateral seismic loads for load pattern EQ +X according to IS 1893:2016, as calculated by ETABS.

Direction and Eccentricity

Direction = X + Eccentricity Y

Eccentricity Ratio = 5% for all diaphragms

Structural Period

Period Calculation Method = User Specified

User Period		T=1.862 sec

Factors and Coefficients

Seismic Zone Factor, Z [IS Table 3]		$Z = 0.1$
Response Reduction Factor, R [IS Table 9]		$R = 5$
Importance Factor, I [IS Table 8]		$I = 1.2$
Site Type [IS Table 1] = II		

Seismic Response

Spectral Acceleration Coefficient, S_a/g [IS 6.4.2]	$\frac{S_a}{g} = \frac{1.36}{T}$	$\frac{S_a}{g} = 0.445$

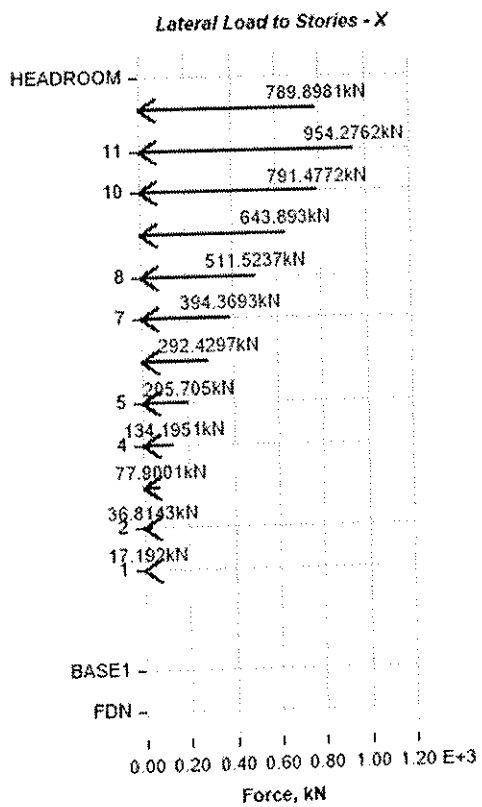
Equivalent Lateral Forces

Seismic Coefficient, A_h [IS 6.4.2]	$A_h = \frac{ZI\frac{S_a}{g}}{2R}$

Calculated Base Shear

Direction	Period Used (sec)	W (kN)	V_b (kN)
X + Ecc. Y	3.059	440879.4121	4849.6735

Applied Story Forces



Story	Elevation	X-Dir	Y-Dir
	m	kN	kN
TERRACE	40.87	789.8981	0
11	37.82	954.2762	0
10	34.77	791.4772	0
9	31.72	643.893	0
8	28.67	511.5237	0
7	25.62	394.3693	0
6	22.57	292.4297	0
5	19.52	205.705	0
4	16.47	134.1951	0
3	13.42	77.9001	0
2	10.37	36.8143	0
1	7.32	17.192	0
STILT	3.66	0	0
BASE1	0	0	0
FDN	-3	0	0

IS 1893:2016 Auto Seismic Load Calculation

This calculation presents the automatically generated lateral seismic loads for load pattern EQ +Y according to IS 1893:2016, as calculated by ETABS.

Direction and Eccentricity

Direction = Y + Eccentricity X

Eccentricity Ratio = 5% for all diaphragms

Structural Period

Period Calculation Method = User Specified

User Period T=2.166 sec

Factors and Coefficients

Seismic Zone Factor, Z [IS Table 3] $Z = 0.1$

Response Reduction Factor, R [IS Table 9] $R = 5$

Importance Factor, I [IS Table 8] $I = 1.2$

Site Type [IS Table 1] = II

Seismic Response

Spectral Acceleration Coefficient, S_a/g [IS 6.4.2] $\frac{S_a}{g} = \frac{1.36}{T}$ $\frac{S_a}{g} = 0.4840$

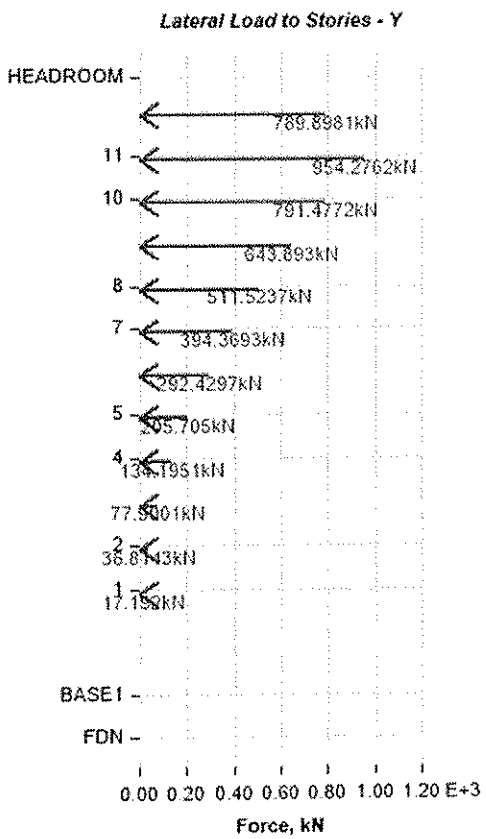
Equivalent Lateral Forces

Seismic Coefficient, A_h [IS 6.4.2] $A_h = \frac{ZI\frac{S_a}{g}}{2R}$

Calculated Base Shear

Direction	Period Used (sec)	W (kN)	V_b (kN)
Y + Ecc. X	2.81	440879.4121	4849.6735

Applied Story Forces



Story	Elevation	X-Dir	Y-Dir
	m	kN	kN
TERRACE	40.87	0	789.8981
11	37.82	0	954.2762
10	34.77	0	791.4772
9	31.72	0	643.893
8	28.67	0	511.5237
7	25.62	0	394.3693
6	22.57	0	292.4297
5	19.52	0	205.705
4	16.47	0	134.1951
3	13.42	0	77.9001
2	10.37	0	36.8143
1	7.32	0	17.192
STILT	3.66	0	0
BASE1	0	0	0
FDN	-3	0	0

MODAL PARTICIPATING MASS RATIOS

Case	Mode	Period	UX	UY	UZ	Sum UX	Sum UY	Sum UZ	RX	RY	RZ	Sum RX	Sum RY	Sum RZ
		sec												
Modal	1	3.059	3.059	0.603	0.045	0.000	0.603	0.045	0.000	0.004	0.071	0.097	0.004	0.071
Modal	2	2.81	2.810	0.117	0.486	0.000	0.720	0.531	0.000	0.041	0.013	0.126	0.045	0.084
Modal	3	2.717	2.717	0.021	0.183	0.000	0.741	0.714	0.000	0.016	0.003	0.476	0.060	0.086
Modal	4	2.156	2.156	0.003	0.001	0.000	0.744	0.714	0.000	0.000	0.000	0.021	0.060	0.087
Modal	5	2.04	2.040	0.010	0.008	0.000	0.754	0.723	0.000	0.001	0.000	0.030	0.061	0.087
Modal	6	1.824	1.824	0.000	0.000	0.000	0.754	0.723	0.000	0.000	0.000	0.001	0.061	0.087
Modal	7	0.859	0.859	0.129	0.001	0.000	0.883	0.724	0.000	0.000	0.151	0.007	0.061	0.238
Modal	8	0.761	0.761	0.005	0.041	0.000	0.888	0.765	0.000	0.022	0.007	0.086	0.083	0.245
Modal	9	0.732	0.732	0.000	0.116	0.000	0.888	0.880	0.000	0.065	0.000	0.028	0.148	0.245
Modal	10	0.529	0.529	0.002	0.000	0.000	0.890	0.881	0.000	0.000	0.001	0.019	0.149	0.246
Modal	11	0.519	0.519	0.001	0.001	0.000	0.890	0.881	0.000	0.001	0.000	0.006	0.149	0.247
Modal	12	0.501	0.501	0.000	0.000	0.004	0.890	0.881	0.004	0.000	0.000	0.000	0.149	0.247
Modal	13	0.465	0.465	0.000	0.000	0.001	0.890	0.881	0.006	0.000	0.001	0.000	0.149	0.247
Modal	14	0.464	0.464	0.000	0.000	0.001	0.890	0.881	0.006	0.000	0.001	0.000	0.149	0.248
Modal	15	0.443	0.443	0.000	0.000	0.000	0.890	0.881	0.006	0.000	0.000	0.000	0.149	0.248
Modal	16	0.433	0.433	0.000	0.000	0.000	0.890	0.881	0.007	0.000	0.000	0.000	0.149	0.248
Modal	17	0.423	0.423	0.050	0.000	0.000	0.941	0.881	0.007	0.000	0.035	0.002	0.149	0.283
Modal	18	0.412	0.412	0.000	0.000	0.000	0.941	0.881	0.007	0.000	0.000	0.000	0.149	0.283
Modal	19	0.407	0.407	0.000	0.000	0.002	0.941	0.881	0.009	0.000	0.001	0.000	0.149	0.284
Modal	20	0.396	0.396	0.000	0.000	0.003	0.941	0.881	0.012	0.000	0.002	0.000	0.149	0.286
Modal	21	0.396	0.396	0.000	0.000	0.000	0.941	0.881	0.012	0.000	0.000	0.000	0.149	0.286
Modal	22	0.383	0.383	0.000	0.000	0.000	0.941	0.881	0.012	0.000	0.002	0.000	0.149	0.287
Modal	23	0.375	0.375	0.000	0.000	0.000	0.941	0.881	0.012	0.000	0.000	0.000	0.149	0.288
Modal	24	0.369	0.369	0.000	0.000	0.001	0.941	0.881	0.013	0.000	0.000	0.000	0.149	0.288
Modal	25	0.368	0.368	0.000	0.000	0.002	0.941	0.881	0.015	0.000	0.000	0.000	0.149	0.288
Modal	26	0.349	0.349	0.000	0.020	0.000	0.941	0.901	0.015	0.009	0.000	0.021	0.158	0.288

STORY DRIFT

Story	Output Case	Direction	Drift	Drift/	X	Y	Z
TERRACE	EQ +X	X	0.000837	1/1194	1.3	44.5516	40.87
11	EQ +X	X	0.000946	1/1057	6.3627	44.5516	37.82
10	EQ +X	X	0.001072	1/933	6.3627	44.5516	34.77
9	EQ +X	X	0.001199	1/834	6.3627	44.5516	31.72
8	EQ +X	X	0.00131	1/763	6.3627	44.5516	28.67
7	EQ +X	X	0.001397	1/716	6.3627	44.5516	25.62
6	EQ +X	X	0.001454	1/688	6.3627	44.5516	22.57
5	EQ +X	X	0.001474	1/679	6.3627	44.5516	19.52
4	EQ +X	X	0.001451	1/689	1.3	44.5516	16.47
3	EQ +X	X	0.001389	1/720	6.3627	0.00002547	13.42
2	EQ +X	X	0.001268	1/789	42.4759	0.00002453	10.37
1	EQ +X	X	0.001047	1/955	42.4759	0.00002453	7.32
STILT	EQ +X	X	0.000737	1/1356	0.00004929	1.3	3.66
BASE1	EQ +X	X	0.000332	1/3013	44.4374	16.1544	0
TERRACE	RSA- X	X	0.00083	1/1205	42.4759	0.00002453	40.87
11	RSA- X	X	0.000912	1/1096	6.3627	0.00002547	37.82
10	RSA- X	X	0.000997	1/1003	6.3627	0.00002547	34.77
9	RSA- X	X	0.001075	1/930	6.3627	0.00002547	31.72
8	RSA- X	X	0.00114	1/877	6.3627	0.00002547	28.67
7	RSA- X	X	0.001195	1/837	6.3627	0.00002547	25.62
6	RSA- X	X	0.001239	1/807	6.3627	0.00002547	22.57
5	RSA- X	X	0.001268	1/789	6.3627	0.00002547	19.52
4	RSA- X	X	0.001277	1/783	42.4759	0.00002453	16.47
3	RSA- X	X	0.001258	1/795	6.3627	0.00002547	13.42
2	RSA- X	X	0.001198	1/835	42.4759	0.00002453	10.37
1	RSA- X	X	0.001045	1/957	42.4759	0.00002453	7.32
STILT	RSA- X	X	0.000767	1/1303	54.3052	0.0002	3.66
BASE1	RSA- X	X	0.000325	1/3073	9.7918	3.8292	0
TERRACE	EQ +Y	Y	0.001298	1/770	54.3052	2.2292	40.87
11	EQ +Y	Y	0.001372	1/729	54.3052	2.2292	37.82
10	EQ +Y	Y	0.001461	1/684	54.3052	2.2292	34.77
9	EQ +Y	Y	0.001546	1/647	54.3052	2.2292	31.72
8	EQ +Y	Y	0.001613	1/620	54.3052	2.2292	28.67
7	EQ +Y	Y	0.001653	1/605	54.3052	2.2292	25.62
6	EQ +Y	Y	0.00166	1/602	54.3052	2.2292	22.57
5	EQ +Y	Y	0.001627	1/615	54.3052	2.2292	19.52
4	EQ +Y	Y	0.001547	1/647	54.3052	2.2292	16.47
3	EQ +Y	Y	0.001413	1/708	54.3052	2.2292	13.42
2	EQ +Y	Y	0.001209	1/827	54.3052	2.2292	10.37
1	EQ +Y	Y	0.000925	1/1081	54.3052	2.2292	7.32
STILT	EQ +Y	Y	0.000622	1/1609	54.3052	46.7808	3.66
BASE1	EQ +Y	Y	0.000269	1/3724	49.6001	69.7738	0
TERRACE	RSA-Y	Y	0.000916	1/1092	54.3052	46.7808	40.87
11	RSA-Y	Y	0.000962	1/1039	54.3052	1.3002	37.82
10	RSA-Y	Y	0.001012	1/988	54.3052	2.2292	34.77

9	RSA-Y	Y	0.001052	1/951	54.3052	2.2292	31.72
8	RSA-Y	Y	0.001078	1/927	54.3052	2.2292	28.67
7	RSA-Y	Y	0.001091	1/916	54.3052	2.2292	25.62
6	RSA-Y	Y	0.00109	1/917	54.3052	2.2292	22.57
5	RSA-Y	Y	0.001073	1/932	54.3052	2.2292	19.52
4	RSA-Y	Y	0.001035	1/966	54.3052	2.2292	16.47
3	RSA-Y	Y	0.000967	1/1034	54.3052	2.2292	13.42
2	RSA-Y	Y	0.000852	1/1173	54.3052	2.2292	10.37
1	RSA-Y	Y	0.000676	1/1480	54.3052	46.7808	7.32
STILT	RSA-Y	Y	0.000477	1/2095	54.3052	69.7738	3.66
BASE1	RSA-Y	Y	0.000213	1/4704	49.6001	69.7738	0

STORY MAX OVER AVG DISPLACEMENTS:

Story	Output Case	Direction	Maximum	Average	Ratio
TERRACE	EQ +X	X	49.037	46.623	1.052
11	EQ +X	X	46.518	44.306	1.05
10	EQ +X	X	43.68	41.668	1.048
9	EQ +X	X	40.465	38.654	1.047
8	EQ +X	X	36.87	35.259	1.046
7	EQ +X	X	32.935	31.527	1.045
6	EQ +X	X	28.731	27.525	1.044
5	EQ +X	X	24.345	23.338	1.043
4	EQ +X	X	19.88	19.067	1.043
3	EQ +X	X	15.456	14.829	1.042
2	EQ +X	X	11.22	10.765	1.042
1	EQ +X	X	7.354	7.059	1.042
STILT	EQ +X	X	3.52	3.392	1.038
TERRACE	EQ +Y	Y	56.357	43.978	1.282
11	EQ +Y	Y	52.397	41.092	1.275
10	EQ +Y	Y	48.213	38.004	1.269
9	EQ +Y	Y	43.756	34.685	1.262
8	EQ +Y	Y	39.041	31.14	1.254
7	EQ +Y	Y	34.121	27.406	1.245
6	EQ +Y	Y	29.078	23.544	1.235
5	EQ +Y	Y	24.015	19.628	1.224
4	EQ +Y	Y	19.054	15.749	1.21
3	EQ +Y	Y	14.337	12.013	1.193
2	EQ +Y	Y	10.027	8.542	1.174
1	EQ +Y	Y	6.339	5.483	1.156
STILT	EQ +Y	Y	2.954	2.558	1.155
TERRACE	RSA- X	X	42.4	35.722	1.187
11	RSA- X	X	40.194	33.959	1.184
10	RSA- X	X	37.797	32.017	1.181
9	RSA- X	X	35.168	29.862	1.178
8	RSA- X	X	32.293	27.478	1.175
7	RSA- X	X	29.179	24.874	1.173
6	RSA- X	X	25.844	22.064	1.171

5	RSA- X	X	22.318	19.075	1.17
4	RSA- X	X	18.645	15.946	1.169
3	RSA- X	X	14.885	12.73	1.169
2	RSA- X	X	11.128	9.513	1.17
1	RSA- X	X	7.507	6.418	1.17
STILT	RSA- X	X	3.694	3.173	1.164
TERRACE	RSA-Y	Y	36.905	31.665	1.165
11	RSA-Y	Y	34.309	29.525	1.162
10	RSA-Y	Y	31.605	27.288	1.158
9	RSA-Y	Y	28.772	24.937	1.154
8	RSA-Y	Y	25.818	22.477	1.149
7	RSA-Y	Y	22.764	19.92	1.143
6	RSA-Y	Y	19.638	17.288	1.136
5	RSA-Y	Y	16.474	14.606	1.128
4	RSA-Y	Y	13.32	11.91	1.118
3	RSA-Y	Y	10.243	9.254	1.107
2	RSA-Y	Y	7.339	6.712	1.093
1	RSA-Y	Y	4.759	4.401	1.081
STILT	RSA-Y	Y	2.293	2.125	1.079

STORY STIFFNESS:

Story	Output Case	Shear X	Drift X	Stiff X	Shear Y	Drift Y	Stiff Y
		kN	mm	kN/m	kN	mm	kN/m
HEADROOM	EQ +X	3.3019	1.522	2169.021	0.0634	0.179	0
TERRACE	EQ +X	820.1039	2.335	351187.98	0.8286	0.308	0
11	EQ +X	1813.7439	2.662	681376.412	1.9291	0.313	0
10	EQ +X	2645.2102	3.042	869666.934	2.9843	0.317	0
9	EQ +X	3329.4373	3.425	971973.504	3.9877	0.32	0
8	EQ +X	3881.2734	3.763	1031336.107	4.9318	0.321	0
7	EQ +X	4315.504	4.031	1070520.631	5.8084	0.316	0
6	EQ +X	4646.8573	4.21	1103654.258	6.6085	0.303	0
5	EQ +X	4890.0025	4.286	1140932.897	7.3231	0.283	0
4	EQ +X	5059.5409	4.24	1193314.971	7.9436	0.253	0
3	EQ +X	5169.9915	4.063	1272400.345	8.4638	0.209	0
2	EQ +X	5235.7796	3.706	1412671.189	8.8815	0.146	0
1	EQ +X	5291.5527	3.667	1443066	9.3283	0.094	0
STILT	EQ +X	5312.2441	2.55	2083060.526	9.5549	0.063	0
BASE1	EQ +X	5315.9454	0.882	6026289.797	9.5895	0.03	0
HEADROOM	EQ +Y	0.1444	0.237	0	3.0491	2.076	1468.477
TERRACE	EQ +Y	1.4831	0.36	0	818.1487	2.885	283560.603
11	EQ +Y	3.3268	0.364	0	1808.8131	3.085	586282.216
10	EQ +Y	5.1044	0.369	0	2636.6537	3.319	794364.555
9	EQ +Y	6.8045	0.376	0	3316.6406	3.545	935540.514
8	EQ +Y	8.4135	0.381	0	3863.6793	3.734	1034849.715
7	EQ +Y	9.9154	0.381	0	4292.625	3.863	1111301.283
6	EQ +Y	11.2929	0.383	0	4618.2877	3.916	1179393.476
5	EQ +Y	12.5274	0.369	0	4855.4362	3.879	1251868.084
4	EQ +Y	13.6004	0.352	0	5018.7977	3.736	1343229.802
3	EQ +Y	14.4954	0.34	0	5123.0594	3.471	1475856.464
2	EQ +Y	15.2009	0.321	0	5182.8709	3.059	1694505.829
1	EQ +Y	16.0337	0.339	0	5229.8581	2.92	1791099.803
STILT	EQ +Y	16.4574	0.238	0	5245.4575	1.954	2684951.008
BASE1	EQ +Y	16.5266	0.078	0	5248.1213	0.648	8102107.986

On behalf of DTCP HRR Panel, the detailed Structural design calculations are reviewed and found in order.

13/3/26

Superintending Engineer, P.W.D.,
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STORY FORCES:

Story	Output Case	P	VX	VY	T	MX	MY
TERRACE	EQ +X	0	-820.104	-0.8286	29375.04	2.6793	-2509.24
TERRACE	EQ +Y	0	-1.4831	-818.149	-24225.3	2502.671	-4.87
TERRACE	RSA- X	3.4187	1031.581	121.9434	34409.11	429.3668	3350.62
TERRACE	RSA-Y	2.227	100.5492	1020.822	30992.06	3523.919	364.251
11	EQ +X	0	-1813.74	-1.9291	65171.34	8.5631	-8041.16
11	EQ +Y	0	-3.3268	-1808.81	-53912.5	8019.551	-15.0169
11	RSA- X	3.1224	1917.03	261.777	64789.66	1224.424	8971.347
11	RSA-Y	5.8747	214.5497	1877.643	58798.17	9404.576	950.1241
10	EQ +X	-9.4E-07	-2645.21	-2.9843	95105.86	17.6653	-16109.1
10	EQ +Y	0	-5.1044	-2636.65	-78718.6	16061.35	-30.5854
10	RSA- X	3.1551	2444.147	383.918	83641.25	2397.09	16159.44
10	RSA-Y	10.1126	315.1049	2374.875	75872.3	16712.33	1865.183
9	EQ +X	-1.3E-06	-3329.44	-3.9877	119718.5	29.8276	-26263.8
9	EQ +Y	0	-6.8045	-3316.64	-99091.5	26177.1	-51.3391
9	RSA- X	3.0438	2723.945	490.3296	94462.22	3889.249	24042.61
9	RSA-Y	14.2177	402.7919	2619.252	85372.11	24558.79	3047.468
8	EQ +X	-2.1E-06	-3881.27	-4.9318	139548.5	44.8696	-38101.7
8	EQ +Y	0	-8.4135	-3863.68	-115482	37961.32	-77.0002
8	RSA- X	2.6686	2914.277	583.4897	102222.2	5656.264	32139.49
8	RSA-Y	18.1085	479.1987	2754.386	91529.61	32399.14	4460.173
7	EQ +X	-3.1E-06	-4315.5	-5.8084	155130.6	62.5851	-51264
7	EQ +Y	0	-9.9154	-4292.63	-128334	51053.83	-107.242
7	RSA- X	2.3651	3127.866	665.8207	110414.1	7662.614	40343.25
7	RSA-Y	21.8632	546.4528	2892.384	97606.34	40045.83	6071.421
6	EQ +X	-3.1E-06	-4646.86	-6.6085	166998.6	82.7411	-65436.9
6	EQ +Y	0	-11.2929	-4618.29	-138093	65139.6	-141.686
6	RSA- X	3.0691	3367.501	739.1812	119187.6	9876.485	48750.78
6	RSA-Y	25.49	606.6025	3063.984	104456.5	47530.43	7859.257
5	EQ +X	-4.3E-06	-4890	-7.3231	175684.2	105.0765	-80351.4
5	EQ +Y	0	-12.5274	-4855.44	-145203	79948.69	-179.894
5	RSA- X	4.7206	3582.942	804.62	127033.2	12272.58	57467.73
5	RSA-Y	28.9338	661.1846	3254.546	111592	54992.02	9801.864
4	EQ +X	-3.8E-06	-5059.54	-7.9436	181716.6	129.3046	-95783
4	EQ +Y	0	-13.6004	-5018.8	-150107	95256.02	-221.376
4	RSA- X	6.5588	3770.151	862.333	133788.3	14826.85	66539.24
4	RSA-Y	32.0412	710.8897	3473.345	119228	62604.6	11881.72
3	EQ +X	-3.7E-06	-5169.99	-8.4638	185622.4	155.119	-111552
3	EQ +Y	0	-14.4954	-5123.06	-153244	110881.3	-265.587
3	RSA- X	8.1042	3990.759	911.7174	141260.7	17516.14	76027.04
3	RSA-Y	34.6109	755.3117	3759.123	128548.3	70603.11	14082.67
2	EQ +X	-3.7E-06	-5235.78	-8.8815	187924.7	182.2076	-127521
2	EQ +Y	0	-15.2009	-5182.87	-155055	126689.1	-311.949
2	RSA- X	9.0413	4293.968	951.5519	150948.9	20316.82	86090.27
2	RSA-Y	36.4895	792.9734	4118.216	139911.3	79294	16388.12

1	EQ +X	8.83E-07	-5291.55	-9.3283	189890.5	216.3492	-146888
1	EQ +Y	6.15E-07	-16.0337	-5229.86	-156411	145830.4	-370.633
1	RSA- X	9.2643	4875.678	994.5296	170710.3	23814.73	99306.38
1	RSA-Y	36.5634	839.0918	4728.715	158151.1	91088.18	19305.85
STILT	EQ +X	-7.5E-06	-5312.24	-9.5549	190588.1	251.3198	-166331
STILT	EQ +Y	0	-16.4574	-5245.46	-156883	165028.8	-430.867
STILT	RSA- X	15.0778	5184.492	1012.449	181172.1	27411.12	114094.5
STILT	RSA-Y	35.8353	858.267	5028.728	167374.5	104697.3	22313.33
BASE1	EQ +X	-7.8E-06	-5315.95	-9.5895	190712	280.0882	-182278
BASE1	EQ +Y	0	-16.5266	-5248.12	-156968	180773.1	-480.447
BASE1	RSA- X	16.9781	5216.092	1014.2	182117.4	30381.51	127089
BASE1	RSA-Y	35.6979	860.242	5057.502	168203.5	116877.6	24812.72

ETABS Shear Wall Design (C1)

IS 456:2000 Pier Design

Pier Details

Story ID	Pier ID	Centroid X (mm)	Centroid Y (mm)	Length (mm)	Thickness (mm)	Pier Ductility	LLRF
BASE1	P28	18326.2	49129.4	900	300	Special Wall	0.6

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	1	500	500

Design Code Parameters

Γ_S	Γ_C	IP_{MAX}	IP_{MIN}	P_{MAX}	MinEcc Major	MinEcc Minor
1.15	1.5	0.04	0.0025	0.8	Yes	Yes

Pier Leg Location, Length and Thickness

Station Location	ID	Left X_1 mm	Left Y_1 mm	Right X_2 mm	Right Y_2 mm	Length mm	Thickness mm
Top	Leg 1	18326.2	48679.4	18326.2	49579.4	900	300
Bottom	Leg 1	18326.2	48679.4	18326.2	49579.4	900	300

Flexural Design for P_u, M_{u2} and M_{u3}

Station Location	Required Rebar Area (mm²)	Required Reinf Ratio	Current Reinf Ratio	Flexural Combo	P_u kN	M_{u2} kN-m	M_{u3} kN-m	Pier A_g mm²
Top	4184	0.0155	0.0233	101 1.5 DL+1.5 LL	4987.6921	-99.7538	-106.0999	269999
Bottom	5522	0.0205	0.0233	129 1.5 DL+1.5 WL +Y	4949.9492	98.999	387.8177	269999

Shear Design

Station Location	ID	Rebar mm²/m	Shear Combo	P_u kN	M_u kN-m	V_u kN	V_c kN	$V_c + V_s$ kN
Top	Leg 1	750	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	3759.5757	-125.3466	125.0427	196.9786	391.8482
Bottom	Leg 1	750	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	3789.9417	248.557	125.0427	204.9156	399.7852

Boundary Element Check

Station Location	ID	Edge Length (mm)	Governing Combo	P_u kN	M_u kN-m	Stress Comp MPa	Stress Limit MPa
Top–Left	Leg 1	300	112 0.45 SL X+1.5 SL Y+1.5 DL	4685.6859	-11.252	17.63	8
Top–Right	Leg 1	300	120 0.45 SL X+1.5 SL Y+0 9 DL	2764.7621	0.8572	10.26	8
Bottom–Left	Leg 1	300	116 0.45 RSA X+1.5 RSA Y+1.5 DL	4613.7849	-17.4535	17.52	8
Botttom–Right	Leg 1	450	112 0.45 SL X+1.5 SL Y+1.5 DL	4716.0519	244.5977	23.51	8

ETABS Concrete Frame Design (C2)

IS 456:2000 + IS 13920:2016 Column Section Design (Summary)

Column Element Details

Level	Element	Unique Name	Section ID	Combo ID	Station Loc	Length (mm)	LLRF	Type
BASE1	C15	3184	600*900	101 1.5 DL+1.5 LL	2400	3000	0.6	Ductile Frame

Section Properties

b (mm)	h (mm)	dc (mm)	Cover (Torsion) (mm)
600	900	60	30

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	1	500	500

Design Code Parameters

ɣc	ɣs
1.5	1.15

Axial Force and Biaxial Moment Design For P_u , M_{u2} , M_{u3}

Design P_u kN	Design M_{u2} kN-m	Design M_{u3} kN-m	Minimum M_2 kN-m	Minimum M_3 kN-m	Rebar Area mm²	Rebar % %
9098.1799	-225.6349	-10.0199	225.6349	316.6167	4320	0.8

Axial Force and Biaxial Moment Factors

	K Factor Unitless	Length mm	Initial Moment kN-m	Additional Moment kN-m	Minimum Moment kN-m
Major Bend(M3)	0.691213	2400	33.953	0	316.6167
Minor Bend(M2)	0.686663	2400	-6.8749	0	225.6349

Shear Design for V_{u2} , V_{u3}

	Shear V_u kN	Shear V_c kN	Shear V_s kN	Shear V_p kN	Rebar A_{sv} /s mm²/m
Major, V_{u2}	30.5368	357.4804	201.6005	32.6272	665.06
Minor, V_{u3}	4.609	350.7306	194.4007	47.5895	997.59

Additional Moment Reduction Factor k (IS 39.7.1.1)

A_g cm²	A_{sc} cm²	P_{uz} kN	P_b kN	P_u kN	k Unitless
5400	43.2	11340	4531.696	9098.1799	0.329277

Additional Moment (IS 39.7.1)

	Consider M_a	Length Factor	Section Depth (mm)	KL/Depth Ratio	KL/Depth Limit	KL/Depth Exceeded	M_a Moment (kN-m)
Major Bending (M_3)	Yes	0.8	900	1.843	12	No	0
Minor Bending (M_2)	Yes	0.8	600	2.747	12	No	0

ETABS Shear Wall Design (C3)

IS 456:2000 Pier Design

Pier Details

Story ID	Pier ID	Centroid X (mm)	Centroid Y (mm)	Length (mm)	Thickness (mm)	Pier Ductility	LLRF
1	P119	35403	16154.4	1000	230	Special Wall	0.6

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	1	500	500

Design Code Parameters

Γ_S	Γ_C	IP_{MAX}	IP_{MIN}	P_{MAX}	MinEcc Major	MinEcc Minor
1.15	1.5	0.04	0.0025	0.8	Yes	Yes

Pier Leg Location, Length and Thickness

Station Location	ID	Left X_1 mm	Left Y_1 mm	Right X_2 mm	Right Y_2 mm	Length mm	Thickness mm
Top	Leg 1	34903	16154.4	35903	16154.4	1000	230
Bottom	Leg 1	34903	16154.4	35903	16154.4	1000	230

Flexural Design for P_u, M_{u2} and M_{u3} (Part 1 of 2)

Station Location	Required Rebar Area (mm^2)	Required Reinf Ratio	Current Reinf Ratio	Flexural Combo	P_u kN	M_{u2} kN-m
Top	1327	0.0058	0.0301	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	2384.8613	81.9971
Bottom	2673	0.0116	0.0301	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	2416.4195	82.9161

Flexural Design for P_u, M_{u2} and M_{u3} (Part 2 of 2)

M_{u3} kN-m	Pier A_g mm^2
-312.0012	230000
445.1182	230000

Shear Design

Station Location	ID	Rebar mm^2/m	Shear Combo	P_u kN	M_u kN-m	V_u kN	V_c kN	$V_c + V_s$ kN
Top	Leg 1	575	114 1.5 RSA X+0.45 RSA Y+1.5 DL	1938.4036	73.9983	210.0322	110.3947	276.3948
Bottom	Leg 1	575	114 1.5 RSA X+0.45 RSA Y+1.5 DL	1969.9618	458.0811	210.0322	148.8135	314.8136

Boundary Element Check

Station Location	ID	Edge Length (mm)	Governing Combo	P_u kN	M_u kN-m	Stress Comp MPa	Stress Limit MPa
Top–Left	Leg 1	345	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	2384.8613	-312.0012	18.51	8
Top–Right	Leg 1	230	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	2384.8613	78.4878	12.42	8
Bottom–Left	Leg 1	230	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	2416.4195	-205.2708	15.86	8
Botttom–Right	Leg 1	345	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	2416.4195	445.1182	22.12	8

ETABS Shear Wall Design (C4)

IS 456:2000 Pier Design

Pier Details

Story ID	Pier ID	Centroid X (mm)	Centroid Y (mm)	Length (mm)	Thickness (mm)	Pier Ductility	LLRF
STILT	P137	49504.6	2828.9	1200	300	Special Wall	0.6

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	1	500	500

Design Code Parameters

Γ_S	Γ_C	IP_{MAX}	IP_{MIN}	P_{MAX}	MinEcc Major	MinEcc Minor
1.15	1.5	0.04	0.0025	0.8	Yes	Yes

Pier Leg Location, Length and Thickness

Station Location	ID	Left X_1 mm	Left Y_1 mm	Right X_2 mm	Right Y_2 mm	Length mm	Thickness mm
Top	Leg 1	49504.7	2228.9	49504.5	3428.9	1200	300
Bottom	Leg 1	49504.7	2228.9	49504.5	3428.9	1200	300

Flexural Design for P_u, M_{u2} and M_{u3} (Part 1 of 2)

Station Location	Required Rebar Area (mm^2)	Required Reinf Ratio	Current Reinf Ratio	Flexural Combo	P_u kN	M_{u2} kN-m
Top	3637	0.0101	0.0227	129 1.5 DL+1.5 WL +Y	5842.0466	-127.7052
Bottom	3840	0.0107	0.0227	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	4840.3253	133.5553

Flexural Design for P_u, M_{u2} and M_{u3} (Part 2 of 2)

M_{u3} kN-m	Pier A_g mm^2
324.9546	360000
-751.6003	360000

Shear Design

Station Location	ID	Rebar mm^2/m	Shear Combo	P_u kN	M_u kN-m	V_u kN	V_c kN	$V_c + V_s$ kN
Top	Leg 1	750	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	3480.0645	507.5341	-336.6924	221.1085	480.9346
Bottom	Leg 1	750	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	3529.4599	-328.7056	-336.6924	225.5107	485.3368

Boundary Element Check

Station Location	ID	Edge Length (mm)	Governing Combo	P_u kN	M_u kN-m	Stress Comp MPa	Stress Limit MPa
Top–Left	Leg 1	0	101 1.5 DL+1.5 LL	0	0	0	0
Top–Right	Leg 1	450	113 -0.45 SL X+1.5 SL Y+1.5 DL	5167.7732	322.419	18.83	8
Bottom–Left	Leg 1	450	113 -0.45 SL X+1.5 SL Y+1.5 DL	5217.1686	-2.1246	14.52	8
Botttom–Right	Leg 1	300	112 0.45 SL X+1.5 SL Y+1.5 DL	5130.2919	9.6309	14.38	8

ETABS Shear Wall Design (C5)

IS 456:2000 Pier Design

Pier Details

Story ID	Pier ID	Centroid X (mm)	Centroid Y (mm)	Length (mm)	Thickness (mm)	Pier Ductility	LLRF
STILT	P20	9791.8	45151.6	1200	230	Special Wall	0.6

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	1	500	500

Design Code Parameters

Γ_S	Γ_C	IP_{MAX}	IP_{MIN}	P_{MAX}	MinEcc Major	MinEcc Minor
1.15	1.5	0.04	0.0025	0.8	Yes	Yes

Pier Leg Location, Length and Thickness

Station Location	ID	Left X_1 mm	Left Y_1 mm	Right X_2 mm	Right Y_2 mm	Length mm	Thickness mm
Top	Leg 1	9791.8	44551.6	9791.8	45751.6	1200	230
Bottom	Leg 1	9791.8	44551.6	9791.8	45751.6	1200	230

Flexural Design for P_u, M_{u2} and M_{u3} (Part 1 of 2)

Station Location	Required Rebar Area (mm^2)	Required Reinf Ratio	Current Reinf Ratio	Flexural Combo	P_u kN	M_{u2} kN-m
Top	6469	0.0234	0.0296	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	4638.4979	147.0165

Station Location	Required Rebar Area (mm²)	Required Reinf Ratio	Current Reinf Ratio	Flexural Combo	P_u kN	M_{u2} kN-m
Bottom	7068	0.0256	0.0296	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	4676.3677	148.1193

Flexural Design for P_u, M_{u2} and M_{u3} (Part 2 of 2)

M_{u3} kN-m	Pier A_g mm²
-219.4939	276000
317.1764	276000

Shear Design

Station Location	ID	Rebar mm²/m	Shear Combo	P_u kN	M_u kN-m	V_u kN	V_c kN	$V_c + V_s$ kN
Top	Leg 1	575	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	4109.3835	-69.3399	115.3048	209.4694	408.6696
Bottom	Leg 1	575	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	4147.2533	317.1764	115.3048	209.4694	408.6696

Boundary Element Check

Station Location	ID	Edge Length (mm)	Governing Combo	P_u kN	M_u kN-m	Stress Comp MPa	Stress Limit MPa
Top–Left	Leg 1	345	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	4638.4979	-69.3399	18.06	8
Top–Right	Leg 1	0	101 1.5 DL+1.5 LL	0	0	0	0
Bottom–Left	Leg 1	345	116 0.45 RSA X+1.5 RSA Y+1.5 DL	4338.6549	-2.9404	15.77	8
Botttom–Right	Leg 1	460	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	4676.3677	317.1764	22.69	8

ETABS Shear Wall Design (C6)

IS 456:2000 Pier Design

Pier Details

Story ID	Pier ID	Centroid X (mm)	Centroid Y (mm)	Length (mm)	Thickness (mm)	Pier Ductility	LLRF
STILT	P12	6362.8	59956	1500	230	Special Wall	0.6

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	1	500	500

Design Code Parameters

Γ_S	Γ_C	IP_{MAX}	IP_{MIN}	P_{MAX}	MinEcc Major	MinEcc Minor
1.15	1.5	0.04	0.0025	0.8	Yes	Yes

Pier Leg Location, Length and Thickness

Station Location	ID	Left X_1 mm	Left Y_1 mm	Right X_2 mm	Right Y_2 mm	Length mm	Thickness mm
Top	Leg 1	6362.8	59206	6362.8	60706	1500	230
Bottom	Leg 1	6362.8	59206	6362.8	60706	1500	230

Flexural Design for P_u, M_{u2} and M_{u3}

Station Location	Required Rebar Area (mm²)	Required Reinf Ratio	Current Reinf Ratio	Flexural Combo	P_u kN	M_{u2} kN-m	M_{u3} kN-m	Pier A_g mm²
Top	8160	0.0237	0.0291	101 1.5 DL+1.5 LL	6021.1774	-171.5236	345.1335	345000
Bottom	8335	0.0242	0.0291	101 1.5 DL+1.5 LL	6068.5146	172.9021	-347.8469	345000

Shear Design

Station Location	ID	Rebar mm²/m	Shear Combo	P_u kN	M_u kN-m	V_u kN	V_c kN	$V_c + V_s$ kN
Top	Leg 1	575	117 -0.45 RSA X+1.5 RSA Y+1.5 DL	4808.49	220.4798	-129.6612	261.8362	510.8359
Bottom	Leg 1	575	117 -0.45 RSA X+1.5 RSA Y+1.5 DL	4855.8272	223.2449	-129.6612	261.8362	510.8359

Boundary Element Check

Station Location	ID	Edge Length (mm)	Governing Combo	P_u kN	M_u kN-m	Stress Comp MPa	Stress Limit MPa
Top–Left	Leg 1	0	101 1.5 DL+1.5 LL	0	0	0	0
Top–Right	Leg 1	460	112 0.45 SL X+1.5 SL Y+1.5 DL	5447.4694	235.403	18.52	8
Bottom–Left	Leg 1	575	116 0.45 RSA X+1.5 RSA Y+1.5 DL	5436.5985	-379.3526	20.16	8
Botttom–Right	Leg 1	460	112 0.45 SL X+1.5 SL Y+1.5 DL	5494.8066	232.2937	18.62	8

ETABS Shear Wall Design (C7)

IS 456:2000 Pier Design

Pier Details

Story ID	Pier ID	Centroid X (mm)	Centroid Y (mm)	Length (mm)	Thickness (mm)	Pier Ductility	LLRF
STILT	P14	5762.8	69773.8	1200	230	Special Wall	0.6

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	1	500	500

Design Code Parameters

Γ_S	Γ_C	IP_{MAX}	IP_{MIN}	P_{MAX}	MinEcc Major	MinEcc Minor
1.15	1.5	0.04	0.0025	0.8	Yes	Yes

Pier Leg Location, Length and Thickness

Station Location	ID	Left X_1 mm	Left Y_1 mm	Right X_2 mm	Right Y_2 mm	Length mm	Thickness mm
Top	Leg 1	5162.8	69773.8	6362.8	69773.8	1200	230
Bottom	Leg 1	5162.8	69773.8	6362.8	69773.8	1200	230

Flexural Design for P_u, M_{u2} and M_{u3} (Part 1 of 2)

Station Location	Required Rebar Area (mm^2)	Required Reinf Ratio	Current Reinf Ratio	Flexural Combo	P_u kN	M_{u2} kN-m
Top	4525	0.0164	0.0296	110 1.5 SL X+0.45 SL Y+1.5 DL	4408.3057	-116.9028
Bottom	5130	0.0186	0.0296	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	4378.143	116.819

Flexural Design for P_u, M_{u2} and M_{u3} (Part 2 of 2)

M_{u3} kN-m	Pier A_g mm^2
208.601	276000
-365.4259	276000

Shear Design

Station Location	ID	Rebar mm^2/m	Shear Combo	P_u kN	M_u kN-m	V_u kN	V_c kN	$V_c + V_s$ kN
Top	Leg 1	575	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	3502.4795	119.0502	-124.2487	206.1191	405.3191
Bottom	Leg 1	575	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	3540.3493	102.2007	-124.2487	209.4692	408.6692

Boundary Element Check

Station Location	ID	Edge Length (mm)	Governing Combo	P_u kN	M_u kN-m	Stress Comp MPa	Stress Limit MPa
Top–Left	Leg 1	0	101 1.5 DL+1.5 LL	0	0	0	0
Top–Right	Leg 1	345	110 1.5 SL X+0.45 SL Y+1.5 DL	4408.3057	79.0475	17.4	8
Bottom–Left	Leg 1	460	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	4378.143	-365.4259	22.48	8
Botttom–Right	Leg 1	460	111 1.5 SL X+-0.45 SL Y+1.5 DL	4385.1751	172.8983	19.02	8

ETABS Shear Wall Design (C8)

IS 456:2000 Pier Design

Pier Details

Story ID	Pier ID	Centroid X (mm)	Centroid Y (mm)	Length (mm)	Thickness (mm)	Pier Ductility	LLRF
STILT	P15	11582.5	69273.8	1000	300	Special Wall	0.6

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	1	500	500

Design Code Parameters

Γ_S	Γ_C	IP_{MAX}	IP_{MIN}	P_{MAX}	MinEcc Major	MinEcc Minor
1.15	1.5	0.04	0.0025	0.8	Yes	Yes

Pier Leg Location, Length and Thickness

Station Location	ID	Left X_1 mm	Left Y_1 mm	Right X_2 mm	Right Y_2 mm	Length mm	Thickness mm
Top	Leg 1	11582.5	68773.8	11582.5	69773.8	1000	300
Bottom	Leg 1	11582.5	68773.8	11582.5	69773.8	1000	300

Flexural Design for P_u, M_{u2} and M_{u3} (Part 1 of 2)

Station Location	Required Rebar Area (mm²)	Required Reinf Ratio	Current Reinf Ratio	Flexural Combo	P_u kN	M_{u2} kN-m
Top	5003	0.0167	0.023	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	5278.2917	143.2551
Bottom	5133	0.0171	0.023	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	5319.4549	144.1741

Flexural Design for P_u, M_{u2} and M_{u3} (Part 2 of 2)

M_{u3} kN-m	Pier A_g mm²
214.5819	300002
-216.2553	300002

Shear Design

Station Location	ID	Rebar mm²/m	Shear Combo	P_u kN	M_u kN-m	V_u kN	V_c kN	$V_c + V_s$ kN
Top	Leg 1	750	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	5020.9499	126.5655	-66.1558	225.6645	442.1884
Bottom	Leg 1	750	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	5062.1132	-46.8511	-66.1558	227.6863	444.2102

Boundary Element Check

Station Location	ID	Edge Length (mm)	Governing Combo	P_u kN	M_u kN-m	Stress Comp MPa	Stress Limit MPa
Top–Left	Leg 1	0	101 1.5 DL+1.5 LL	0	0	0	0
Top–Right	Leg 1	300	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	5278.2917	126.5655	20.13	8
Bottom–Left	Leg 1	300	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	5319.4549	-46.8511	18.67	8
Botttom–Right	Leg 1	300	112 0.45 SL X+1.5 SL Y+1.5 DL	5165.4281	37.8076	17.97	8

ETABS Shear Wall Design (C9)

IS 456:2000 Pier Design

Pier Details

Story ID	Pier ID	Centroid X (mm)	Centroid Y (mm)	Length (mm)	Thickness (mm)	Pier Ductility	LLRF
BASE1	P121	36440	24722.2	1000	300	Special Wall	0.6

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	1	500	500

Design Code Parameters

Γ_S	Γ_C	IP_{MAX}	IP_{MIN}	P_{MAX}	MinEcc Major	MinEcc Minor
1.15	1.5	0.04	0.0025	0.8	Yes	Yes

Pier Leg Location, Length and Thickness

Station Location	ID	Left X_1 mm	Left Y_1 mm	Right X_2 mm	Right Y_2 mm	Length mm	Thickness mm
Top	Leg 1	36440	24222.2	36440	25222.2	1000	300
Bottom	Leg 1	36440	24222.2	36440	25222.2	1000	300

Flexural Design for P_u, M_{u2} and M_{u3}

Station Location	Required Rebar Area (mm²)	Required Reinf Ratio	Current Reinf Ratio	Flexural Combo	P_u kN	M_{u2} kN-m	M_{u3} kN-m	Pier A_g mm²
Top	4960	0.0165	0.023	101 1.5 DL+1.5 LL	5704.7096	-114.0942	6.7442	300000
Bottom	5017	0.0167	0.023	101 1.5 DL+1.5 LL	5738.4497	114.769	42.5605	300000

Shear Design

Station Location	ID	Rebar mm²/m	Shear Combo	P_u kN	M_u kN-m	V_u kN	V_c kN	$V_c + V_s$ kN
Top	Leg 1	750	117 -0.45 RSA X+1.5 RSA Y+1.5 DL	4889.8021	113.3846	34.9555	224.8307	441.3525
Bottom	Leg 1	750	117 -0.45 RSA X+1.5 RSA Y+1.5 DL	4923.5421	216.6128	34.9555	225.9318	442.4535

Boundary Element Check

Station Location	ID	Edge Length (mm)	Governing Combo	P_u kN	M_u kN-m	Stress Comp MPa	Stress Limit MPa
Top–Left	Leg 1	300	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	5211.0584	-53.2842	18.44	8
Top–Right	Leg 1	300	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	5211.0584	77.7198	18.92	8
Bottom–Left	Leg 1	300	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	5244.7985	-55.906	18.6	8
Botttom–Right	Leg 1	450	113 -0.45 SL X+1.5 SL Y+1.5 DL	5178.089	234.3983	21.95	8

ETABS Shear Wall Design (C9)

IS 456:2000 Pier Design

Pier Details

Story ID	Pier ID	Centroid X (mm)	Centroid Y (mm)	Length (mm)	Thickness (mm)	Pier Ductility	LLRF
BASE1	P121	36440	24722.2	1000	300	Special Wall	0.6

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	1	500	500

Design Code Parameters

Γ_S	Γ_C	IP_{MAX}	IP_{MIN}	P_{MAX}	MinEcc Major	MinEcc Minor
1.15	1.5	0.04	0.0025	0.8	Yes	Yes

Pier Leg Location, Length and Thickness

Station Location	ID	Left X_1 mm	Left Y_1 mm	Right X_2 mm	Right Y_2 mm	Length mm	Thickness mm
Top	Leg 1	36440	24222.2	36440	25222.2	1000	300
Bottom	Leg 1	36440	24222.2	36440	25222.2	1000	300

Flexural Design for P_u, M_{u2} and M_{u3}

Station Location	Required Rebar Area (mm²)	Required Reinf Ratio	Current Reinf Ratio	Flexural Combo	P_u kN	M_{u2} kN-m	M_{u3} kN-m	Pier A_g mm²
Top	4960	0.0165	0.023	101 1.5 DL+1.5 LL	5704.7096	-114.0942	6.7442	300000
Bottom	5017	0.0167	0.023	101 1.5 DL+1.5 LL	5738.4497	114.769	42.5605	300000

Shear Design

Station Location	ID	Rebar mm²/m	Shear Combo	P_u kN	M_u kN-m	V_u kN	V_c kN	$V_c + V_s$ kN
Top	Leg 1	750	117 -0.45 RSA X+1.5 RSA Y+1.5 DL	4889.8021	113.3846	34.9555	224.8307	441.3525
Bottom	Leg 1	750	117 -0.45 RSA X+1.5 RSA Y+1.5 DL	4923.5421	216.6128	34.9555	225.9318	442.4535

Boundary Element Check

Station Location	ID	Edge Length (mm)	Governing Combo	P_u kN	M_u kN-m	Stress Comp MPa	Stress Limit MPa
Top–Left	Leg 1	300	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	5211.0584	-53.2842	18.44	8
Top–Right	Leg 1	300	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	5211.0584	77.7198	18.92	8
Bottom–Left	Leg 1	300	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	5244.7985	-55.906	18.6	8
Botttom–Right	Leg 1	450	113 -0.45 SL X+1.5 SL Y+1.5 DL	5178.089	234.3983	21.95	8

ETABS Shear Wall Design (C10)

IS 456:2000 Pier Design

Pier Details

Story ID	Pier ID	Centroid X (mm)	Centroid Y (mm)	Length (mm)	Thickness (mm)	Pier Ductility	LLRF
STILT	P35	29807	69273.8	1000	300	Special Wall	0.6

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	1	500	500

Design Code Parameters

Γ_S	Γ_C	IP_{MAX}	IP_{MIN}	P_{MAX}	MinEcc Major	MinEcc Minor
1.15	1.5	0.04	0.0025	0.8	Yes	Yes

Pier Leg Location, Length and Thickness

Station Location	ID	Left X_1 mm	Left Y_1 mm	Right X_2 mm	Right Y_2 mm	Length mm	Thickness mm
Top	Leg 1	29807	68773.8	29807	69773.8	1000	300
Bottom	Leg 1	29807	68773.8	29807	69773.8	1000	300

Flexural Design for P_u, M_{u2} and M_{u3}

Station Location	Required Rebar Area (mm²)	Required Reinf Ratio	Current Reinf Ratio	Flexural Combo	P_u kN	M_{u2} kN-m	M_{u3} kN-m	Pier A_g mm²
Top	7285	0.0243	0.023	101 1.5 DL+1.5 LL	6187.7658	140.2543	251.5533	300000
Bottom	7409	0.0247	0.023	101 1.5 DL+1.5 LL	6228.9286	-141.1733	-253.2267	300000

Shear Design

Station Location	ID	Rebar mm²/m	Shear Combo	P_u kN	M_u kN-m	V_u kN	V_c kN	$V_c + V_s$ kN
Top	Leg 1	750	117 -0.45 RSA X+1.5 RSA Y+1.5 DL	5209.4416	108.6721	-56.4848	227.684	444.2057
Bottom	Leg 1	750	117 -0.45 RSA X+1.5 RSA Y+1.5 DL	5250.6044	37.7026	-56.4848	227.684	444.2057

Boundary Element Check

Station Location	ID	Edge Length (mm)	Governing Combo	P_u kN	M_u kN-m	Stress Comp MPa	Stress Limit MPa
Top–Left	Leg 1	0	101 1.5 DL+1.5 LL	0	0	0	0

Station Location	ID	Edge Length (mm)	Governing Combo	P_u kN	M_u kN-m	Stress Comp MPa	Stress Limit MPa
Top–Right	Leg 1	450	113 -0.45 SL X+1.5 SL Y+1.5 DL	5582.5392	124.7983	21.1	8
Bottom–Left	Leg 1	450	114 1.5 RSA X+0.45 RSA Y+1.5 DL	5486.924	-10.2843	18.5	8
Botttom–Right	Leg 1	450	113 -0.45 SL X+1.5 SL Y+1.5 DL	5623.702	59.2649	19.93	8

ETABS Shear Wall Design (C11)

IS 456:2000 Pier Design

Pier Details

Story ID	Pier ID	Centroid X (mm)	Centroid Y (mm)	Length (mm)	Thickness (mm)	Pier Ductility	LLRF
BASE1	P132	42062.5	24722.2	1000	300	Special Wall	0.6

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	1	500	500

Design Code Parameters

Γ_S	Γ_C	IP_{MAX}	IP_{MIN}	P_{MAX}	MinEcc Major	MinEcc Minor
1.15	1.5	0.04	0.0025	0.8	Yes	Yes

Pier Leg Location, Length and Thickness

Station Location	ID	Left X_1 mm	Left Y_1 mm	Right X_2 mm	Right Y_2 mm	Length mm	Thickness mm
Top	Leg 1	42062.5	24222.2	42062.5	25222.2	1000	300
Bottom	Leg 1	42062.5	24222.2	42062.5	25222.2	1000	300

Flexural Design for P_u, M_{u2} and M_{u3}

Station Location	Required Rebar Area (mm²)	Required Reinf Ratio	Current Reinf Ratio	Flexural Combo	P_u kN	M_{u2} kN-m	M_{u3} kN-m	Pier A_g mm²
Top	10616	0.0354	0.023	101 1.5 DL+1.5 LL	7368.204	-147.3641	-58.7748	300000
Bottom	10556	0.0352	0.023	101 1.5 DL+1.5 LL	7401.9441	148.0389	104.3992	300000

Shear Design

Station Location	ID	Rebar mm²/m	Shear Combo	P_u kN	M_u kN-m	V_u kN	V_c kN	$V_c + V_s$ kN
Top	Leg 1	750	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	6527.7332	-9.0395	94.2864	227.684	444.2057
Bottom	Leg 1	750	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	6561.4732	273.1535	94.2864	227.684	444.2057

Boundary Element Check

Station Location	ID	Edge Length (mm)	Governing Combo	P_u kN	M_u kN-m	Stress Comp MPa	Stress Limit MPa
Top–Left	Leg 1	450	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	6675.6629	-9.0395	22.43	8
Top–Right	Leg 1	450	113 -0.45 SL X+1.5 SL Y+1.5 DL	6566.2599	73.7458	23.36	8
Bottom–Left	Leg 1	450	116 0.45 RSA X+1.5 RSA Y+1.5 DL	6558.5571	-91.7796	23.7	8
Botttom–Right	Leg 1	450	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	6709.4029	273.1535	27.83	8

ETABS Shear Wall Design (C12)

IS 456:2000 Pier Design

Pier Details

Story ID	Pier ID	Centroid X (mm)	Centroid Y (mm)	Length (mm)	Thickness (mm)	Pier Ductility	LLRF
BASE1	P2	600.1	64287.4	1200	300	Special Wall	0.6

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	1	500	500

Design Code Parameters

Γ_S	Γ_C	IP_{MAX}	IP_{MIN}	P_{MAX}	MinEcc Major	MinEcc Minor
1.15	1.5	0.04	0.0025	0.8	Yes	Yes

Pier Leg Location, Length and Thickness

Station Location	ID	Left X_1 mm	Left Y_1 mm	Right X_2 mm	Right Y_2 mm	Length mm	Thickness mm
Top	Leg 1	0.1	64287.4	1200.1	64287.4	1200	300
Bottom	Leg 1	0.1	64287.4	1200.1	64287.4	1200	300

Flexural Design for P_u, M_{u2} and M_{u3} (Part 1 of 2)

Station Location	Required Rebar Area (mm^2)	Required Reinf Ratio	Current Reinf Ratio	Flexural Combo	P_u kN	M_{u2} kN-m
Top	900	0.0025	0.0227	131 0.9 DL+1.5 WL +Y	2275.7979	-45.516
Bottom	1737	0.0048	0.0227	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	4659.6985	93.194

Flexural Design for P_u, M_{u2} and M_{u3} (Part 2 of 2)

M_{u3} kN-m	Pier A_g mm^2
82.2612	360000
-657.4035	360000

Shear Design

Station Location	ID	Rebar mm^2/m	Shear Combo	P_u kN	M_u kN-m	V_u kN	V_c kN	$V_c + V_s$ kN
Top	Leg 1	750	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	4044.094	400.0504	-206.0064	129.6	389.4261
Bottom	Leg 1	750	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	4084.5821	178.3107	-206.0064	161.1359	420.9619

Boundary Element Check

Station Location	ID	Edge Length (mm)	Governing Combo	P_u kN	M_u kN-m	Stress Comp MPa	Stress Limit MPa
Top–Left	Leg 1	300	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	4619.2104	-41.3834	13.41	8
Top–Right	Leg 1	450	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	4619.2104	400.0504	18.39	8
Bottom–Left	Leg 1	450	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	4659.6985	-657.4035	22.07	8
Botttom–Right	Leg 1	300	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	4659.6985	178.3107	15.42	8

ETABS Shear Wall Design (C13)

IS 456:2000 Pier Design

Pier Details

Story ID	Pier ID	Centroid X (mm)	Centroid Y (mm)	Length (mm)	Thickness (mm)	Pier Ductility	LLRF
STILT	P13	5762.8	64287.4	1200	300	Special Wall	0.6

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	1	500	500

Design Code Parameters

Γ_S	Γ_C	IP_{MAX}	IP_{MIN}	P_{MAX}	MinEcc Major	MinEcc Minor
1.15	1.5	0.04	0.0025	0.8	Yes	Yes

Pier Leg Location, Length and Thickness

Station Location	ID	Left X_1 mm	Left Y_1 mm	Right X_2 mm	Right Y_2 mm	Length mm	Thickness mm
Top	Leg 1	5162.8	64287.4	6362.8	64287.4	1200	300
Bottom	Leg 1	5162.8	64287.4	6362.8	64287.4	1200	300

Flexural Design for P_u, M_{u2} and M_{u3}

Station Location	Required Rebar Area (mm²)	Required Reinf Ratio	Current Reinf Ratio	Flexural Combo	P_u kN	M_{u2} kN-m	M_{u3} kN-m	Pier A_g mm²
Top	4690	0.013	0.0227	101 1.5 DL+1.5 LL	6106.4673	146.6012	288.958	360000
Bottom	4854	0.0135	0.0227	101 1.5 DL+1.5 LL	6155.8627	-147.704	-291.2954	360000

Shear Design

Station Location	ID	Rebar mm²/m	Shear Combo	P_u kN	M_u kN-m	V_u kN	V_c kN	$V_c + V_s$ kN
Top	Leg 1	750	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	4415.8153	123.7017	-131.752	243.8649	503.691
Bottom	Leg 1	750	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	4465.2107	145.2501	-131.752	247.4037	507.2298

Boundary Element Check

Station Location	ID	Edge Length (mm)	Governing Combo	P_u kN	M_u kN-m	Stress Comp MPa	Stress Limit MPa
Top–Left	Leg 1	300	114 1.5 RSA X+0.45 RSA Y+1.5 DL	5096.3845	-28.7235	14.56	8
Top–Right	Leg 1	300	111 1.5 SL X+-0.45 SL Y+1.5 DL	5144.674	55.0634	15.06	8
Bottom–Left	Leg 1	450	114 1.5 RSA X+0.45 RSA Y+1.5 DL	5145.7799	-327.8711	18.85	8
Botttom–Right	Leg 1	300	111 1.5 SL X+-0.45 SL Y+1.5 DL	5194.0694	270.9892	18.19	8

ETABS Shear Wall Design (C14)

IS 456:2000 Pier Design

Pier Details

Story ID	Pier ID	Centroid X (mm)	Centroid Y (mm)	Length (mm)	Thickness (mm)	Pier Ductility	LLRF
2	P50	38976.4	55079.1	1500	230	Special Wall	0.6

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	1	500	500

Design Code Parameters

Γ_S	Γ_C	IP_{MAX}	IP_{MIN}	P_{MAX}	MinEcc Major	MinEcc Minor
1.15	1.5	0.04	0.0025	0.8	Yes	Yes

Pier Leg Location, Length and Thickness

Station Location	ID	Left X_1 mm	Left Y_1 mm	Right X_2 mm	Right Y_2 mm	Length mm	Thickness mm
Top	Leg 1	38976.4	54329.1	38976.4	55829.1	1500	230
Bottom	Leg 1	38976.4	54329.1	38976.4	55829.1	1500	230

Flexural Design for P_u, M_{u2} and M_{u3}

Station Location	Required Rebar Area (mm²)	Required Reinf Ratio	Current Reinf Ratio	Flexural Combo	P_u kN	M_{u2} kN-m	M_{u3} kN-m	Pier A_g mm²
Top	8110	0.0235	0.0291	101 1.5 DL+1.5 LL	6262.7271	156.3039	-351.339	345000
Bottom	8242	0.0239	0.0291	101 1.5 DL+1.5 LL	6302.1748	-157.1016	353.552	345000

Shear Design

Station Location	ID	Rebar mm²/m	Shear Combo	P_u kN	M_u kN-m	V_u kN	V_c kN	$V_c + V_s$ kN
Top	Leg 1	575	112 0.45 SL X+1.5 SL Y+1.5 DL	5223.7285	-36.0884	167.6642	261.8366	510.8366
Bottom	Leg 1	575	112 0.45 SL X+1.5 SL Y+1.5 DL	5263.1762	475.2873	167.6642	261.8366	510.8366

Boundary Element Check

Station Location	ID	Edge Length (mm)	Governing Combo	P_u kN	M_u kN-m	Stress Comp MPa	Stress Limit MPa
Top–Left	Leg 1	575	116 0.45 RSA X+1.5 RSA Y+1.5 DL	5647.7645	-235.2018	19.1	8
Top–Right	Leg 1	345	122 1.5 RSA X+0.45 RSA Y+0.9 DL	3371.0979	6.2219	9.84	8
Bottom–Left	Leg 1	460	116 0.45 RSA X+1.5 RSA Y+1.5 DL	5687.2122	-100.6932	17.65	8
Botttom–Right	Leg 1	575	116 0.45 RSA X+1.5 RSA Y+1.5 DL	5687.2122	395.9198	21.08	8

ETABS Shear Wall Design (C15)

IS 456:2000 Pier Design

Pier Details

Story ID	Pier ID	Centroid X (mm)	Centroid Y (mm)	Length (mm)	Thickness (mm)	Pier Ductility	LLRF
STILT	P50	38976.4	55079.1	1500	300	Special Wall	0.6

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	1	500	500

Design Code Parameters

Γ_S	Γ_C	IP_{MAX}	IP_{MIN}	P_{MAX}	MinEcc Major	MinEcc Minor
1.15	1.5	0.04	0.0025	0.8	Yes	Yes

Pier Leg Location, Length and Thickness

Station Location	ID	Left X_1 mm	Left Y_1 mm	Right X_2 mm	Right Y_2 mm	Length mm	Thickness mm
Top	Leg 1	38976.4	54329.1	38976.4	55829.1	1500	300
Bottom	Leg 1	38976.4	54329.1	38976.4	55829.1	1500	300

Flexural Design for P_u, M_{u2} and M_{u3}

Station Location	Required Rebar Area (mm^2)	Required Reinf Ratio	Current Reinf Ratio	Flexural Combo	P_u kN	M_{u2} kN-m	M_{u3} kN-m	Pier A_g mm^2
Top	5539	0.0123	0.0223	101 1.5 DL+1.5 LL	7484.2677	182.7114	428.9982	450000
Bottom	5730	0.0127	0.0223	101 1.5 DL+1.5 LL	7546.012	-184.0899	-432.5374	450000

Shear Design

Station Location	ID	Rebar mm^2/m	Shear Combo	P_u kN	M_u kN-m	V_u kN	V_c kN	$V_c + V_s$ kN
Top	Leg 1	750	117 -0.45 RSA X+1.5 RSA Y+1.5 DL	6182.5978	265.4847	-112.0307	297.8413	622.6239
Bottom	Leg 1	750	117 -0.45 RSA X+1.5 RSA Y+1.5 DL	6244.3421	356.4269	-112.0307	301.9573	626.7399

Boundary Element Check

Station Location	ID	Edge Length (mm)	Governing Combo	P_u kN	M_u kN-m	Stress Comp MPa	Stress Limit MPa
Top–Left	Leg 1	450	116 0.45 RSA X+1.5 RSA Y+1.5 DL	6590.9179	-45.2441	15.05	8
Top–Right	Leg 1	450	116 0.45 RSA X+1.5 RSA Y+1.5 DL	6590.9179	265.4847	17.01	8
Bottom–Left	Leg 1	450	116 0.45 RSA X+1.5 RSA Y+1.5 DL	6652.6622	-426.2495	18.57	8
Botttom–Right	Leg 1	450	116 0.45 RSA X+1.5 RSA Y+1.5 DL	6652.6622	356.4269	17.95	8

ETABS Shear Wall Design (C16)

IS 456:2000 Pier Design

Pier Details

Story ID	Pier ID	Centroid X (mm)	Centroid Y (mm)	Length (mm)	Thickness (mm)	Pier Ductility	LLRF
STILT	P38	28608.9	55029	1600.2	300	Special Wall	0.6

Flexural Design for P_u, M_{u2} and M_{u3}

Station Location	Required Rebar Area (mm²)	Required Reinf Ratio	Current Reinf Ratio	Flexural Combo	P_u kN	M_{u2} kN-m	M_{u3} kN-m	Pier A_g mm²
Top	11411	0.0238	0.0223	101 1.5 DL+1.5 LL	10140.1071	-202.8021	76.6441	480000
Bottom	11650	0.0243	0.0223	101 1.5 DL+1.5 LL	10194.0912	-203.8818	36.4166	480000

Shear Design

Station Location	ID	Rebar mm²/m	Shear Combo	P_u kN	M_u kN-m	V_u kN	V_c kN	$V_c + V_s$ kN
Top	Leg 1	750	117 -0.45 RSA X+1.5 RSA Y+1.5 DL	8736.1521	485.7032	-89.7947	364.2944	710.7292
Bottom	Leg 1	750	117 -0.45 RSA X+1.5 RSA Y+1.5 DL	8790.1361	681.0019	-89.7947	364.2944	710.7292

Boundary Element Check

Station Location	ID	Edge Length (mm)	Governing Combo	P_u kN	M_u kN-m	Stress Comp MPa	Stress Limit MPa
Top–Left	Leg 1	600	114 1.5 RSA X+0.45 RSA Y+1.5 DL	9048.8669	-150.9991	20.03	8
Top–Right	Leg 1	600	114 1.5 RSA X+0.45 RSA Y+1.5 DL	9048.8669	287.5005	21.1	8
Bottom–Left	Leg 1	600	114 1.5 RSA X+0.45 RSA Y+1.5 DL	9102.851	-306.6417	21.36	8
Botttom–Right	Leg 1	750	116 0.45 RSA X+1.5 RSA Y+1.5 DL	9009.227	681.0019	24.09	8

ETABS Shear Wall Design (C18)

IS 456:2000 Pier Design

Pier Details

Story ID	Pier ID	Centroid X (mm)	Centroid Y (mm)	Length (mm)	Thickness (mm)	Pier Ductility	LLRF
BASE1	P69	53304.9	53695.6	2000	300	Special Wall	0.6

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	1	500	500

Design Code Parameters

Γ_S	Γ_C	IP_{MAX}	IP_{MIN}	P_{MAX}	MinEcc Major	MinEcc Minor
1.15	1.5	0.04	0.0025	0.8	Yes	Yes

Pier Leg Location, Length and Thickness

Station Location	ID	Left X_1 mm	Left Y_1 mm	Right X_2 mm	Right Y_2 mm	Length mm	Thickness mm
Top	Leg 1	52304.9	53695.6	54304.9	53695.6	2000	300
Bottom	Leg 1	52304.9	53695.6	54304.9	53695.6	2000	300

Flexural Design for P_u, M_{u2} and M_{u3} (Part 1 of 2)

Station Location	Required Rebar Area (mm²)	Required Reinf Ratio	Current Reinf Ratio	Flexural Combo	P_u kN	M_{u2} kN-m
Top	9661	0.0161	0.022	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	10335.9215	-206.7184
Bottom	13266	0.0221	0.022	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	10403.4011	-208.068

Flexural Design for P_u, M_{u2} and M_{u3} (Part 2 of 2)

M_{u3} kN-m	Pier A_g mm²
-1584.5143	599995
2554.8015	599995

Shear Design

Station Location	ID	Rebar mm²/m	Shear Combo	P_u kN	M_u kN-m	V_u kN	V_c kN	$V_c + V_s$ kN
Top	Leg 1	750	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	7768.249	381.0735	729.0659	444.6851	877.7253

Station Location	ID	Rebar mm²/m	Shear Combo	P_u kN	M_u kN-m	V_u kN	V_c kN	$V_c + V_s$ kN
Bottom	Leg 1	750	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	7835.7286	2554.8015	729.0659	507.8238	940.864

Boundary Element Check

Station Location	ID	Edge Length (mm)	Governing Combo	P_u kN	M_u kN-m	Stress Comp MPa	Stress Limit MPa
Top–Left	Leg 1	750	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	10335.9215	-1584.5143	25.15	8
Top–Right	Leg 1	750	110 1.5 SL X+0.45 SL Y+1.5 DL	9405.6322	803.0397	19.69	8
Bottom–Left	Leg 1	750	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	10403.4011	-1175.7897	23.22	8
Botttom–Right	Leg 1	900	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	10403.4011	2554.8015	30.11	8

ETABS Shear Wall Design (C19)

IS 456:2000 Pier Design

Pier Details

Story ID	Pier ID	Centroid X (mm)	Centroid Y (mm)	Length (mm)	Thickness (mm)	Pier Ductility	LLRF
STILT	P109	30707	16154.4	1800	230	Special Wall	0.6

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	1	500	500

Design Code Parameters

Γ_S	Γ_C	IP_{MAX}	IP_{MIN}	P_{MAX}	MinEcc Major	MinEcc Minor
1.15	1.5	0.04	0.0025	0.8	Yes	Yes

Pier Leg Location, Length and Thickness

Station Location	ID	Left X_1 mm	Left Y_1 mm	Right X_2 mm	Right Y_2 mm	Length mm	Thickness mm
Top	Leg 1	29807	16154.4	31607	16154.4	1800	230
Bottom	Leg 1	29807	16154.4	31607	16154.4	1800	230

Flexural Design for P_u, M_{u2} and M_{u3}

Station Location	Required Rebar Area (mm²)	Required Reinf Ratio	Current Reinf Ratio	Flexural Combo	P_u kN	M_{u2} kN-m	M_{u3} kN-m	Pier A_g mm²
Top	10636	0.0257	0.0288	101 1.5 DL+1.5 LL	7341.8057	217.3639	-494.2506	414000
Bottom	10875	0.0263	0.0288	101 1.5 DL+1.5 LL	7398.6105	-219.0181	498.0747	414000

Shear Design

Station Location	ID	Rebar mm²/m	Shear Combo	P_u kN	M_u kN-m	V_u kN	V_c kN	$V_c + V_s$ kN
Top	Leg 1	575	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	6026.4044	263.1226	168.0389	314.2041	613.0042
Bottom	Leg 1	575	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	6083.2092	808.9477	168.0389	314.2041	613.0042

Boundary Element Check

Station Location	ID	Edge Length (mm)	Governing Combo	P_u kN	M_u kN-m	Stress Comp MPa	Stress Limit MPa
Top–Left	Leg 1	575	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	6828.087	-406.724	19.77	8
Top–Right	Leg 1	575	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	6828.087	263.1226	18.61	8
Bottom–Left	Leg 1	690	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	6884.8918	-705.0566	22.31	8
Botttom–Right	Leg 1	690	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	6884.8918	808.9477	23.14	8

ETABS Shear Wall Design (C20)

IS 456:2000 Pier Design

Pier Details

Story ID	Pier ID	Centroid X (mm)	Centroid Y (mm)	Length (mm)	Thickness (mm)	Pier Ductility	LLRF
BASE1	P57	44437.4	59829.7	1752.6	300	Special Wall	0.6

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	1	500	500

Design Code Parameters

Γ_S	Γ_C	IP_{MAX}	IP_{MIN}	P_{MAX}	MinEcc Major	MinEcc Minor
1.15	1.5	0.04	0.0025	0.8	Yes	Yes

Pier Leg Location, Length and Thickness

Station Location	ID	Left X_1 mm	Left Y_1 mm	Right X_2 mm	Right Y_2 mm	Length mm	Thickness mm
Top	Leg 1	44437.4	58953.4	44437.4	60706	1752.6	300
Bottom	Leg 1	44437.4	58953.4	44437.4	60706	1752.6	300

Flexural Design for P_u, M_{u2} and M_{u3}

Station Location	Required Rebar Area (mm^2)	Required Reinf Ratio	Current Reinf Ratio	Flexural Combo	P_u kN	M_{u2} kN-m	M_{u3} kN-m	Pier A_g mm^2
Top	1314	0.0025	0.0227	131 0.9 DL+1.5 WL +Y	3052.5231	61.0505	1407.7396	525779
Bottom	2264	0.0043	0.0227	129 1.5 DL+1.5 WL +Y	4972.091	99.4418	1946.7824	525779

Shear Design

Station Location	ID	Rebar mm^2/m	Shear Combo	P_u kN	M_u kN-m	V_u kN	V_c kN	$V_c + V_s$ kN
Top	Leg 1	750	117 -0.45 RSA X+1.5 RSA Y+1.5 DL	4429.3993	738.382	-120.8712	189.2806	568.7562
Bottom	Leg 1	750	117 -0.45 RSA X+1.5 RSA Y+1.5 DL	4488.532	1019.8203	-120.8712	222.2173	601.6928

Boundary Element Check

Station Location	ID	Edge Length (mm)	Governing Combo	P_u kN	M_u kN-m	Stress Comp MPa	Stress Limit MPa
Top–Left	Leg 1	450	116 0.45 RSA X+1.5 RSA Y+1.5 DL	4797.2381	-548.6522	12.7	8
Top–Right	Leg 1	450	112 0.45 SL X+1.5 SL Y+1.5 DL	4907.0209	848.9985	14.86	8
Bottom–Left	Leg 1	450	114 1.5 RSA X+0.45 RSA Y+1.5 DL	4940.0778	-576.3716	13.15	8
Botttom–Right	Leg 1	450	112 0.45 SL X+1.5 SL Y+1.5 DL	4966.1536	1108.4513	16.66	8

ETABS Shear Wall Design (C21)

IS 456:2000 Pier Design

Pier Details

Story ID	Pier ID	Centroid X (mm)	Centroid Y (mm)	Length (mm)	Thickness (mm)	Pier Ductility	LLRF
BASE1	P67	53655.2	44551.8	1300	300	Special Wall	0.6

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	1	500	500

Design Code Parameters

Γ_S	Γ_C	IP_{MAX}	IP_{MIN}	P_{MAX}	MinEcc Major	MinEcc Minor
1.15	1.5	0.04	0.0025	0.8	Yes	Yes

Pier Leg Location, Length and Thickness

Station Location	ID	Left X_1 mm	Left Y_1 mm	Right X_2 mm	Right Y_2 mm	Length mm	Thickness mm
Top	Leg 1	53005.2	44551.8	54305.2	44551.8	1300	300
Bottom	Leg 1	53005.2	44551.8	54305.2	44551.8	1300	300

Flexural Design for P_u, M_{u2} and M_{u3} (Part 1 of 2)

Station Location	Required Rebar Area (mm^2)	Required Reinf Ratio	Current Reinf Ratio	Flexural Combo	P_u kN	M_{u2} kN-m
Top	8989	0.023	0.0226	131 0.9 DL+1.5 WL +Y	-2349.8504	46.997
Bottom	10592	0.0272	0.0226	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	-195.6756	-44.0324

Flexural Design for P_u, M_{u2} and M_{u3} (Part 2 of 2)

M_{u3} kN-m	Pier A_g mm^2
-730.23	390000
1866.7812	390000

Shear Design

Station Location	ID	Rebar mm^2/m	Shear Combo	P_u kN	M_u kN-m	V_u kN	V_c kN	$V_c + V_s$ kN
Top	Leg 1	1964.93	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	-239.5377	-911.9397	961.0238	223.5758	961.0238
Bottom	Leg 1	1927.53	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	-195.6756	1866.7812	961.0238	237.6139	961.0238

Boundary Element Check

Station Location	ID	Edge Length (mm)	Governing Combo	P_u kN	M_u kN-m	Stress Comp MPa	Stress Limit MPa
Top--Left	Leg 1	450	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	3366.8183	-911.9397	19.43	8
Top--Right	Leg 1	0	101 1.5 DL+1.5 LL	0	0	0	0
Bottom--Left	Leg 1	300	114 1.5 RSA X+0.45 RSA Y+1.5 DL	3576.0244	-16.361	9.36	8
Botttom--Right	Leg 1	450	114 1.5 RSA X+0.45 RSA Y+1.5 DL	3576.0244	1262.3692	24.11	8

ETABS Shear Wall Design (C22)

IS 456:2000 Pier Design

Pier Details

Story ID	Pier ID	Centroid X (mm)	Centroid Y (mm)	Length (mm)	Thickness (mm)	Pier Ductility	LLRF
BASE1	P1	750.1	69773.8	1500	300	Special Wall	0.6

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	1	500	500

Design Code Parameters

Γ_S	Γ_C	IP_{MAX}	IP_{MIN}	P_{MAX}	MinEcc Major	MinEcc Minor
1.15	1.5	0.04	0.0025	0.8	Yes	Yes

Pier Leg Location, Length and Thickness

Station Location	ID	Left X_1 mm	Left Y_1 mm	Right X_2 mm	Right Y_2 mm	Length mm	Thickness mm
Top	Leg 1	0.1	69773.8	1500.1	69773.8	1500	300
Bottom	Leg 1	0.1	69773.8	1500.1	69773.8	1500	300

Flexural Design for P_u, M_{u2} and M_{u3} (Part 1 of 2)

Station Location	Required Rebar Area (mm^2)	Required Reinf Ratio	Current Reinf Ratio	Flexural Combo	P_u kN	M_{u2} kN-m

Station Location	Required Rebar Area (mm²)	Required Reinf Ratio	Current Reinf Ratio	Flexural Combo	P_u kN	M_{u2} kN-m
Top	6237	0.0139	0.0223	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	1705.8251	-46.8747
Bottom	11872	0.0264	0.0223	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	3615.1122	72.3022

Flexural Design for P_u, M_{u2} and M_{u3} (Part 2 of 2)

M_{u3} kN-m	Pier A_g mm²
1978.271	450000
-2809.3347	450000

Shear Design

Station Location	ID	Rebar mm²/m	Shear Combo	P_u kN	M_u kN-m	V_u kN	V_c kN	$V_c + V_s$ kN
Top	Leg 1	2637.15	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	1705.8251	1978.271	-1409.9222	267.9215	1409.9222
Bottom	Leg 1	2467.18	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	1756.4351	-1015.8991	-1409.9222	341.5259	1409.9222

Boundary Element Check

Station Location	ID	Edge Length (mm)	Governing Combo	P_u kN	M_u kN-m	Stress Comp MPa	Stress Limit MPa
Top–Left	Leg 1	0	101 1.5 DL+1.5 LL	0	0	0	0
Top–Right	Leg 1	450	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	3564.5022	1978.271	25.51	8
Bottom–Left	Leg 1	600	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	3615.1122	-2809.3347	33.01	8
Botttom–Right	Leg 1	0	101 1.5 DL+1.5 LL	0	0	0	0

ETABS Shear Wall Design (C23)

IS 456:2000 Pier Design

Pier Details

Story ID	Pier ID	Centroid X (mm)	Centroid Y (mm)	Length (mm)	Thickness (mm)	Pier Ductility	LLRF
BASE1	P139	53555.2	0.2	1500	300	Special Wall	0.6

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	1	500	500

Design Code Parameters

Γ_S	Γ_C	IP_{MAX}	IP_{MIN}	P_{MAX}	MinEcc Major	MinEcc Minor
1.15	1.5	0.04	0.0025	0.8	Yes	Yes

Pier Leg Location, Length and Thickness

Station Location	ID	Left X_1 mm	Left Y_1 mm	Right X_2 mm	Right Y_2 mm	Length mm	Thickness mm
Top	Leg 1	52805.2	0.2	54305.2	0.2	1500	300
Bottom	Leg 1	52805.2	0.2	54305.2	0.2	1500	300

Flexural Design for P_u, M_{u2} and M_{u3} (Part 1 of 2)

Station Location	Required Rebar Area (mm²)	Required Reinf Ratio	Current Reinf Ratio	Flexural Combo	P_u kN	M_{u2} kN-m
Top	10382	0.0231	0.0223	131 0.9 DL+1.5 WL +Y	-2897.1506	57.943
Bottom	15936	0.0354	0.0223	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	-1092.288	-57.3603

Flexural Design for P_u, M_{u2} and M_{u3} (Part 2 of 2)

M_{u3} kN-m	Pier A_g mm²
-864.4324	450000
2853.5657	450000

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	1	500	500

Design Code Parameters

Γ_S	Γ_C	IP_{MAX}	IP_{MIN}	P_{MAX}	MinEcc Major	MinEcc Minor
1.15	1.5	0.04	0.0025	0.8	Yes	Yes

Pier Leg Location, Length and Thickness

Station Location	ID	Left X_1 mm	Left Y_1 mm	Right X_2 mm	Right Y_2 mm	Length mm	Thickness mm
Top	Leg 1	28609	54228.8	28608.8	55829.1	1600.2	300
Bottom	Leg 1	28609	54228.8	28608.8	55829.1	1600.2	300

Flexural Design for P_u, M_{u2} and M_{u3}

Station Location	Required Rebar Area (mm^2)	Required Reinf Ratio	Current Reinf Ratio	Flexural Combo	P_u kN	M_{u2} kN-m	M_{u3} kN-m	Pier A_g mm^2
Top	10557	0.022	0.0223	101 1.5 DL+1.5 LL	9241.5544	240.1859	560.605	480073
Bottom	10768	0.0224	0.0223	101 1.5 DL+1.5 LL	9307.4249	-241.6565	564.6008	480073

Shear Design

Station Location	ID	Rebar mm^2/m	Shear Combo	P_u kN	M_u kN-m	V_u kN	V_c kN	$V_c + V_s$ kN
Top	Leg 1	750	117 -0.45 RSA X+1.5 RSA Y+1.5 DL	7963.5581	289.1563	-74.54	364.349	710.8358
Bottom	Leg 1	750	117 -0.45 RSA X+1.5 RSA Y+1.5 DL	8029.4285	500.9523	-74.54	364.349	710.8358

Boundary Element Check

Station Location	ID	Edge Length (mm)	Governing Combo	P_u kN	M_u kN-m	Stress Comp MPa	Stress Limit MPa
Top–Left	Leg 1	600	114 1.5 RSA X+0.45 RSA Y+1.5 DL	8163.5906	-37.6615	17.3	8
Top–Right	Leg 1	600	114 1.5 RSA X+0.45 RSA Y+1.5 DL	8163.5906	199.6618	18.56	8
Bottom–Left	Leg 1	600	114 1.5 RSA X+0.45 RSA Y+1.5 DL	8229.4611	-166.0857	18.44	8
Botttom–Right	Leg 1	600	116 0.45 RSA X+1.5 RSA Y+1.5 DL	8159.3268	500.9523	20.91	8

ETABS Shear Wall Design (C17)

IS 456:2000 Pier Design

Pier Details

Story ID	Pier ID	Centroid X (mm)	Centroid Y (mm)	Length (mm)	Thickness (mm)	Pier Ductility	LLRF
BASE1	P111	28613.4	10479.9	1600	300	Special Wall	0.6

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	1	500	500

Design Code Parameters

Γ_S	Γ_C	IP_{MAX}	IP_{MIN}	P_{MAX}	MinEcc Major	MinEcc Minor
1.15	1.5	0.04	0.0025	0.8	Yes	Yes

Pier Leg Location, Length and Thickness

Station Location	ID	Left X_1 mm	Left Y_1 mm	Right X_2 mm	Right Y_2 mm	Length mm	Thickness mm
Top	Leg 1	28613.4	9679.9	28613.4	11279.9	1600	300
Bottom	Leg 1	28613.4	9679.9	28613.4	11279.9	1600	300

Shear Design

Station Location	ID	Rebar mm²/m	Shear Combo	P_u kN	M_u kN-m	V_u kN	V_c kN	$V_c + V_s$ kN
Top	Leg 1	2451	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	-1142.8981	-1042.1087	1319.4583	258.0666	1319.4583
Bottom	Leg 1	2345.88	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	-1092.288	2853.5657	1319.4583	303.5908	1319.4583

Boundary Element Check

Station Location	ID	Edge Length (mm)	Governing Combo	P_u kN	M_u kN-m	Stress Comp MPa	Stress Limit MPa
Top–Left	Leg 1	450	114 1.5 RSA X+0.45 RSA Y+1.5 DL	4131.0505	-1088.3096	18.85	8
Top–Right	Leg 1	0	101 1.5 DL+1.5 LL	0	0	0	0
Bottom–Left	Leg 1	300	114 1.5 RSA X+0.45 RSA Y+1.5 DL	4181.6605	-415.3526	12.98	8
Botttom–Right	Leg 1	600	114 1.5 RSA X+0.45 RSA Y+1.5 DL	4181.6605	2102.6959	27.98	8

ETABS Concrete Frame Design (FB11)

IS 456:2000 + IS 13920:2016 Beam Section Design (Summary)

Beam Element Details (Part 1 of 2)

Level	Element	Unique Name	Section ID	Combo ID	Station Loc	Length (mm)
5	B124	3969	B230X600	115 1.5 RSA X+-0.45 RSA Y+1.5 DL	0	6731

Beam Element Details (Part 2 of 2)

LLRF	Type
1	Ductile Frame

Section Properties

b (mm)	h (mm)	b_f (mm)	d_s (mm)	d_{ct} (mm)	d_{cb} (mm)
230	600	230	0	60	60

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
27386.13	30	1	500	500

Design Code Parameters

γ_C	γ_S
1.5	1.15

Factored Forces and Moments

Factored M_{u3} kN-m	Factored T_u kN-m	Factored V_{u2} kN	Factored P_u kN
-191.3446	8.4226	131.1048	1768.7057

Design Moments, M_{u3} & M_t

Factored Moment kN-m	Factored M_t kN-m	Positive Moment kN-m	Negative Moment kN-m
-191.3446	17.8792	0	-209.2238

Design Moment and Flexural Reinforcement for Moment, M_{u3} & T_u

	Design -Moment kN-m	Design +Moment kN-m	-Moment Rebar mm²	+Moment Rebar mm²	Minimum Rebar mm²	Required Rebar mm²
Top (+2 Axis)	-209.2238		1038	0	1038	327
Bottom (-2 Axis)		0	519	0	229	519

Shear Force and Reinforcement for Shear, V_{u2} & T_u

Shear V_e kN	Shear V_c kN	Shear V_s kN	Shear V_p kN	Rebar A_{sv} /s mm²/m
183.5459	0	242.1379	64.7086	1242.56

Torsion Force and Torsion Reinforcement for Torsion, T_u & V_{U2}

T_u kN-m	V_u kN	Core b_1 mm	Core d_1 mm	Rebar A_{svt} /s mm²/m
8.4226	131.1048	130	500	649.71

ETABS Concrete Frame Design (FB16)

IS 456:2000 + IS 13920:2016 Beam Section Design (Summary)

Beam Element Details

Level	Element	Unique Name	Section ID	Combo ID	Station Loc	Length (mm)	LLRF	Type
1	B375	5398	B300*600	101 1.5 DL+1.5 LL	8996.3	9296.3	1	Ductile Frame

Section Properties

b (mm)	h (mm)	b_f (mm)	d_s (mm)	d_{ct} (mm)	d_{cb} (mm)
300	600	300	0	60	60

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
27386.13	30	1	500	500

Design Code Parameters

ɣc	ɣs
1.5	1.15

Factored Forces and Moments

Factored M_{u3} kN-m	Factored T_u kN-m	Factored V_{u2} kN	Factored P_u kN
-451.9534	8.0767	336.49	1153.5037

Design Moments, M_{u3} & M_t

Factored Moment kN-m	Factored M_t kN-m	Positive Moment kN-m	Negative Moment kN-m
-451.9534	14.2529	0	-466.2063

Design Moment and Flexural Reinforcement for Moment, M_{u3} & T_u

	Design -Moment kN-m	Design +Moment kN-m	-Moment Rebar mm²	+Moment Rebar mm²	Minimum Rebar mm²	Required Rebar mm²
Top (+2 Axis)	-466.2063		2400	0	2400	600
Bottom (-2 Axis)		0	1200	0	1106	1200

Shear Force and Reinforcement for Shear, V_{u2} & T_u

Shear V_e kN	Shear V_c kN	Shear V_s kN	Shear V_p kN	Rebar A_{sv} /s mm²/m
336.49	183.7803	195.7853	123.9494	1004.7

Torsion Force and Torsion Reinforcement for Torsion, T_u & V_{U2}

T_u kN-m	V_u kN	Core b_1 mm	Core d_1 mm	Rebar A_{svt} /s mm²/m
8.0767	336.49	200	500	969.77

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THE LANDLENS SUITE

Eight ways to know a piece of land before you pay for it.

This report covers one part of the picture. These cover the rest, drawn from the same government records, for any property in Tamil Nadu.

LandLens One
Ask anything about a property and get an answer grounded in live government records, with the sources shown.
/landlens/one

Verify My Land
Every record check run on one property and returned as a single report.
/landlens/verify-my-land

Legal Opinion
An advocate's written opinion on the title, built on the records we pull for it.
/landlens

One Map
Every layer on one map: the parcel, its boundary, zoning, water bodies and what sits around it.
/landlens/one/map

PriceMap
What land actually changed hands for around this plot, taken from the registered deeds.
/landlens/pricemap

Build Scope
What you are allowed to build here: floor space, height, coverage and setbacks.
/landlens/build-scope

Property Tracker
Watch a property and hear about it when something new is registered against it.
/landlens/property-tracker

Deal Room
Run the transaction in one place: documents, stamping, signatures and the parties.
/landlens/deal-room

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Twenty-four checks you can run yourself, at no cost.

Records and verification

The registers themselves, read for you.

- Encumbrance Certificate
- Patta and Chitta
- Field Measurement Sketch
- EC Analyzer
- Bank charge check
- Court case search
- Seller background check
- Approval check by survey

Value and duty

What it is worth and what it costs to register.

- Guideline value by street
- Guideline value by survey
- Stamp duty and registration fees
- Capital gains
- Floor space index
- Area unit converter

Zoning and land use

What the plan says can happen on this land.

- Land use zone finder
- CMDA land use check
- Coastal regulation zone
- Master plan check
- Water bodies finder
- Airport height clearance

Registers and directories

Who holds it, and which office keeps the record.

- Find your registering office
- Temple property check
- Waqf property check
- RERA register

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Services we run for you
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Every claim in this document traces back to a government record.

- Legal opinions, due diligence and title verification
- Building plan, layout and sub-division approvals
- Completion and occupancy certificates, regularisation
- Escrow, negotiation and NRI property management
- Land survey, soil testing, architecture and construction

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Prepared from the registers named on the page each finding sits on. Where a register could not be read, this document says so in its place rather than leaving the gap to be read as a clean result.