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Professor

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IIT Madras
January 08th 2025

To

M/s. ALTIS PROPERTIES PVT. LTD.,
No. 19, Blue Haven, 4th Floor,
Harrington Road,
Nungambakkam,
Chennai - 600031.

Greetings Sir,

Sub: Approval for "Vetting of Structural drawings from IIT Chennai"- Proposed Construction of Residential High Rise Group Development Building for M/s. ALTIS PROPERTIES PVT. LTD., Sl. No: 8/15, 8/19, 8/20, 8/2B1A & 8/2B1F1A, Kanathur Reddykuppam Village, Thiruporur Taluk, Chengalpattu District.

This is with reference to "Vetting of structural drawings from IIT" for the proposed residential building Proposed residential building for M/s. ALTIS PROPERTIES PVT. LTD., Sl. No: 8/15, 8/19, 8/20, 8/2B1A & 8/2B1F1A, Kanathur Reddykuppam Village, Thiruporur Taluk, Chengalpattu District. The Proposed Construction of the Residential High Rise Group Development Building Consisting of an Extended combined Double Basement floor + Combined Ground / Stilt Floor for Tower 01, Tower 02 & Tower 03 - Tower 01 – Ground part/stilt floor part + 34 Floors with Swimming Pool at 3rd Floor Level (with 126 DU)+ Tower 02 - Ground part/stilt floor part + 33 Floors (with 128 DU), Tower 03 - Ground part/stilt floor part + 33 Floors(with 63 DU), Totally 317 Dwelling Units, I would like to inform you that thorough checking of the assumptions and adopted analysis methodology has been completed and are found to be in accordance with standard practice/procedures and relevant IS Code.

The execution of the work should be done as per given design and drawings with proper quality control of materials. For any related clarification in relation with the above-mentioned design and drawings, the undersigned may be contacted.

Thanking you and assuring you our best service always,

Yours Sincerely

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PROPOSED RESIDENTIAL TOWER AT ECR, CHENNAI

DESIGN BRIEF REPORT FOR STRUCTURAL SERVICES



Client:	altis BUILT WITH PASSION	M/s. ALTIS PROPERTIES, CHENNAI.
Structural Consultant:		BURO ENGINNERS (I) PVT LTD Civil & Structural Consultants New No.31, (old No. 14), Besant Avenue, Adyar, Chennai 600 020.

DOCUMENT NO : STR - DBR/Rev-R0

DATE	ISSUE	PREPARED	CHECKED	REVISION
02-10-2024	Primary Report	PRK	P.J	R0

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1.0 PROJECT INFORMATION

1.1 Introduction:

This Design Brief Report (DBR) is for the Proposed Residential Development at ECR, Chennai, for M/s. Altis Properties.

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The proposed residential building having 2 Basement + Ground floor + 33 Upper floors for Tower2 & 3, & 2 Basement + Ground floor + 34 Upper floors for Tower1.

This report provides the information on Codes of Practice, Design loading, Material Strength considered for the Design and Analysis of the building. In addition, this report includes Structural system, Foundation system, Method statement of structural analysis which will be adopted for design and analysis for the building.

1.2 Facilities:

The proposed building for M/S.Altis Properties, is primarily a residential building housing apartments and a clubhouse on the sub structure levels (Basement 1 to Basement2) to provide car parking facilities.

2.0 STORY INFORMATION

Story	Facilities
Basement2	Parking, STP, Pump Room, Panel room and Water tank
Basement1	Parking, Pump Room, Panel room and Water tank
Ground Floor	Fire Driveway, Landscape, Lobby, Reception, DG room, Drop off and Club house
Level1	Residential Unit, Landscape, Reception, Multipurpose Hall, Gym, aerobics and toilets
Level2	Residential Units, Restaurants, Multipurpose Hall, Badminton, Squash, Parlour, SPA, Pool Table, GYM and Swimming Pool.
Level3	Residential Units, Multipurpose Hall, Swimming Pool.
Level4	Residential units, Corridor and Lobby
Level5 to Level34	Residential units, Corridor and Lobby
Terrace	Open terrace, Solar Panels, OHT & LMR

2.1 Floor to Floor Height:

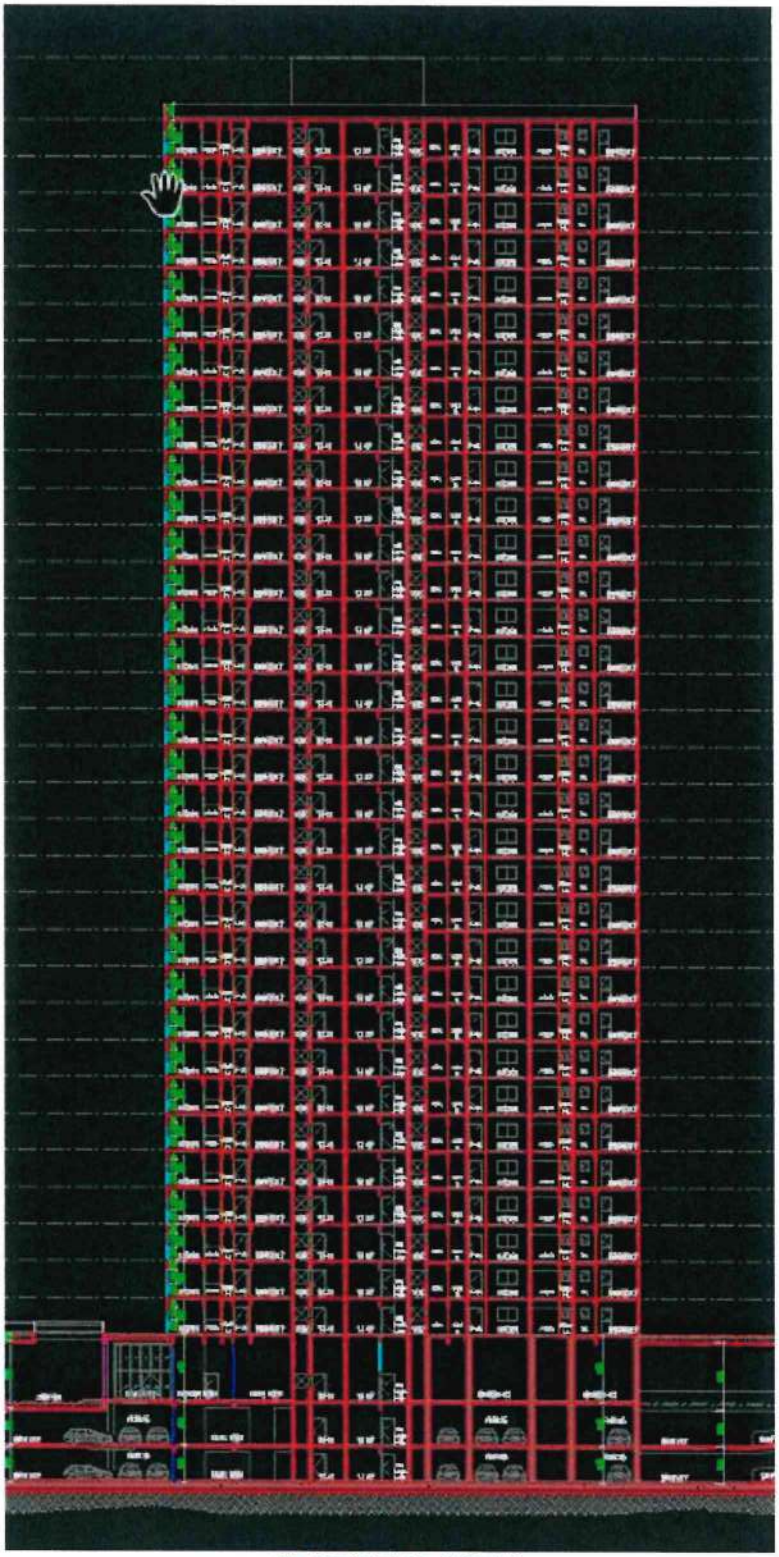
Basement 2	3.3m
Basement 1	3.95m/3.3m
Ground Floor	6.00m
Level1	3.30m
Level2 to Terrace	3.30m

2.2 Aspect Ratio of the building:

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Tower	Building Height (m)	Building Height (m)	Base Dimension-X-Direction (m)	Base Dimension-Y-Direction (m)	Slenderness Ratio (X-Direction)	Slenderness Ratio (Y-Direction)
1	126.8	118.35	47.7	32.77	2.66	3.61
2	123.5	115.05	47.7	20.85	2.59	5.52
3	123.5	115.05	56.02	12.6	2.20	9.15

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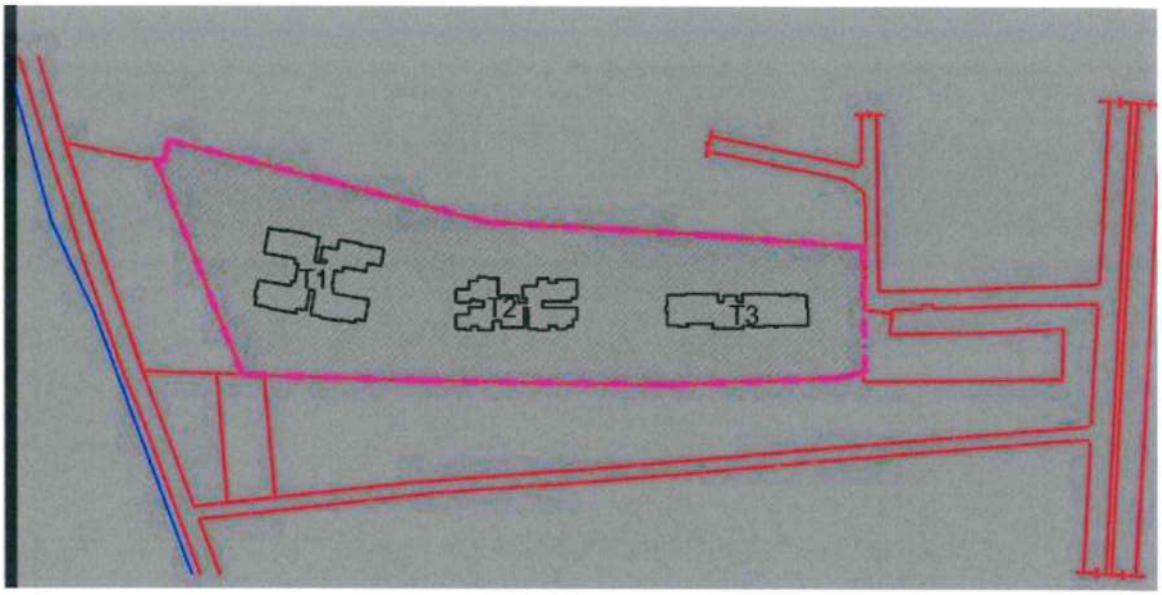
SECTIONAL VIEW

3.0 SITE DISCRIPTION

The site has direct access from East Coast Road (ECR) on its eastern side, ensuring excellent connectivity. To the west, it is bordered by backwaters, which may impact

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drainage, environmental considerations, and offer aesthetic potential. Partial residential buildings lie to the north and south, requiring careful management of construction impacts and compliance with local regulations. Proper planning will be essential for environmental protection, flood management, and community relations. The site's strategic location provides both opportunities and challenges for development.





EMPTY PLOT
SITE PLAN

3.1 Ground Condition:

We have reviewed the following reports to assess the stratigraphy and ground conditions at the site:
Geo Marine Consultants (P) Limited, Kannappa Nagar, Kottivakkam, Chennai, Geotechnical Investigation Report: GT-2703.
Based on the borehole records, the general geological sequence observed is as follows:

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Stratum	Depth from existing ground level
Loose & Medium Dense, Clayey Silty Sand/ Silty Sand	0.0m to 3.0m
Loose & Medium Dense, Clayey Silty Sand/ Silty Sand	3.0m to 10.5m/13.0m
Disintegrated to Completely Weathered Rock	10.5m/13.0m to 14.0m/16.0m
Highly to Moderately Weathered Rock Formation	Beyond 14.0m/16.0m

4.0 CODES OF PRACTICE

The relevant Indian Standard codes below are followed.

4.1 Code, Standards and References:

All design of structures shall comply with the requirements specified in the following.

a. Relevant Indian Standard Codes of Practice
b. National Building Code.
c. Local Building regulations.
d. Other relevant international codes where required.

All applicable latest edition of codes and standards will be referred and adopted in the analysis of structures and the design and detailing of structural members. All structural elements design shall be carried out primarily based on. Indian Standards and Codes with latest revision, with amendments if any, as on date. In addition, other international codes and standards shall also be referred when required and relevant.

In the analysis, design and detailing of the building, the following Indian Standard codes of latest amendment will be used.

CODE	DESCRIPTION
IS 875(Part 1) 1987	Code of practice for Design Loads (other than earthquake) for buildings and structures – Unit weights of buildings materials and stored materials
IS 875 (Part 2) 1987	Code of practice for Design Loads (other than earthquake) for buildings and structures – Imposed

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	Loads
IS 875 (Part 3) 2015	Code of practice for Design Loads (other than earthquake) for buildings and structures - Wind Loads
IS 875 (Part 5) 1987	Code of practice for Design Loads (other than earthquake) for buildings and structures - Special Loads and load combinations
IS 456 - 2000	Code of Practice for Plain and Reinforced Concrete
IS 16700 - 2023	Criteria for Structural Safety of Tall Concrete Buildings
IS 1343 - 2012	Code of Practice for Prestressed Concrete
IS 1893 - 2016 IS 4326 –1993	Criteria for earthquake resistant design of structures Code of practice for Earthquake Resistant Design and Construction of Buildings
IS 3370 - 2009 IS 1904-1995 IS 1080 - 1997 IS 2950 - 1998 IS 800 – 2007 BS 8110: 1997 ACI 318 IS 13920: 2016 SP24	Code of Practice for Concrete structures for the storage of liquids Code of Practice for design and construction of Foundation Code of Practice for design and construction of shallow Foundation Code of Practice for design and construction of Raft Foundation Code of practice for General Construction in steel Plain and reinforced concrete-code of practice (British standard) Plain and reinforced concrete-code of practice (American standard) Code of practice for ductile detailing of reinforced concrete structures subjected to seismic forces Explanatory Handbook on Indian standard code of practice

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SP34	Handbook on concrete reinforcement and detailing

5.0 COVER AND FIRE RATING

Cover to reinforcement considered for various elements

Structural element	Exposure condition	Fire rating in hours	Cover	
Raft	Severe		50 (Bottom)	50 (Top)
Basement- 3 Floor slab	Severe		50 (Bottom)	25 (Top)
Basement wall	Severe		45 (Soil side)	30 (Building side)
Column		2	40	
Shear wall		2	30	
Beam (Simply supported)		2	40	
Beam (Continuous)		2	30	
Slab (Simply supported)		2	35	
Slab (Continuous)		2	25	

6.0 STRUCTURAL SYSTEM

The basement floors feature a structural system composed of a reinforced concrete (RC) beam and slab framework, which is interconnected by retaining walls, lift core walls, staircase walls, and columns. This design primarily accommodates parking, ramps, and various service areas. At Basement 2, a pile foundation with a connecting slab has been implemented, specifically designed to resist uplift water pressure.

For the structure spanning from the ground level to Level 4, the system maintains the RC beam and slab configuration, supported by columns, core walls, and staircase walls. To align with the architectural design vision, transfer girders are utilized at these levels. Notably, floating walls are excluded from the lateral load-resisting elements. The design

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of these floors is focused on housing amenities, landscaped areas, roadways, a pool deck, a gym, and residential units.

Moving to Levels 5 through the roof, the structural system continues with the RC beam and slab approach, again supported by columns, core walls, and staircase walls. The floor slabs are specifically engineered to accommodate all residential units, while the RC walls are designed to effectively resist 100% of the lateral loads. Additionally, ductile detailing has been incorporated throughout all structural elements to enhance their resilience and performance.

Expansion joints have been incorporated at the basement levels to effectively separate all the three towers.

7.0 FOUNDATION & BASEMENT-2 SLAB

The following are inferred from the Geo-technical investigation report.

The subsoil at the project site is stratified as follows:

- 0.0 m to 3.0 m: Loose to medium dense clayey silty sand/silty sand.
- 3.0 m to 10.5 m/13.0 m: Loose to medium dense clayey silty sand/silty sand.
- 10.5 m/13.0 m to 14.0 m/16.0 m: Disintegrated to completely weathered rock.
- Beyond 14.0 m/16.0 m: Highly to moderately weathered rock formation, extending up to 18.0 m in BH-01.

A total of 6 boreholes were terminated after drilling approximately 21 m depth in refusal/rock strata. Refusal strata encountered is in the form of Moderately/Slightly Weathered strong/very strong rock. The N value recorded at this depth is more than 100.

The report has also stated the ground water table is encountered at 0.25 to 0.5 m from EGL. We have considered for basement wall and the Stitch slab design water head of 7.5 m from the EGL.

The report recommends based on the configuration of the structure (2 Basements); the depth of the foundation is less than 9.0m. For such formations it is not possible to adopt any kind of open foundation system, from shear and settlement considerations Hence, it is advisable to adopt deep pile foundation system.

S. No.	Diameter of Pile (mm)	Vertical Load Carrying Capacity (kN)	Pull Out Capacity (kN)	Lateral Load Carrying Capacity (kN)

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1	500	1400	800	45
2	550	1600	900	50
3	600	1800	1000	55
4	750	2200	1100	80
5	800	2500	1200	90
6	900	3000	1500	110

Hence Foundation system adopted is piled foundation with connecting slab for Tower and non-tower proton.

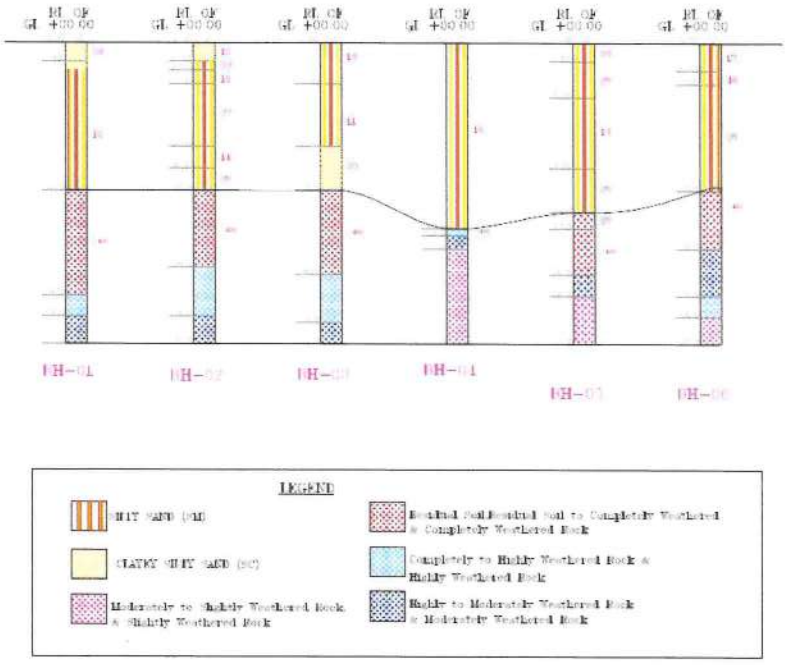


FIG No.2.7 CROSS SECTIONAL VARIATION OF SUB SOIL PROFILE THROUGH BH-01 TO 06

COMPILED SOIL - ROCK PROFILE

The following are the values used for the design of basement walls.

1. Fill Density

MATERIAL	UNIT WEIGHT kN/m3
Brown clayey silty sand	19
Moderately Weathered Rock	21

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2. Phi(degree) - Characteristic Effective Shear Resistance Angle

MATERIAL	Phi (Degree)
Brown clayey silty sand	30
Moderately Weathered Rock	40

8.0 MATERIAL GRADES

Materials specified will confirm to the latest edition of the relevant Indian Standards. Specifications for materials will include for sampling and testing as stipulated in the design standards. Detailed material specifications will be included in the technical specifications.

8.1 Concrete

Durability provisions for concrete structures shall be as per 'Severe' conditions of environment in accordance with IS 456:2000.

Keeping the durability and structural requirements, the proposed Compressive Strength of structural concrete at 28 days, for various structural elements/members are as indicated in the below table

Structural Elements		Compressive Strength at 28 days	Concrete grade
Minimum grade of concrete for any structural member is considered as		30 N/mm^2	M30
All Structural concrete for:			
Columns, Shear walls & Core walls	Foundation to Level 10 Floor level	60 N/mm^2	M60
	Level 10 level to Level 25	50 N/mm^2	M50
	Level25 to Terrace and above floor	40 N/mm^2	M40
Footing		30 N/mm^2	M30
Beams and slabs	Basement1 to Level10	35 N/mm^2	M35
	Level 10 to Roof	30 N/mm^2	M30
Overhead Water Tank, UG Water Tank, STP & Pump room		30 N/mm^2	M30

8.2 Reinforcement

All reinforcement shall confirm to IS: 1786-2008 having minimum yield strength of 550 N/sq mm (Fe 550).

Youngs' Modulus (Es)	200,000 N/mm^2
Yield Stress (fy)	550 N/mm^2

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Diameters {in mm} (d)	8, 10, 12, 16, 20, 25 & 32
Density (ϒ)	78.5 kN/Cu.m

9.0 DESIGN OF LOADINGS

9.1 Material Density

Unit weight of materials are as per IS: 875 (Part-I) 1987.

Unit weight of concrete	-	25 KN / Cum.
Unit weight of steel	-	78.5 KN / Cum.
Screed concrete	-	24 KN / Cum.
Unit weight of dry soil	-	18 KN / Cum.
Unit weight of saturated soil	-	20 KN / Cum.
Unit weight of Glass	-	27.2 KN / Cum.
Unit weight of water	-	9.81 KN / Cum.
Aerated block masonry	-	8.65 KN / Cum.
Light weight concrete filling	-	16.0 KN / Cum (Supplier - Nuvoco)

9.2 Superimposed Dead Loads and Live Loads

The following are the imposed loads such as SDL and LL to be considered for the design of floor system depending on usage floor. In addition to these loads, self-weight of structural elements will be considered depending on member sizes shown in the floor plans.

Usage	SDL (kN/m2)				LL (kN/m2)
	Partition Wall	Services	Finishes	Total	
Parking - Cars	0.00	0.50	2.40	2.90	3.00
Staircase	0.00	0.00	3.00	3.00	3.00
Toilet	0.00	0.00	3.36	3.36	2.00

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Bed, Living, Dinning & Kitchen	0.00	0.00	1.20	1.20	2.00
Balcony	0.00	0.00	4.36	4.36	3.00
Refuge Balcony	0.00	0.00	4.36	4.36	5.00
Lobby & Corridor	0.00	0.00	1.20	1.20	3.00
Reception & Lounge (Ground Floor)	0.00	0.50	2.40	2.90	5.00
Ramp	0.00	0.00	2.40	2.40	3.00
Panel Room	0.00	0.50	2.40	2.90	10.00
DG room	0.00	0.50	2.40	2.90	15.00
Multipurpose Hall, Pre-Function	0.00	0.00	1.80	1.80	5.00
Gym	0.00	0.50	2.40	2.90	10.00
Lounge and Lobby	0.00	0.00	1.80	1.80	5.00
Terrace	0.00	0.00	3.60	3.60	5.00
LMR	0.00	0.00	3.60	3.60	10.00
OHT	0.00	10xWater Height	3.6	0.00	0.00
Podium and Level1 Landscape	0.00	12.60(0.25x24+0.4x20=12.6		14.00	5.00
Fire Driveway	0.00	12.60(0.25x24+0.4x20=12.6)		14.00	25.00
Swimming Pool	0.00	7.2(0.3*24)		7.20	25.00
Pump Room	0.00	0.50	2.40	2.90	15.00
Badminton	0.00	0.50	2.40	2.90	5.00

Permissible reduction in imposed load on each floor is considered for design of columns and footings as per IS 875 Part (2).

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a) SUPER IMPOSED DEAD LOADS (kN/m^2)

Floor Finishes of 50 mm thickness have been considered on all the typical floors, Basement floors 100mm, toilet 100+40=140mm, balcony-150+30=180mm, Club House 100mm & Landscape 650mm

TERRACES (Load in kN/m2)

Waterproofing + Screed 3.60 (0.15(average floor finish.) x 24=3.60)

b) SELF-WEIGHT OF LIGHT WEIGHT WALLS (kN/m^2)

Infill walls (20mm for External wall & internal wall 15mm plastering on Either side)

(i) 200mm thick light weight block wall 2.60kN/m^2
(ii) 100mm thick light weight block wall 1.60kN/m^2

Water Tank Water height x 10

c) RETAINING WALL LOADING

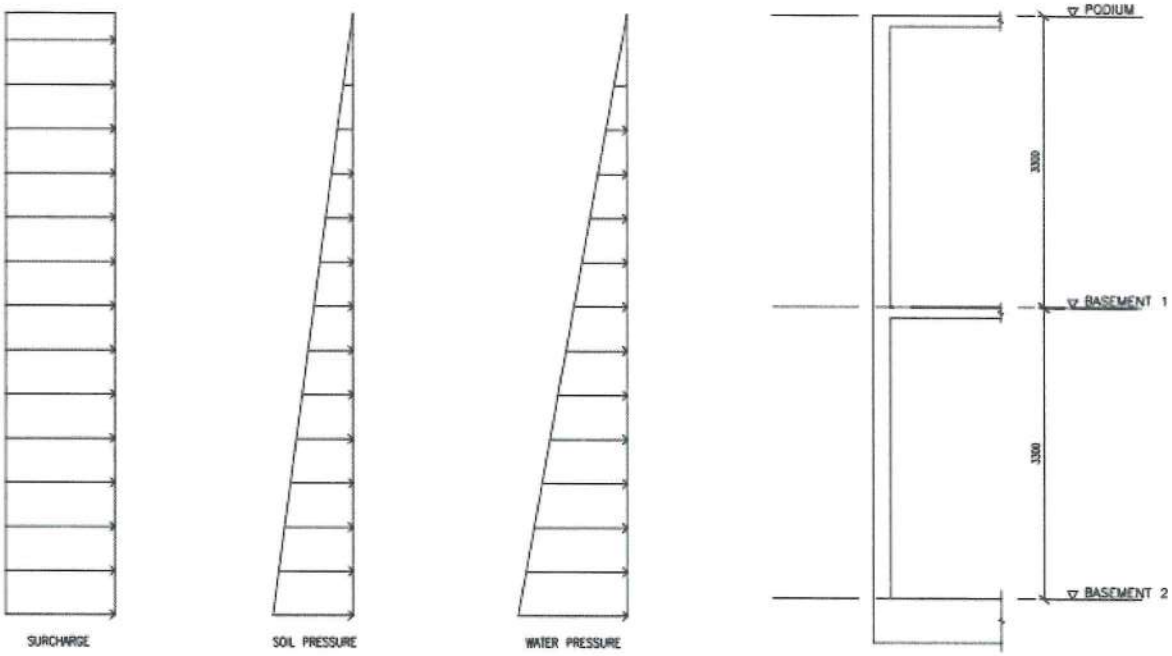
As per geo technical investigation report, the retaining wall has been designed considering soil pressure, water pressure and surcharge.

Coefficient of Active Earth Pressure ka = 0.33

Surcharge Considered for the retaining wall design = 15kN/m^2

Water table considered up to ground floor for the retaining wall design

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RETAINING WALL LOADING DIAGRAM
SCALE 1:50

5 kN/m^2	21.78 kN/m^2	66 kN/m^2

9.3 Seismic Design Parameters:

Design of lateral force under seismic condition shall be as per IS1893 – 2016. Total lateral force (base shear) of the building shall be estimated at ground floor level as per clause 7.2.1 of IS1893 – 2016 which provides by

Base shear Vb = Ah W

Ah is horizontal seismic coefficient, and W is seismic weight of the building, Horizontal seismic coefficient depends on location of the building (Zone factor Z), usage of the building (Importance factor, I), building lateral resisting system (Response reduction factor, R) and design acceleration coefficient (Sa /g) which is based on subsoil condition and fundamental natural period (Ta).

For the proposed development is for commercial use. Considering it, the seismic weight is summation of total dead load and 25% of live load where live load is equal and less than 3 kN/sq.m and 50% of live load greater that 3 kN/sq.m

1) The lateral load resisting system of the buildings is ductile shear wall with Gravity Columns. The Columns are detailed as per IS: 13920-2016,

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Clause- 11, Confirming to this all the RC Ductile Walls are designed for 100% Lateral Loads, also the Columns are independently designed in accordance with the deformation compatibility.

2) As per IS 1893:2016 code, Chennai lies in Zone III with Zone factor Z = 0.16

3) The Design Base Shear is given by V_b = Ah x W, Where Ah = Z / 2 x I/R x S_a /g

   I = Importance Factor = 1.2

   Soil Type 1 (Rock or Dense soil)

   R (Response reduction factor) = 4.0.

   Sa/g = Average Response acceleration coefficient

   For the building height with reference to IS: 1893-2016, since the buildings are well connected with basement walls so for the time period calculation the heights are considered ground floor to roof that is 65.55m.

   With reference to IS 1893 - 2016 clause 7.6.2 (b) the time period for building each direction are as follows,

The fundamental natural period (Ta) for building,

c) All other buildings:

$$T_a = \frac{0.09h}{\sqrt{d}}$$

where

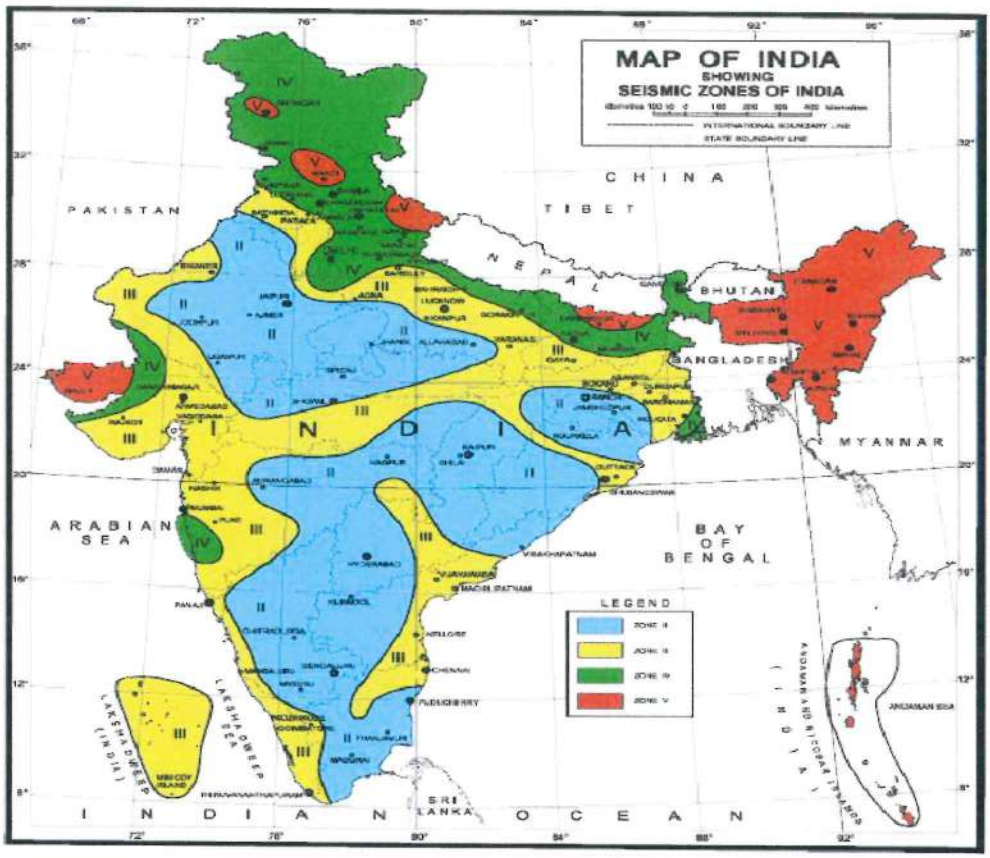
h = height of building, as defined in **7.6.2**(a), in m; and

d = base dimension of the building at the plinth level along the considered direction of earthquake shaking, in m.

Description	As Per IS 1893-2016				As Per Etabs Model			
	X-Direction		Y-Direction		X-Direction		Y-Direction	
	Time Period (Sec)	Frequency (Hz)	Time Period (Sec)	Frequency (Hz)	Time Period (Sec)	Frequency (Hz)	Time Period (Sec)	Frequency (Hz)

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Tower1								
Tower2								
Tower3								



SEISMIC ZONE CLASSIFICATION FROM IS 1893: 2016

Dynamic Analysis

Response spectrum method of Dynamic Analysis carried out with following parameters pertaining to dynamic analysis.

Number of modes Considered	: 12 Numbers (Min)
Modal Combination Method Used	: Complete Quadratic combination (CQC).
Directional Combination Method used	: Square root of the sum of Square (SRSS).
Modal case type	: Ritz vector Method

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Cut off frequency in case response spectrum method of analysis - 33 Hz.

Mass participation is 90% as per our analysis

Damping 5%is used for seismic analysis

Dynamic analysis of building is carried out. The members are designed accordingly.

9.4 Deformation Compatibility Procedure:

Clause 7.11.2 of IS:1893 (Part 1) specifies that structural elements not part of the seismic load-resisting system must retain their vertical load-carrying capacity under moments induced by 'R' times the storey displacement. To calculate this displacement, it is acceptable to use seismic forces derived from the computed fundamental time period of the structure.

The procedure we have adopted in ETABS for calculating induced moments and designing members not part of the lateral load-resisting system is as follows:

1. Define a new load case 'EQX_Displacement' with parameters:
    - R = 1
    - I = 1
    - Time period set to 'Program Calculated'

   All other parameters remain the same as those considered for EQX.
2. The analysis results for the load case 'P-delta-DL+LL+EQX_Displacement' will provide the induced moments due to the 'R' times displacement (EQX) multiplied by the axial forces resulting from DL and LL.
3. Members will be designed and checked using the following load combinations:
    - 1.2DL + 1.2LL ± 1.2('Pdelta-DL+LL+EQX')
    - 0.9DL ± 1.5('Pdelta-DL+LL+EQX')
4. This process is repeated for each lateral load case, considering loads applied in both the positive and negative directions.

9.5 Wind Loads

The wind pressure shall be calculated based on the basic wind speed and other provisions laid in IS 875 Part (3) - 2015

Design Wind Speed, VZ — Vbxk1x k2x k3x k4

Vb → Basic Wind velocity for Chennai — 50m/s

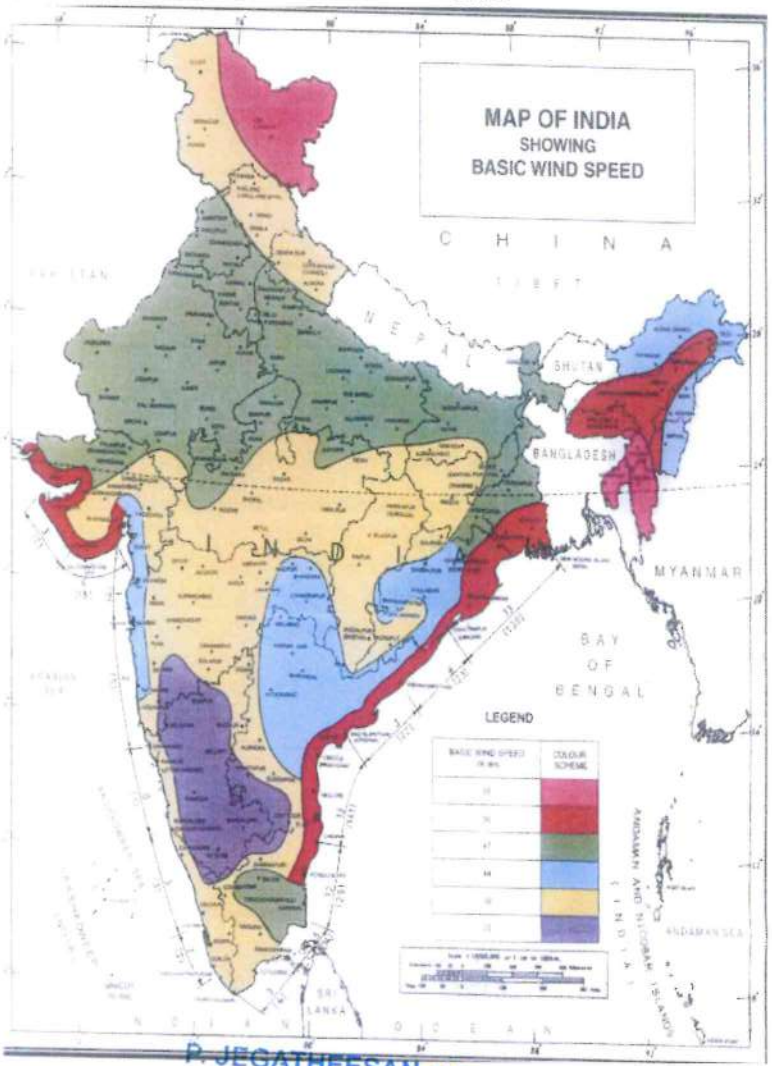
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K1	→	Risk coefficient for all general buildings	— 1.00
k2	→	Terrain category 2	— To suit the height of the structure for terrain (1.25)
k2		(H=116m -GF to Roof)	— Varies as per Height
k3	→	Topography factor	— 1.00
k4	→	Importance Factor for cyclonic Region	— 1.00

Based on the above,

Max. design wind speed (VZ)	(Vbxk1x k2x k3x k4)	= 62.5m/s
Max. design wind pressure (Pz)	— 0.6 x Vz2	= 2343.75 N/m2
Design wind pressure: pd	= Pz x Kax Kd x Kc	= 1708.60N/m2

Kd	→ Wind directionality factor	— 0.90
ka	→ Area averaging factor	— 0.90
Kc	→ Combination factor	— 0.90



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INDIAN WIND SPEED CLASSIFICATION FROM IS 875 PART (III)

9.6 Temperature Loads:

The building is completely covered with block work on the sides. So, there will be no appreciable differential temperature during the service life of building. The roof slab and the podium of building is to be analysed for ± 15°C difference in temperature is applied to Etabs model and necessary load combinations are considered in analysis & Design of the building. The roof slab is assigning as semi rigid diaphragm for ultimate load combination.

10.0 LOAD COMBINATION

The various loads combinations used for design in accordance with IS 1893-2016 are as follows:

1. 1.5 (DL + LL)
2. 1.2 (DL + LL + SPECX + 30%SPECY)
3. 1.2 (DL + LL + SPECY + 30%SPECX)
4. 1.2 (DL + LL ± WindX)
5. 1.2 (DL + LL ± WindY)
6. 1.5 (DL + SPECX + 30%SPECY)
7. 1.5 (DL + SPECY + 30%SPECX)
8. 1.5 (DL ± WindX)
9. 1.5 (DL ± WindY)
10. 0.9DL + 1.5SPECX + 30%SPECY
11. 0.9DL + 1.5SPECY + 30%SPECX
12. 0.9DL ± 1.5WindX
13. 0.9DL ± 1.5WindY

Where accidental / fire tender load case is applicable, the following load combination is considered

1.50 DL + 1.05 AL + 1.50 LL

For design of Stitch slab the load combination is considered as

14. 0.9DL+1.2Water Pressure (Uplift)

Load Combination for foundation sizing

15. DL+LL
16. DL+LL+SPECX
17. DL+LL+SPECY
18. DL+SPECX
19. DL+SPECY
20. DL+LL±WX
21. DL+LL±WY

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22. DL±WX
23. DL±WY

The various service loads combinations of structure as per IS 456 are as follows
24. 1.0DL +1.0 LL
25. 1.0DL + 1.0SPECX
26. 1.0DL + 1.0SPECY
27. 1.0DL ± 1.0WindX
28. 1.0DL ± 1.0WindY
29. 1.0DL ± 1.0TEMP
30. 1.0DL + 0.8LL + 0.8SPECX
31. 1.0DL + 0.8LL + 0.8SPECY
32. 1.0DL + 0.8LL ± 0.8WindX
33. 1.0DL + 0.8LL ± 0.8WindY

Where,
DL - Dead load,
LL - Live load
Wind X- Wind load in x - direction
Wind Y- Wind load in y-direction
SPECX- Earthquake load in x-direction
SPECY - Earthquake load in y-direction
TEMP - Temperature load
AL -Accidental Load (such as fire tender load)

11.0 SERVICIBILITY LIMITS

11.1 Lateral Deflection (Wind)

Overall Deflection < Height/500
Storey Deflection < Storey height/500

11.2 Lateral Deflection (Seismic)

Overall Drift < H / 250
Storey Drift < 0.004 times storey height

11.3 Vertical Deflection of Beams and Slabs due to Gravity Loads

Total Deflection (DL + LL) < Span/250
Deflection including the effects of Temperature, Creep and Shrinkage Occurring after erection of partitions and the application of finishes < Span/350 or 20mm whichever is less.

12.0 STRUCTURAL ANALYSIS AND DESIGN APPROACH

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The structural analysis and design of the building were conducted using ETABS software, utilizing a comprehensive response spectral analysis in line with IS 1893-2016 guidelines. In this analysis, all walls were represented as shell elements to accurately capture their behaviour under load. The floor slabs were modelled as shell /membrane elements, which allows for a more precise simulation of their structural performance. Beams and columns were modelled as line elements, enabling effective representation of their load-carrying capabilities. Additionally, spandrel beams were also modelled as shell elements to account for their interaction with adjacent walls and slabs.

To ensure accurate transfer of lateral loads, floor diaphragms were assigned based on the stiffness of the vertical elements, allowing the overall system to respond effectively under lateral forces. Property modifiers were applied to all structural components in accordance with IS 16700-2023 standards, improving the precision of the modelling process.

A P-Delta analysis was conducted to capture the secondary order effects on vertical elements, which is crucial for understanding how these elements respond to both vertical and lateral loads. Furthermore, a dynamic wind load analysis was performed based on IS 875-Part 3, providing a thorough assessment of the wind forces acting on the structure.

As part of the design process, a wind tunnel study has been recommended to the client to obtain more precise data on wind loads. The forces resulting from this study will be integrated into the design once it is completed, ensuring that the structure can withstand real-world wind conditions effectively.

For the foundation design, the pile foundation system was modelled using SAFE software. This modelling process included the consideration of uplift water pressure loads, which were critical for designing the stitched raft slabs, ensuring their stability and performance under potential uplift conditions.

The overall structure has undergone a detailed review based on several critical criteria outlined in IS 1893-2016, including:

1. Modal Participation Mass Ratios: This analysis assesses the distribution of mass participating in various modes of vibration, ensuring that the structure responds adequately to seismic forces.

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2. Building Displacements and Drifts: Evaluations were conducted to determine the lateral displacements and drifts of the building under seismic and wind loads, which is essential for ensuring serviceability and structural integrity.

3. Soft Story Effects: The design review considered potential soft story effects, which can occur when the stiffness of one or more stories is significantly less than that of others, potentially leading to structural vulnerabilities.

4. Torsional Irregularities: The assessment also included the evaluation of torsional irregularities, ensuring that the structure maintains stability and performance during lateral loading conditions.

5. Mass Irregularity: The analysis examined mass irregularity within the structure, which occurs when there is an uneven distribution of mass across the floors.

This comprehensive approach to structural analysis and design ensures that the building will perform safely and effectively under expected loads and conditions. Please refer annexures for the detailed workings for all the 3 towers.

Assumptions for 3D model analysis using ETABS

Column: Frame Element

RC Wall: Wall (Shell) Element

Beam Element: Frame Element

Slab: Shell Element

The following are general parameters adopted in the analysis and design,

Modulus of Elasticity of Concrete -5000$\sqrt{}$fck

Consideration of Diaphragm - Rigid Diaphragm.

Slab/Wall element considered as Shell element

Stiffness modification factors are adopted in the analysis as per IS -16700-2023, Table.6.

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Table 6 Cracked RC Section Properties

(Clause 7.2)

Sl No.	Structural Element	Un-factored Loads		Factored Loads	
		Area	Moment of Inertia	Area	Moment of Inertia
(1)	(2)	(3)	(4)	(5)	(6)
i)	Slabs	$1.0\ A_g$	$0.35\ I_g$	$1.00\ A_g$	$0.25\ I_g$
ii)	Beams	$1.0\ A_g$	$0.7\ I_g$	$1.00\ A_g$	$0.35\ I_g$
iii)	Columns	$1.0\ A_g$	$0.9\ I_g$	$1.00\ A_g$	$0.70\ I_g$
iv)	Walls	$1.0\ A_g$	$0.9\ I_g$	$1.00\ A_g$	$0.70\ I_g$

The following parameters and methods are adopted in creating ETABS 3D model for the buildings and design of structural elements.

- ✓ The 3D ETABS model generated based on the preliminary floor plans (shuttering drawings) prepared using preliminary sizes.
- ✓ Sectional properties are assigned to all the structural elements as per the preliminary floor plans (shuttering drawings).
- ✓ External & Internal in fill wall loads are assigned as uniformly distributed line load on beams and as area load if the wall is intending to distribute on slab directly.
- ✓ Slabs are modelled as shell element if floor system and slabs are assigned with horizontal diaphragms.
- ✓ Live Load reduction is considered in the design of Foundation and Column as per the Code: IS 875-1987 (Part-II), clause.3.2.1.
- ✓ Area design load i.e. Live load/SDL or any other load is applied at floor relevant to its usage.
- ✓ All lateral loads & parameters are assigned as per Codes IS 1893-2016 & IS 875-Part-3, 2015.
- ✓ Temperature loads are applied on to the terraces and to areas directly exposed to atmosphere.
- ✓ Beams under Torsion is required to maintain Equilibrium will be designed for Torsion in accordance with IS 456-2000, clause 41.1 to 41.4 and for all other beams torsional stiffness is neglected in the analysis by applying stiffness modifier as 0.000001 to torsional constant "J". Hence no specific design for Torsion is required for these beams.

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- ✓ Concrete cover to reinforcement complied accordance with IS 456-2000, Table.16 & 16A.
- ✓ All vertical wall elements are assigned with auto meshing/manual messing appropriately to achieve accuracy in results.

Design approach of structural elements

Shear wall/Column:

RC Structural Walls & Columns which are supporting both vertical loads and lateral forces are designed for the most adverse load conditions and envelope of the forces which will be the maximum for that structural element from the load combinations considered in the 3D Etabs Model.

RCDC a design software will be used to design the element for the maximum forces obtained from the Etabs model analysis results.

Beams: Each Beam will be designed for maximum forces from the 3D analysis using Etabs and RCDC Softwares.

Area Load & Application: Applied as uniformly distributed area load with intensity proportionate to its usage as mentioned in the Loading items in the DBR.

Line (Wall) Load & Application: Non load bearing or infill wall loads are calculated aappropriately and Applied as uniformly distributed line load.

13.0 COMPUTER PROGRAMS

The following Software / spreadsheet to be used to carry out Structural analysis and design.

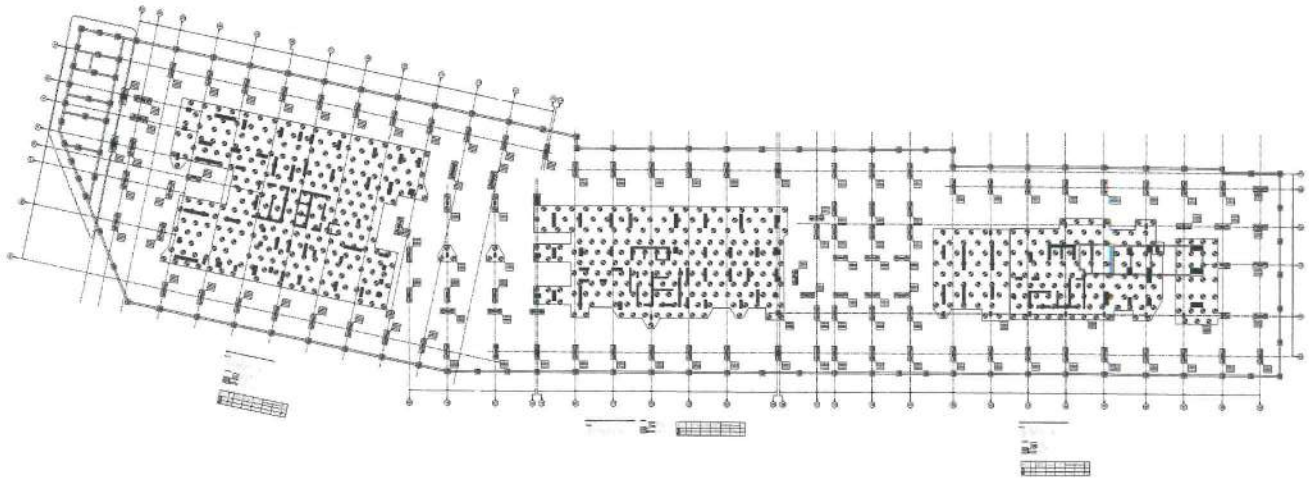
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1.	PROKON Ver 2.3	- Wall & Beam design
2.	ETABS Ver 19.1	- Three-Dimensional Program
3.	SAFE Ver 20.0	- Raft Analysis / Strip Analysis
4.	In-House Spreadsheet	- one way/ two-way slab design
5.	Rapt-6	- Post Tensioning Analysis & Design
6.	RCDC	- Beam Design, Isolated footing design, Column design and Wall design
STAAD PRO & ETABS		- Structural Steel Design.

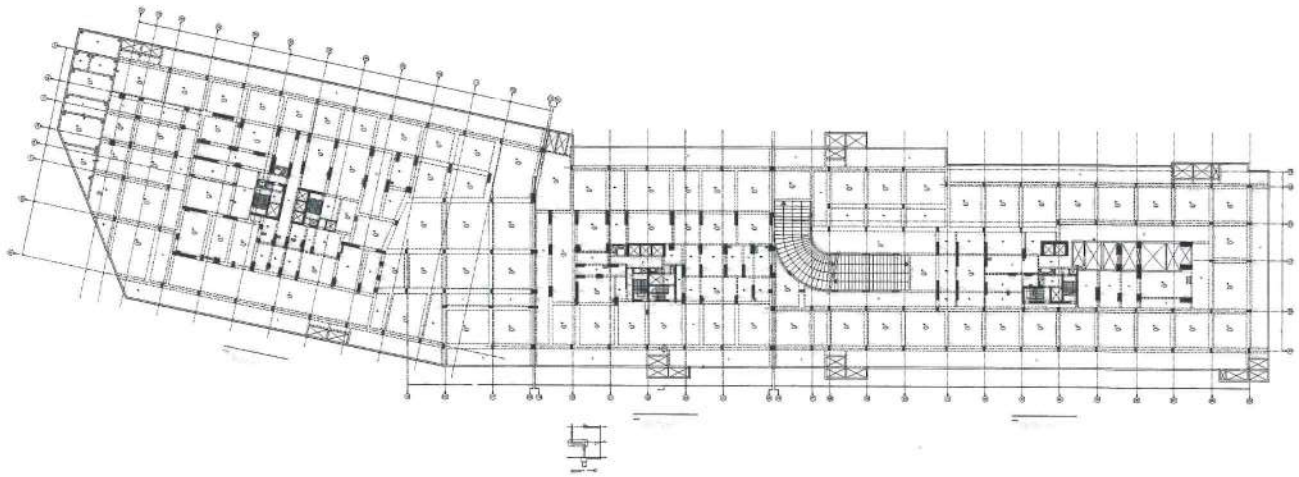
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DRAWING DETAILS:

PILE LAYOUT:

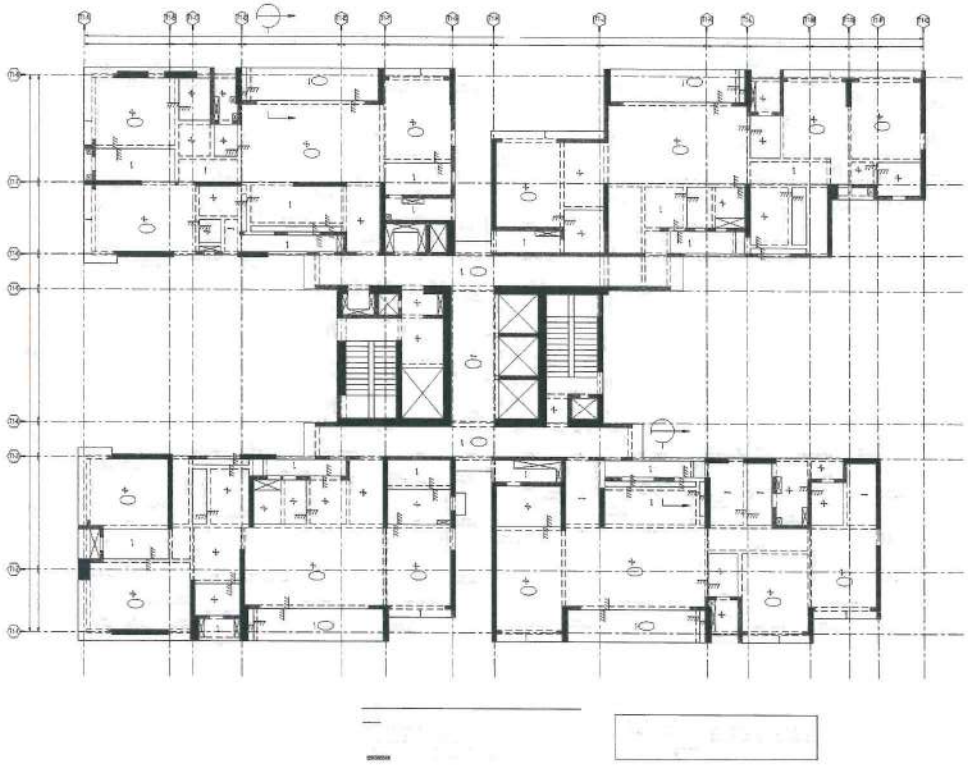


BASEMENT-1:

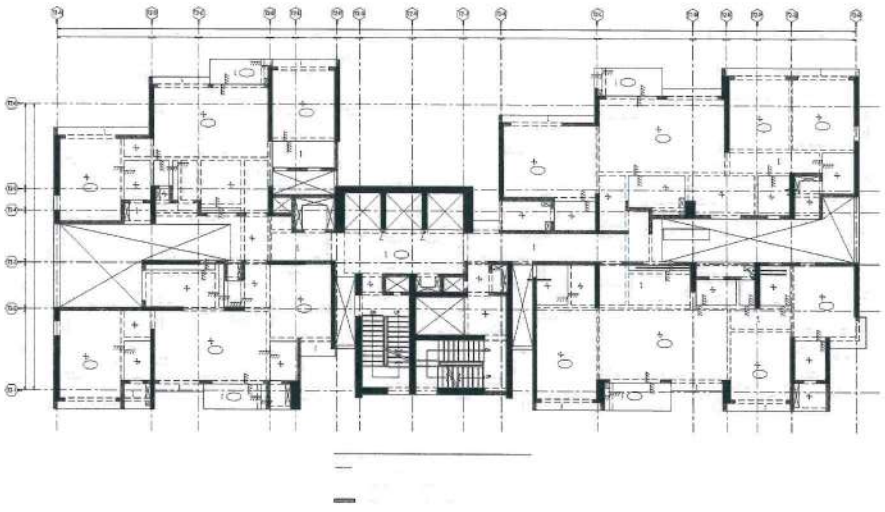


TYPICAL FLOOR (T1):

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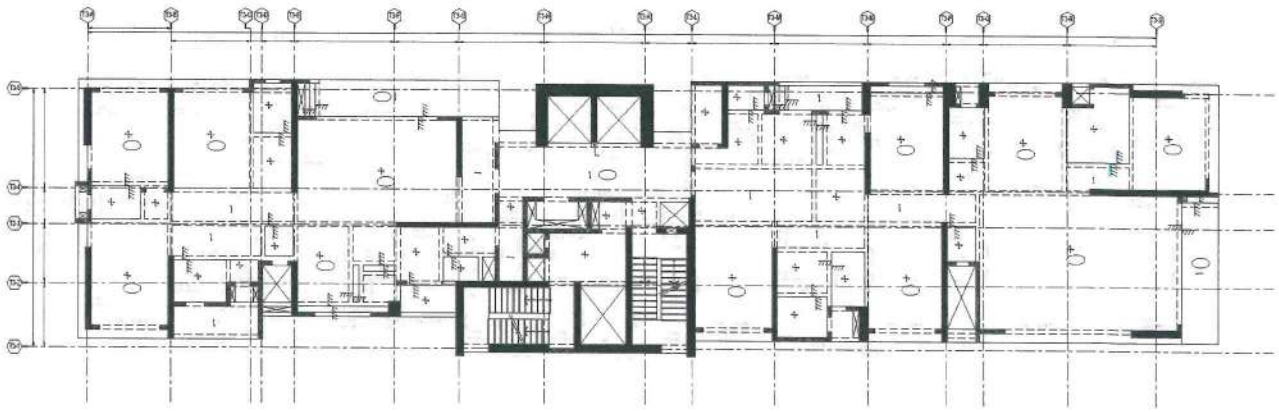


TYPICAL FLOOR (T2):



TYPICAL FLOOR (T3):

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ETABS®



CLUSTER1 REPORT

Model File: CLUSTER1-MODEL1-29-06-2024, Revision 0
23-05-2025

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1 Structure Data

This chapter provides model geometry information, including items such as story levels, point coordinates, and element connectivity.

1.1 Story Data

Table 1.1 - Story Definitions

Tower	Name	Height m	Master Story	Similar To	Splice Story	Color
T1	UPPER ROOF	3.3	No	5TH	No	Green
T1	ROOF	3.3	Yes	None	No	Red
T1	34TH	3.3	No	5TH	No	Yellow
T1	33RD	3.3	No	5TH	No	Blue
T1	32ND	3.3	No	5TH	No	Cyan
T1	31ST	3.3	No	5TH	No	Magenta
T1	30TH	3.3	No	5TH	No	Gray8Dark
T1	29TH	3.3	No	5TH	No	Green
T1	28TH	3.3	No	5TH	No	Red
T1	27TH	3.3	No	5TH	No	Yellow
T1	26TH-R	3.3	No	5TH	No	Blue
T1	25TH	3.3	No	5TH	No	Cyan
T1	24TH	3.3	No	5TH	No	Magenta
T1	23RD	3.3	No	5TH	No	Gray8Dark
T1	22ND	3.3	No	5TH	No	Green
T1	21ST	3.3	No	5TH	No	Red
T1	20TH	3.3	No	5TH	No	Yellow
T1	19TH	3.3	No	5TH	No	Blue
T1	18TH	3.3	No	5TH	No	Cyan
T1	17TH-R	3.3	No	5TH	No	Magenta
T1	16TH	3.3	No	5TH	No	Gray8Dark
T1	15TH	3.3	No	5TH	No	Green
T1	14TH	3.3	No	5TH	No	Red
T1	13TH	3.3	No	5TH	No	Yellow
T1	12TH	3.3	No	5TH	No	Blue
T1	11TH	3.3	No	5TH	No	Cyan
T1	10TH	3.3	No	5TH	No	Magenta
T1	9TH	3.3	No	5TH	No	Gray8Dark
T1	8TH	3.3	No	5TH	No	Green
T1	7TH	3.3	No	5TH	No	Red
T1	6TH	3.3	No	5TH	No	Yellow
T1	5TH	3.3	Yes	None	No	Blue
T1	4TH	3.3	No	None	No	Cyan
T1	3RD	3.3	No	None	No	Magenta
T1	2ND	3.3	No	None	No	Gray8Dark
T1	1ST	6	No	None	No	Green
T1	GROUND	3.95	No	None	No	Red
T1	BASEMENT1	4.5	No	None	No	Yellow

2 Properties

This chapter provides property information for materials, frame sections, shell sections, and links.

2.1 Materials

Table 2.1 - Material Properties - General

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Material	Type	SymType	Grade	Color	Notes
A416Gr270	Tendon	Uniaxial	Grade 270	Cyan	
HYSD415	Rebar	Uniaxial	HYSD Grade 415	Blue	
HYSD550	Rebar	Uniaxial	HYSD Grade 550	Red	
M30	Concrete	Isotropic	M30	Magenta	
M40	Concrete	Isotropic	M40	Gray8Dark	
M50	Concrete	Isotropic	M50	Green	
M60	Concrete	Isotropic	M60	12615935	

Loads

This chapter provides loading information as applied to the model.

3.1 Load Patterns

Table 3.1 - Load Pattern Definitions

Name	Is Auto Load	Type	Self Weight Multiplier	Auto Load
~LLRF	Yes	Other	0	
~SPECX-SECC	Yes	Other	0	
~SPECX-WALLECC	Yes	Other	0	
~SPECXECC	Yes	Other	0	
~SPECY-SECC	Yes	Other	0	
~SPECY-WALLECC	Yes	Other	0	
~SPECYECC	Yes	Other	0	
DEAD	No	Dead	1	
DI	No	Super Dead	0	
EQX	No	Seismic	0	IS 1893:2016
EQY	No	Seismic	0	IS 1893:2016
LL1	No	Live	0	
LL2	No	Live	0	
LL3	No	Live	0	
WIND-CASE1	No	Wind	0	User Loads
WIND-CASE10	No	Wind	0	User Loads
WIND-CASE11	No	Wind	0	User Loads
WIND-CASE12	No	Wind	0	User Loads
WIND-CASE13	No	Wind	0	User Loads
WIND-CASE14	No	Wind	0	User Loads
WIND-CASE15	No	Wind	0	User Loads
WIND-CASE16	No	Wind	0	User Loads
WIND-CASE17	No	Wind	0	User Loads
WIND-CASE18	No	Wind	0	User Loads
WIND-CASE19	No	Wind	0	User Loads
WIND-CASE2	No	Wind	0	User Loads
WIND-CASE20	No	Wind	0	User Loads
WIND-CASE21	No	Wind	0	User Loads
WIND-CASE22	No	Wind	0	User Loads
WIND-CASE23	No	Wind	0	User Loads
WIND-CASE24	No	Wind	0	User Loads
WIND-CASE3	No	Wind	0	User Loads
WIND-CASE4	No	Wind	0	User Loads
WIND-CASE5	No	Wind	0	User Loads
WIND-CASE6	No	Wind	0	User Loads
WIND-CASE7	No	Wind	0	User Loads
WIND-CASE8	No	Wind	0	User Loads
WIND-CASE9	No	Wind	0	User Loads

3.2 Load Sets

Table 3.2 - Shell Uniform Load Sets

Name	Load Pattern	Load Value kN/m2
BALCONY	DI	4.36
BALCONY	LL1	3
BEDROOM	DI	1.2
BEDROOM	LL1	2
CHAJJA	DI	1.2
CHAJJA	LL1	1.5
CLUB HOUSE	DI	2.9
CLUB HOUSE	LL2	5
CORRIDOR	DI	1.8
CORRIDOR	LL1	3
FIRE VEHICLE	DI	10.1
FIRE VEHICLE	LL2	7.5
GYM	DI	12.9
KITCHEN	DI	1.2
KITCHEN	LL1	2
LANDSCAPE	DI	26.4
LANDSCAPE	LL2	5
LANDSCAPE-1	DI	23.2
LANDSCAPE-1	LL2	5
LIVING	DI	1.2
LIVING	LL1	2
LMR	DI	15
LOBBY	DI	1.8
LOBBY	LL1	3
MULTIPURPOSE HALL	DI	2.9
MULTIPURPOSE HALL	LL2	7.5
ODU	DI	1.2
ODU	LL1	3
PARKING	DI	2.9
PARKING	LL1	3
PLANT ROOM	DI	17.9
REFUGE BALCONY	DI	4.36
REFUGE BALCONY	LL2	5
ROOF	DI	3.6
ROOF	LL3	5
STAIRCASE	DI	3
STAIRCASE	LL1	3
SWIMMING POOL	DI	24.7
SWIMMING POOL	LL1	3
TOILET	DI	3.36
TOILET	LL1	2
UTILITY	DI	1.2
UTILITY	LL1	3
WATER TANK	DI	30

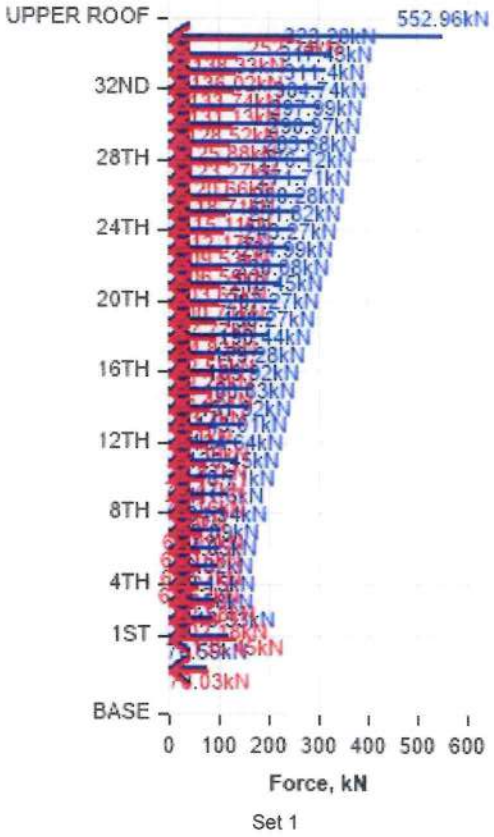
3.3 Auto Wind Loading
User Loads Auto Wind Load Calculation

This calculation presents the user defined lateral wind loads for load pattern WIND-CASE1.

Lateral Forces

Story	Elevation	X-Dir	Y-Dir
	m	kN	kN
UPPER ROOF	129.95	0	0
ROOF	126.65	552.96	252.24
34TH	123.35	323.28	138.33
33RD	120.05	317.43	136.02
32ND	116.75	311.4	133.74
31ST	113.45	304.74	131.13
30TH	110.15	297.99	128.52
29TH	106.85	290.97	125.88
28TH	103.55	283.68	123.27
27TH	100.25	276.12	120.66
26TH-R	96.95	271.71	118.71
25TH	93.65	260.28	115.11
24TH	90.35	251.82	112.17
23RD	87.05	243.27	109.53
22ND	83.75	234.99	106.59
21ST	80.45	226.08	103.65
20TH	77.15	216.45	100.71
19TH	73.85	207.27	97.77
18TH	70.55	198.27	94.83
17TH-R	67.25	190.44	92.55
16TH	63.95	179.28	89.28
15TH	60.65	169.92	86.46
14TH	57.35	160.83	83.7
13TH	54.05	151.92	81
12TH	50.75	143.01	78.39
11TH	47.45	134.64	75.87
10TH	44.15	126.45	73.47
9TH	40.85	118.71	71.16
8TH	37.55	111.6	69
7TH	34.25	104.94	66.99
6TH	30.95	99.09	65.16
5TH	27.65	94.05	63.57
4TH	24.35	89.82	61.62
3RD	21.05	93.15	92.58
2ND	17.75	86.58	102.18
1ST	14.45	118.53	135.45
GROUND	8.45	76.59	78.03
BASEMENT1	4.5	0	0
BASE	0	0	0

Lateral Load to Stories - Set



User Loads Auto Wind Load Calculation

This calculation presents the user defined lateral wind loads for load pattern WIND-CASE2.

Lateral Forces

Story	Elevation	X-Dir	Y-Dir
	m	kN	kN
UPPER ROOF	129.95	0	0
ROOF	126.65	552.96	252.24
34TH	123.35	323.28	138.33
33RD	120.05	317.43	136.02
32ND	116.75	311.4	133.74
31ST	113.45	304.74	131.13
30TH	110.15	297.99	128.52
29TH	106.85	290.97	125.88
28TH	103.55	283.68	123.27
27TH	100.25	276.12	120.66
26TH-R	96.95	271.71	118.71
25TH	93.65	260.28	115.11
24TH	90.35	251.82	112.17
23RD	87.05	243.27	109.53
22ND	83.75	234.99	106.59
21ST	80.45	226.08	103.65
20TH	77.15	216.45	100.71
19TH	73.85	207.27	97.77
18TH	70.55	198.27	94.83
17TH-R	67.25	190.44	92.55
16TH	63.95	179.28	89.28
15TH	60.65	169.92	86.46
14TH	57.35	160.83	83.7
13TH	54.05	151.92	81
12TH	50.75	143.01	78.39
11TH	47.45	134.64	75.87
10TH	44.15	126.45	73.47
9TH	40.85	118.71	71.16
8TH	37.55	111.6	69
7TH	34.25	104.94	66.99
6TH	30.95	99.09	65.16
5TH	27.65	94.05	63.57
4TH	24.35	89.82	61.62
3RD	21.05	93.15	92.58
2ND	17.75	86.58	102.18
1ST	14.45	118.53	135.45
GROUND	8.45	76.59	78.03
BASEMENT1	4.5	0	0
BASE	0	0	0

3.4 Auto Seismic Loading

IS 1893:2016 Auto Seismic Load Calculation

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

Direction and Eccentricity

Direction = X

Structural Period

Period Calculation Method = User Specified

User Period T=2.53 sec

Factors and Coefficients

Seismic Zone Factor, Z [IS Table 3] Z=0.16

Response Reduction Factor, R [IS Table 9]

Importance Factor, I [IS Table 8]

Site Type [IS Table 1] = I

Seismic Response

Spectral Acceleration Coefficient, S_a/g [IS 6.4.2] <Sa>/<g>=<1>/<T> <Sa>/<g>=0.395257

Equivalent Lateral Forces

Seismic Coefficient, A_h [IS 6.4.2] Ah=<Z<I><<Sa>/<g>>>/<2<R>>

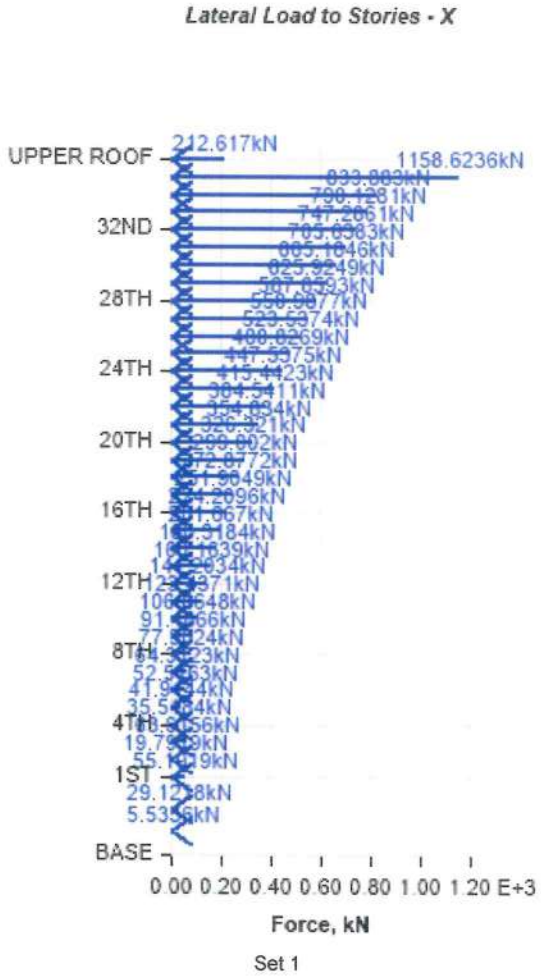
Calculated Base Shear

Direction	Period Used (sec)	W (kN)	V_b (kN)
X	2.53	1119011.6645	12309.1283

Applied Story Forces

Story	Elevation	X-Dir	Y-Dir
	m	kN	kN
UPPER ROOF	129.95	212.617	0
ROOF	126.65	1158.6236	0
34TH	123.35	833.883	0
33RD	120.05	790.1281	0
32ND	116.75	747.2861	0

Story	Elevation	X-Dir	Y-Dir
	m	kN	kN
31ST	113.45	705.6383	0
30TH	110.15	665.1846	0
29TH	106.85	625.9249	0
28TH	103.55	587.8593	0
27TH	100.25	550.9877	0
26TH-R	96.95	523.5374	0
25TH	93.65	480.8269	0
24TH	90.35	447.5375	0
23RD	87.05	415.4423	0
22ND	83.75	384.5411	0
21ST	80.45	354.834	0
20TH	77.15	326.321	0
19TH	73.85	299.002	0
18TH	70.55	272.8772	0
17TH-R	67.25	251.9049	0
16TH	63.95	224.2096	0
15TH	60.65	201.667	0
14TH	57.35	180.3184	0
13TH	54.05	160.1639	0
12TH	50.75	141.2034	0
11TH	47.45	123.4371	0
10TH	44.15	106.8648	0
9TH	40.85	91.4866	0
8TH	37.55	77.3024	0
7TH	34.25	64.3123	0
6TH	30.95	52.5163	0
5TH	27.65	41.9144	0
4TH	24.35	35.5184	0
3RD	21.05	63.6156	0
2ND	17.75	19.7919	0
1ST	14.45	55.1919	0
GROUND	8.45	29.1218	0
BASEMENT1	4.5	5.5356	0
BASE	0	0	0



IS 1893:2016 Auto Seismic Load Calculation

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

Direction and Eccentricity

Direction = Y

Structural Period

Period Calculation Method = User Specified

User Period	T=2.53 sec

Factors and Coefficients

Seismic Zone Factor, Z [IS Table 3]	
Response Reduction Factor, R [IS Table 9]	Z=0.16

Importance Factor, I [IS Table 8]

Site Type [IS Table 1] = I

Seismic Response

Spectral Acceleration Coefficient, S_a/g [IS 6.4.2] <Sa>/<g>=<1>/<T> <Sa>/<g>=0.395257

Equivalent Lateral Forces

Seismic Coefficient, A_h [IS 6.4.2] Ah=<Z<I><<Sa>/<g>>>/<2<R>>

Calculated Base Shear

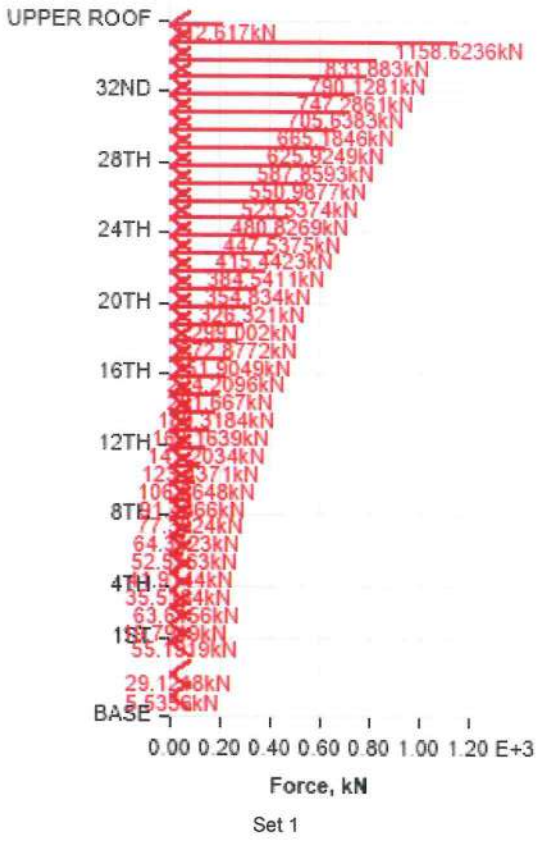
Direction	Period Used (sec)	W (kN)	V_b (kN)
Y	2.53	1119011.6645	12309.1283

Applied Story Forces

Story	Elevation	X-Dir	Y-Dir
	m	kN	kN
UPPER ROOF	129.95	0	212.617
ROOF	126.65	0	1158.6236
34TH	123.35	0	833.883
33RD	120.05	0	790.1281
32ND	116.75	0	747.2861
31ST	113.45	0	705.6383
30TH	110.15	0	665.1846
29TH	106.85	0	625.9249
28TH	103.55	0	587.8593
27TH	100.25	0	550.9877
26TH-R	96.95	0	523.5374
25TH	93.65	0	480.8269
24TH	90.35	0	447.5375
23RD	87.05	0	415.4423
22ND	83.75	0	384.5411
21ST	80.45	0	354.834
20TH	77.15	0	326.321
19TH	73.85	0	299.002
18TH	70.55	0	272.8772
17TH-R	67.25	0	251.9049
16TH	63.95	0	224.2096
15TH	60.65	0	201.667
14TH	57.35	0	180.3184
13TH	54.05	0	160.1639
12TH	50.75	0	141.2034

Story	Elevation	X-Dir	Y-Dir
	m	kN	kN
11TH	47.45	0	123.4371
10TH	44.15	0	106.8648
9TH	40.85	0	91.4866
8TH	37.55	0	77.3024
7TH	34.25	0	64.3123
6TH	30.95	0	52.5163
5TH	27.65	0	41.9144
4TH	24.35	0	35.5184
3RD	21.05	0	63.6156
2ND	17.75	0	19.7919
1ST	14.45	0	55.1919
GROUND	8.45	0	29.1218
BASEMENT1	4.5	0	5.5356
BASE	0	0	0

Lateral Load to Stories - Y



4 Analysis Results

This chapter provides analysis results.

4.1 Structure Results

Table 4.1 - Base Reactions (Part 1 of 2)

Output Case	Case Type	Step Type	FX kN	FY kN	FZ kN	MX kN-m	MY kN-m
DEAD	LinStatic		0.0163	0.0011	568985.1799	8663947.7797	-12645835
LL1	LinStatic		0.0035	0.0002	90046.3932	1347781.7997	-2020102
DI	LinStatic		0.0056	-0.0004	515342.8928	8409686.4548	-11880457
EQX	LinStatic		-12308.6214	0.0089	-0.0001	-4534.0678	-1364856
EQY	LinStatic		-0.0129	-12309.1543	1.512E-05	1312869.3266	4679.5508
SPECX	LinRespSpec	Max	12435.5305	6049.3939	2.005E-05	50497.5394	344323.6831
SPECY	LinRespSpec	Max	5639.1282	12433.3688	9.657E-06	336353.7652	55045.6435
LL2	LinStatic		-0.0001	0.0003	47672.7432	760323.8044	-1247234
LL3	LinStatic		0.0002	0.0001	6055.5056	92556.0578	-135074.8363
SPECX-S	LinRespSpec	Max	6353.7789	3090.8622	1.024E-05	25801.0865	175927.8818
SPECY-S	LinRespSpec	Max	2860.3851	6306.6881	4.899E-06	170611.7082	27921.2907
SPECX-WALL	LinRespSpec	Max	30959.2894	15060.4702	4.992E-05	125717.8325	857222.5027
SPECY-WALL	LinRespSpec	Max	13937.4523	30729.8361	2.387E-05	831319.0266	136048.6949
WIND-CASE4	LinStatic		-7317.9927	6811.5751	-3.113E-05	-575448.1438	-707244.874
WIND-CASE5	LinStatic		8131.1093	-3715.3535	3.047E-05	315148.2117	784013.0073
WIND-CASE6	LinStatic		8131.1179	-3715.2968	2.655E-05	318524.95	782111.4748
WIND-CASE7	LinStatic		8131.1198	7430.6375	2.196E-05	-625740.2501	780417.4894
WIND-CASE8	LinStatic		8131.1285	7430.6942	1.804E-05	-622363.5118	778515.9569
WIND-CASE9	LinStatic		-2439.3477	-9907.57	1.303E-06	834141.7234	-230664.0118
WIND-CASE10	LinStatic		-2439.3411	-9907.5266	-1.695E-06	836723.9351	-232118.1249
WIND-CASE11	LinStatic		-2439.3261	12384.4154	-1.595E-05	-1047437	-237966.9024
WIND-CASE12	LinStatic		-2439.3164	12384.4788	-2.033E-05	-1043663	-240092.1446
WIND-CASE13	LinStatic		3659.0792	-9907.5723	2.099E-05	836174.6307	355949.8785
WIND-CASE14	LinStatic		3659.0858	-9907.5289	1.799E-05	838756.8423	354495.7655
WIND-CASE15	LinStatic		2845.9892	12384.4133	1.117E-06	-1045675	270432.6507
WIND-CASE16	LinStatic		2845.9989	12384.4767	-3.265E-06	-1041901	268307.4086
WIND-CASE17	LinStatic		-3252.459	-3715.3891	-3.513E-06	308969.9116	-309645.4556
WIND-CASE18	LinStatic		-2439.3281	-3715.2627	-9.651E-06	316788.9662	-235681.6027
WIND-CASE19	LinStatic		-3252.452	3715.2715	-9.185E-06	-318289.063	-312042.4676
WIND-CASE20	LinStatic		-2439.3164	8669.1718	-1.911E-05	-728642.658	-239676.6225
WIND-CASE21	LinStatic		2439.3221	-3715.3913	1.486E-05	310867.2717	237854.9049
WIND-CASE22	LinStatic		2845.9872	-3715.2647	7.412E-06	318550.8221	272717.9504
WIND-CASE23	LinStatic		2439.3291	3715.2693	9.19E-06	-316391.7029	235457.893
WIND-CASE1	LinStatic		-7318.0108	-3715.3475	-1.941E-05	309998.2343	-702059.3999
WIND-CASE2	LinStatic		-7318.0027	-3715.2941	-2.31E-05	313176.3409	-703849.0775
WIND-CASE3	LinStatic		-7318.0009	6811.5217	-2.744E-05	-578626.2505	-705455.1964
WIND-CASE24	LinStatic		2845.9989	8669.1698	-2.043E-06	-726880.8022	268722.9306
COMB01	Combination		0.0382	0.002	1842154.0721	28911444	-41893054
COMB02	Combination	Max	14922.6668	7259.2742	1466456.6509	23078685	-32939165
COMB02	Combination	Min	-14922.6063	-7259.2711	1466456.6509	22957491	-33765541
COMB03	Combination	Max	6766.9841	14920.0441	1466456.6509	23421712	-33286298
COMB03	Combination	Min	-6766.9236	-14920.0411	1466456.6509	22614463	-33418408
COMB04	Combination	Max	18653.3154	9074.0914	975895.2654	15442017	-21557177
COMB04	Combination	Min	-18653.276	-9074.0902	975895.2654	15290525	-22590149
COMB05	Combination	Max	8458.712	18650.0539	975895.2654	15870801	-21991095
COMB05	Combination	Min	-8458.6726	-18650.0526	975895.2654	14861740	-22156231
COMB06	Combination	Max	18653.3285	9074.0918	1626492.109	25686198	-36272953

Output Case	Case Type	Step Type	FX kN	FY kN	FZ kN	MX kN-m	MY kN-m
COMB06	Combination	Min	-18653.2629	-9074.0898	1626492.1089	25534705	-37305924
COMB07	Combination	Max	8458.7251	18650.0543	1626492.109	26114982	-36706870
COMB07	Combination	Min	-8458.6595	-18650.0522	1626492.109	25105921	-36872007
SEISMIC WEIGHT	Combination		0.0227	0.0009	1130676.0426	17790742	-25654934
COMB101	Combination		0.0254	0.0013	1228102.7147	19274296	-27928702
COMB102	Combination	Max	12435.5524	6049.3946	1084328.0727	17124132	-24181969
COMB102	Combination	Min	-12435.5086	-6049.3932	1084328.0726	17023137	-24870616
COMB103	Combination	Max	12435.555	6049.395	1194503.3818	18810616	-26795837
COMB103	Combination	Min	-12435.5059	-6049.3927	1194503.3818	18709621	-27484484
COMB104	Combination	Max	5639.1528	12433.37	1194503.3818	19096472	-27085115
COMB104	Combination	Min	-5639.1037	-12433.3677	1194503.3818	18423765	-27195206
COMB201	Combination	Max	9948.4489	4839.5162	1194503.3818	18800517	-26864702
COMB201	Combination	Min	-9948.3998	-4839.514	1194503.3818	18719721	-27415619
COMB202	Combination	Max	4511.3271	9946.6962	1194503.3818	19029202	-27096124
COMB202	Combination	Min	-4511.278	-9946.6939	1194503.3818	18491036	-27184197
COMB203	Combination	Max	12435.5524	6049.3946	1084328.0727	17124132	-24181969
COMB203	Combination	Min	-12435.5086	-6049.3932	1084328.0726	17023137	-24870616
COMB204	Combination	Max	5639.1501	12433.3695	1084328.0727	17409988	-24471247
COMB204	Combination	Min	-5639.1063	-12433.3681	1084328.0726	16737280	-24581338
COMB205	Combination	Max	6504.9273	9907.5842	1194503.3818	19431124	-26512950
COMB205	Combination	Min	-5854.3841	-7926.0567	1194503.3818	17922169	-27705956
COMB206	Combination	Max	6504.9273	9907.5842	1194503.3818	19431124	-26512950
COMB206	Combination	Min	-5854.3841	-7926.0567	1194503.3818	17922169	-27705956
COMB207	Combination	Max	8131.1504	12384.4795	1084328.0727	17912391	-23742279
13TH	COMB07	Combination	Max	Y	0.053515	0.045565	1.174
12TH	COMB07	Combination	Max	X	0.029568	0.022951	1.288
12TH	COMB07	Combination	Max	Y	0.047923	0.040749	1.176
11TH	COMB07	Combination	Max	X	0.026696	0.020997	1.271
11TH	COMB07	Combination	Max	Y	0.042505	0.036121	1.177
10TH	COMB07	Combination	Max	X	0.023867	0.019032	1.254
10TH	COMB07	Combination	Max	Y	0.037249	0.03166	1.177
9TH	COMB07	Combination	Max	X	0.021086	0.017056	1.236
9TH	COMB07	Combination	Max	Y	0.032184	0.027391	1.175
8TH	COMB07	Combination	Max	X	0.018359	0.015069	1.218
8TH	COMB07	Combination	Max	Y	0.02735	0.023344	1.172
7TH	COMB07	Combination	Max	X	0.015693	0.013071	1.201
7TH	COMB07	Combination	Max	Y	0.02279	0.019549	1.166
6TH	COMB07	Combination	Max	X	0.013069	0.011043	1.183
6TH	COMB07	Combination	Max	Y	0.018579	0.016056	1.157
5TH	COMB07	Combination	Max	X	0.010436	0.008947	1.166
5TH	COMB07	Combination	Max	Y	0.014822	0.012924	1.147
4TH	COMB07	Combination	Max	X	0.007914	0.006828	1.159
4TH	COMB07	Combination	Max	Y	0.011665	0.010218	1.142
3RD	COMB07	Combination	Max	X	0.005597	0.004795	1.167
3RD	COMB07	Combination	Max	Y	0.009746	0.008328	1.17
2ND	COMB07	Combination	Max	X	0.003388	0.00294	1.152
2ND	COMB07	Combination	Max	Y	0.006407	0.005818	1.101
1ST	COMB07	Combination	Max	X	0.002315	0.001908	1.213
1ST	COMB07	Combination	Max	Y	0.006603	0.005176	1.276
GROUND	COMB07	Combination	Max	X	0.000794	0.000584	1.361
GROUND	COMB07	Combination	Max	Y	0.002609	0.00178	1.466
BASEMENT1	COMB07	Combination	Max	X	0.000437	0.000318	1.374

Output Case	Case Type	Step Type	FX kN	FY kN	FZ kN	MX kN-m	MY kN-m
BASEMENT1	COMB07	Combination	Max	Y	0.001147	0.00084	1.364
ROOF	COMB07	Combination	Min	X	0.074079	0.037609	1.97
ROOF	COMB07	Combination	Min	Y	0.149079	0.097271	1.533
34TH	COMB07	Combination	Min	X	0.070533	0.035545	1.984
34TH	COMB07	Combination	Min	Y	0.144085	0.094404	1.526
33RD	COMB07	Combination	Min	X	0.067218	0.03364	1.998
33RD	COMB07	Combination	Min	Y	0.139309	0.091656	1.52
32ND	COMB07	Combination	Min	X	0.064005	0.031803	2.013
32ND	COMB07	Combination	Min	Y	0.134613	0.088941	1.514
31ST	COMB07	Combination	Min	X	0.060863	0.030014	2.028
31ST	COMB07	Combination	Min	Y	0.12996	0.086234	1.507
30TH	COMB07	Combination	Min	X	0.057777	0.028262	2.044
30TH	COMB07	Combination	Min	Y	0.125329	0.083522	1.501
29TH	COMB07	Combination	Min	X	0.054734	0.026524	2.064
29TH	COMB07	Combination	Min	Y	0.120707	0.080794	1.494
28TH	COMB07	Combination	Min	X	0.051725	0.024796	2.086
28TH	COMB07	Combination	Min	Y	0.116083	0.078043	1.487
27TH	COMB07	Combination	Min	X	0.048744	0.023087	2.111
27TH	COMB07	Combination	Min	Y	0.11145	0.075263	1.481
26TH-R	COMB07	Combination	Min	X	0.045786	0.021394	2.14
26TH-R	COMB07	Combination	Min	Y	0.106801	0.072451	1.474
25TH	COMB07	Combination	Min	X	0.04285	0.01972	2.173
25TH	COMB07	Combination	Min	Y	0.10213	0.0696	1.467
24TH	COMB07	Combination	Min	X	0.039941	0.018067	2.211
24TH	COMB07	Combination	Min	Y	0.09744	0.066713	1.461
23RD	COMB07	Combination	Min	X	0.037055	0.016433	2.255
23RD	COMB07	Combination	Min	Y	0.092727	0.063788	1.454
22ND	COMB07	Combination	Min	X	0.034194	0.01482	2.307
22ND	COMB07	Combination	Min	Y	0.087989	0.060823	1.447
21ST	COMB07	Combination	Min	X	0.031362	0.013231	2.37
21ST	COMB07	Combination	Min	Y	0.083227	0.057819	1.439
20TH	COMB07	Combination	Min	X	0.028563	0.011667	2.448
20TH	COMB07	Combination	Min	Y	0.078448	0.054778	1.432
19TH	COMB07	Combination	Min	X	0.025805	0.010132	2.547
19TH	COMB07	Combination	Min	Y	0.07366	0.051707	1.425
18TH	COMB07	Combination	Min	X	0.0231	0.008634	2.676
18TH	COMB07	Combination	Min	Y	0.068874	0.048613	1.417
17TH-R	COMB07	Combination	Min	X	0.020458	0.007181	2.849
17TH-R	COMB07	Combination	Min	Y	0.064106	0.045505	1.409
16TH	COMB07	Combination	Min	X	0.017894	0.005784	3.094
16TH	COMB07	Combination	Min	Y	0.059369	0.042391	1.401
15TH	COMB07	Combination	Min	X	0.015421	0.004454	3.462
15TH	COMB07	Combination	Min	Y	0.054676	0.039291	1.392
14TH	COMB07	Combination	Min	Y	0.050044	0.036196	1.383
13TH	COMB07	Combination	Min	Y	0.045488	0.033118	1.373
12TH	COMB07	Combination	Min	Y	0.041024	0.030082	1.364
11TH	COMB07	Combination	Min	Y	0.03667	0.027115	1.352
10TH	COMB07	Combination	Min	Y	0.032442	0.024208	1.34
9TH	COMB07	Combination	Min	Y	0.028359	0.021373	1.327
8TH	COMB07	Combination	Min	X	0.006222	0.002162	2.878
8TH	COMB07	Combination	Min	Y	0.024437	0.018625	1.312
7TH	COMB07	Combination	Min	X	0.005807	0.002519	2.306

Output Case	Case Type	Step Type	FX kN	FY kN	FZ kN	MX kN-m	MY kN-m
7TH	COMB07	Combination	Min	Y	0.020695	0.015944	1.298
6TH	COMB07	Combination	Min	X	0.00521	0.002637	1.976
6TH	COMB07	Combination	Min	Y	0.017136	0.013392	1.28
5TH	COMB07	Combination	Min	X	0.004381	0.002482	1.766
5TH	COMB07	Combination	Min	Y	0.013748	0.010995	1.25
4TH	COMB07	Combination	Min	X	0.003289	0.002021	1.627
4TH	COMB07	Combination	Min	Y	0.010583	0.008829	1.199
3RD	COMB07	Combination	Min	X	0.002102	0.00113	1.86
3RD	COMB07	Combination	Min	Y	0.008464	0.007075	1.196
2ND	COMB07	Combination	Min	Y	0.006293	0.005325	1.182
1ST	COMB07	Combination	Min	Y	0.006689	0.004881	1.371
GROUND	COMB07	Combination	Min	X	0.000458	0.000276	1.659
GROUND	COMB07	Combination	Min	Y	0.002487	0.001556	1.599
BASEMENT1	COMB07	Combination	Min	X	0.000343	0.000236	1.451
BASEMENT1	COMB07	Combination	Min	Y	0.001159	0.000815	1.421
ROOF	SEISMIC WEIGHT	Combination		X	0.025949	0.010564	2.456
ROOF	SEISMIC WEIGHT	Combination		Y	0.05528	0.032554	1.698
34TH	SEISMIC WEIGHT	Combination		X	0.025119	0.010686	2.351
34TH	SEISMIC WEIGHT	Combination		Y	0.05255	0.031231	1.683
33RD	SEISMIC WEIGHT	Combination		X	0.024324	0.010744	2.264
33RD	SEISMIC WEIGHT	Combination		Y	0.049936	0.029877	1.671
32ND	SEISMIC WEIGHT	Combination		X	0.023554	0.010776	2.186
32ND	SEISMIC WEIGHT	Combination		Y	0.047391	0.028516	1.662
31ST	SEISMIC WEIGHT	Combination		X	0.022803	0.010786	2.114
31ST	SEISMIC WEIGHT	Combination		Y	0.044904	0.027154	1.654
30TH	SEISMIC WEIGHT	Combination		X	0.022066	0.01078	2.047
30TH	SEISMIC WEIGHT	Combination		Y	0.042467	0.025795	1.646
29TH	SEISMIC WEIGHT	Combination		X	0.021341	0.010758	1.984
29TH	SEISMIC WEIGHT	Combination		Y	0.040075	0.024442	1.64
28TH	SEISMIC WEIGHT	Combination		X	0.020626	0.010722	1.924
28TH	SEISMIC WEIGHT	Combination		Y	0.037728	0.023097	1.633
27TH	SEISMIC WEIGHT	Combination		X	0.019919	0.010671	1.867
27TH	SEISMIC WEIGHT	Combination		Y	0.035423	0.021763	1.628
26TH-R	SEISMIC WEIGHT	Combination		X	0.019218	0.010607	1.812
26TH-R	SEISMIC WEIGHT	Combination		Y	0.033162	0.020442	1.622
25TH	SEISMIC WEIGHT	Combination		X	0.018523	0.010529	1.759
25TH	SEISMIC WEIGHT	Combination		Y	0.030946	0.019138	1.617
24TH	SEISMIC WEIGHT	Combination		X	0.017835	0.010438	1.709
24TH	SEISMIC WEIGHT	Combination		Y	0.02878	0.017854	1.612
23RD	SEISMIC WEIGHT	Combination		X	0.01715	0.010332	1.66
23RD	SEISMIC WEIGHT	Combination		Y	0.026661	0.01659	1.607
22ND	SEISMIC WEIGHT	Combination		X	0.01647	0.010213	1.613
22ND	SEISMIC WEIGHT	Combination		Y	0.024593	0.01535	1.602
21ST	SEISMIC WEIGHT	Combination		X	0.015793	0.010078	1.567
21ST	SEISMIC WEIGHT	Combination		Y	0.022579	0.014138	1.597
20TH	SEISMIC WEIGHT	Combination		X	0.01512	0.009928	1.523
20TH	SEISMIC WEIGHT	Combination		Y	0.020624	0.012955	1.592
19TH	SEISMIC WEIGHT	Combination		X	0.014451	0.009762	1.48
19TH	SEISMIC WEIGHT	Combination		Y	0.018732	0.011806	1.587
18TH	SEISMIC WEIGHT	Combination		X	0.013785	0.009578	1.439
18TH	SEISMIC WEIGHT	Combination		Y	0.016907	0.010692	1.581
17TH-R	SEISMIC WEIGHT	Combination		X	0.013122	0.009374	1.4

Output Case	Case Type	Step Type	FX kN	FY kN	FZ kN	MX kN-m	MY kN-m
17TH-R	SEISMIC WEIGHT	Combination		Y	0.015154	0.009617	1.576
16TH	SEISMIC WEIGHT	Combination		X	0.012463	0.009149	1.362
16TH	SEISMIC WEIGHT	Combination		Y	0.013479	0.008584	1.57
15TH	SEISMIC WEIGHT	Combination		X	0.011808	0.008901	1.327
15TH	SEISMIC WEIGHT	Combination		Y	0.011891	0.007598	1.565
14TH	SEISMIC WEIGHT	Combination		X	0.011155	0.008628	1.293
14TH	SEISMIC WEIGHT	Combination		Y	0.010394	0.006661	1.56
13TH	SEISMIC WEIGHT	Combination		X	0.010503	0.008325	1.262
13TH	SEISMIC WEIGHT	Combination		Y	0.008993	0.005776	1.557
12TH	SEISMIC WEIGHT	Combination		X	0.00985	0.00799	1.233
12TH	SEISMIC WEIGHT	Combination		Y	0.007694	0.004946	1.556
11TH	SEISMIC WEIGHT	Combination		X	0.009193	0.007617	1.207
11TH	SEISMIC WEIGHT	Combination		Y	0.006502	0.004174	1.558
10TH	SEISMIC WEIGHT	Combination		X	0.008525	0.007201	1.184
10TH	SEISMIC WEIGHT	Combination		Y	0.00542	0.003464	1.565
9TH	SEISMIC WEIGHT	Combination		X	0.007839	0.006734	1.164
9TH	SEISMIC WEIGHT	Combination		Y	0.004451	0.002818	1.579
8TH	SEISMIC WEIGHT	Combination		X	0.007122	0.006205	1.148
8TH	SEISMIC WEIGHT	Combination		Y	0.003594	0.00224	1.604
7TH	SEISMIC WEIGHT	Combination		X	0.006353	0.005602	1.134
7TH	SEISMIC WEIGHT	Combination		Y	0.00284	0.001731	1.641
6TH	SEISMIC WEIGHT	Combination		X	0.005496	0.004902	1.121
6TH	SEISMIC WEIGHT	Combination		Y	0.002169	0.001291	1.68
5TH	SEISMIC WEIGHT	Combination		X	0.004491	0.004078	1.101
5TH	SEISMIC WEIGHT	Combination		Y	0.001522	0.000911	1.67
4TH	SEISMIC WEIGHT	Combination		X	0.003279	0.003108	1.055
4TH	SEISMIC WEIGHT	Combination		Y	0.000821	0.00057	1.441
3RD	SEISMIC WEIGHT	Combination		X	0.002301	0.002099	1.096
3RD	SEISMIC WEIGHT	Combination		Y	0.000924	0.000511	1.808
2ND	SEISMIC WEIGHT	Combination		X	0.001322	0.001182	1.119
2ND	SEISMIC WEIGHT	Combination		Y	0.000609	0.000313	1.945
1ST	SEISMIC WEIGHT	Combination		X	0.00078	0.000703	1.11
1ST	SEISMIC WEIGHT	Combination		Y	0.000403	0.000171	2.351
GROUND	SEISMIC WEIGHT	Combination		X	0.000116	9.8E-05	1.182
GROUND	SEISMIC WEIGHT	Combination		Y	0.000114	7.8E-05	1.462
BASEMENT1	SEISMIC WEIGHT	Combination		X	3.3E-05	2.5E-05	1.314
BASEMENT1	SEISMIC WEIGHT	Combination		Y	2.6E-05	1E-05	2.545
ROOF	COMB101	Combination		X	0.029792	0.012156	2.451
ROOF	COMB101	Combination		Y	0.061164	0.035114	1.742
34TH	COMB101	Combination		X	0.028818	0.012259	2.351
34TH	COMB101	Combination		Y	0.058154	0.033693	1.726
33RD	COMB101	Combination		X	0.027886	0.012293	2.268
33RD	COMB101	Combination		Y	0.055269	0.032236	1.715
32ND	COMB101	Combination		X	0.026982	0.012299	2.194
32ND	COMB101	Combination		Y	0.052459	0.03077	1.705
31ST	COMB101	Combination		X	0.026101	0.012284	2.125
31ST	COMB101	Combination		Y	0.049713	0.029304	1.696
30TH	COMB101	Combination		X	0.025236	0.01225	2.06
30TH	COMB101	Combination		Y	0.047022	0.027839	1.689
29TH	COMB101	Combination		X	0.024386	0.0122	1.999
29TH	COMB101	Combination		Y	0.044381	0.026381	1.682
28TH	COMB101	Combination		X	0.023548	0.012135	1.94

Output Case	Case Type	Step Type	FX kN	FY kN	FZ kN	MX kN-m	MY kN-m
28TH	COMB101	Combination		Y	0.041788	0.02493	1.676
27TH	COMB101	Combination		X	0.022719	0.012056	1.885
27TH	COMB101	Combination		Y	0.039243	0.023492	1.671
26TH-R	COMB101	Combination		X	0.021899	0.011962	1.831
26TH-R	COMB101	Combination		Y	0.036746	0.022067	1.665
25TH	COMB101	Combination		X	0.021087	0.011853	1.779
25TH	COMB101	Combination		Y	0.0343	0.02066	1.66
24TH	COMB101	Combination		X	0.020282	0.011729	1.729
24TH	COMB101	Combination		Y	0.031907	0.019274	1.655
23RD	COMB101	Combination		X	0.019483	0.011591	1.681
23RD	COMB101	Combination		Y	0.029567	0.01791	1.651
22ND	COMB101	Combination		X	0.018689	0.011439	1.634
22ND	COMB101	Combination		Y	0.027283	0.016573	1.646
21ST	COMB101	Combination		X	0.0179	0.011269	1.588
21ST	COMB101	Combination		Y	0.025059	0.015264	1.642
20TH	COMB101	Combination		X	0.017117	0.011084	1.544
20TH	COMB101	Combination		Y	0.022899	0.013988	1.637
19TH	COMB101	Combination		X	0.016339	0.010881	1.502
19TH	COMB101	Combination		Y	0.020809	0.012747	1.632
18TH	COMB101	Combination		X	0.015566	0.01066	1.46
18TH	COMB101	Combination		Y	0.018792	0.011545	1.628
17TH-R	COMB101	Combination		X	0.014797	0.010418	1.42
17TH-R	COMB101	Combination		Y	0.016854	0.010385	1.623
16TH	COMB101	Combination		X	0.014034	0.010153	1.382
16TH	COMB101	Combination		Y	0.015003	0.00927	1.618
15TH	COMB101	Combination		X	0.013276	0.009864	1.346
15TH	COMB101	Combination		Y	0.013246	0.008205	1.614
14TH	COMB101	Combination		X	0.012522	0.009547	1.312
14TH	COMB101	Combination		Y	0.011588	0.007193	1.611
13TH	COMB101	Combination		X	0.011771	0.0092	1.28
13TH	COMB101	Combination		Y	0.010037	0.006238	1.609
12TH	COMB101	Combination		X	0.011021	0.008817	1.25
12TH	COMB101	Combination		Y	0.008596	0.005342	1.609
11TH	COMB101	Combination		X	0.010267	0.008396	1.223
11TH	COMB101	Combination		Y	0.007273	0.004509	1.613
10TH	COMB101	Combination		X	0.009504	0.007927	1.199
10TH	COMB101	Combination		Y	0.00607	0.003742	1.622
9TH	COMB101	Combination		X	0.008723	0.007405	1.178
9TH	COMB101	Combination		Y	0.004992	0.003044	1.64
8TH	COMB101	Combination		X	0.00791	0.006816	1.16
8TH	COMB101	Combination		Y	0.004036	0.00242	1.667
7TH	COMB101	Combination		X	0.007044	0.006148	1.146
7TH	COMB101	Combination		Y	0.003193	0.001869	1.708
6TH	COMB101	Combination		X	0.006084	0.005375	1.132
6TH	COMB101	Combination		Y	0.002442	0.001394	1.752
5TH	COMB101	Combination		X	0.004966	0.004469	1.111
5TH	COMB101	Combination		Y	0.001717	0.000984	1.746
4TH	COMB101	Combination		X	0.003626	0.003407	1.064
4TH	COMB101	Combination		Y	0.000937	0.000614	1.526
3RD	COMB101	Combination		X	0.002544	0.002302	1.105
3RD	COMB101	Combination		Y	0.001058	0.000564	1.877
2ND	COMB101	Combination		X	0.001455	0.001292	1.126

Output Case	Case Type	Step Type	FX kN	FY kN	FZ kN	MX kN-m	MY kN-m
2ND	COMB101	Combination		Y	0.000685	0.00034	2.012
1ST	COMB101	Combination		X	0.00086	0.000769	1.119
1ST	COMB101	Combination		Y	0.000456	0.000183	2.498
GROUND	COMB101	Combination		X	0.000125	0.000106	1.172
GROUND	COMB101	Combination		Y	0.00012	8.4E-05	1.439
BASEMENT1	COMB101	Combination		X	3.6E-05	2.7E-05	1.322
BASEMENT1	COMB101	Combination		Y	3E-05	1.2E-05	2.437
ROOF	COMB102	Combination	Max	X	0.123265	0.111192	1.109
ROOF	COMB102	Combination	Max	Y	0.098188	0.069462	1.414
34TH	COMB102	Combination	Max	X	0.12011	0.108622	1.106
34TH	COMB102	Combination	Max	Y	0.09433	0.066846	1.411
33RD	COMB102	Combination	Max	X	0.116944	0.105995	1.103
33RD	COMB102	Combination	Max	Y	0.090566	0.064236	1.41
32ND	COMB102	Combination	Max	X	0.113749	0.103316	1.101
32ND	COMB102	Combination	Max	Y	0.086849	0.061637	1.409
31ST	COMB102	Combination	Max	X	0.11051	0.100575	1.099
31ST	COMB102	Combination	Max	Y	0.083163	0.059044	1.408
30TH	COMB102	Combination	Max	X	0.107216	0.097766	1.097
30TH	COMB102	Combination	Max	Y	0.0795	0.056456	1.408
29TH	COMB102	Combination	Max	X	0.103858	0.094882	1.095
29TH	COMB102	Combination	Max	Y	0.075854	0.053873	1.408
28TH	COMB102	Combination	Max	X	0.10043	0.091918	1.093
28TH	COMB102	Combination	Max	Y	0.072219	0.051284	1.408
27TH	COMB102	Combination	Max	X	0.096929	0.088873	1.091
27TH	COMB102	Combination	Max	Y	0.068595	0.0487	1.409
26TH-R	COMB102	Combination	Max	X	0.093352	0.085745	1.089
26TH-R	COMB102	Combination	Max	Y	0.06498	0.046121	1.409
25TH	COMB102	Combination	Max	X	0.0897	0.082535	1.087
25TH	COMB102	Combination	Max	Y	0.061378	0.043551	1.409
24TH	COMB102	Combination	Max	X	0.085985	0.079256	1.085
24TH	COMB102	Combination	Max	Y	0.057798	0.040997	1.41
23RD	COMB102	Combination	Max	X	0.082209	0.075909	1.083
23RD	COMB102	Combination	Max	Y	0.054239	0.038459	1.41
22ND	COMB102	Combination	Max	X	0.078374	0.072498	1.081
22ND	COMB102	Combination	Max	Y	0.050708	0.035942	1.411
21ST	COMB102	Combination	Max	X	0.074485	0.069025	1.079
21ST	COMB102	Combination	Max	Y	0.047211	0.033452	1.411
20TH	COMB102	Combination	Max	X	0.070547	0.065497	1.077
20TH	COMB102	Combination	Max	Y	0.043754	0.030989	1.412
19TH	COMB102	Combination	Max	X	0.066568	0.061919	1.075
19TH	COMB102	Combination	Max	Y	0.040346	0.02855	1.413
18TH	COMB102	Combination	Max	X	0.062555	0.058298	1.073
18TH	COMB102	Combination	Max	Y	0.036993	0.026156	1.414
17TH-R	COMB102	Combination	Max	X	0.058517	0.054641	1.071
17TH-R	COMB102	Combination	Max	Y	0.033703	0.023811	1.415
16TH	COMB102	Combination	Max	X	0.054465	0.050958	1.069
16TH	COMB102	Combination	Max	Y	0.030489	0.021525	1.416
15TH	COMB102	Combination	Max	X	0.05041	0.047259	1.067
15TH	COMB102	Combination	Max	Y	0.027364	0.019308	1.417
14TH	COMB102	Combination	Max	X	0.046365	0.043555	1.065
14TH	COMB102	Combination	Max	Y	0.024341	0.017172	1.417
13TH	COMB102	Combination	Max	X	0.042343	0.039857	1.062

Output Case	Case Type	Step Type	FX kN	FY kN	FZ kN	MX kN-m	MY kN-m
13TH	COMB102	Combination	Max	Y	0.021434	0.015121	1.417
12TH	COMB102	Combination	Max	X	0.038356	0.036177	1.06
12TH	COMB102	Combination	Max	Y	0.018658	0.013163	1.417
11TH	COMB102	Combination	Max	X	0.034421	0.032531	1.058
11TH	COMB102	Combination	Max	Y	0.016028	0.011312	1.417
10TH	COMB102	Combination	Max	X	0.03055	0.02893	1.056
10TH	COMB102	Combination	Max	Y	0.013561	0.009577	1.416
9TH	COMB102	Combination	Max	X	0.026762	0.025393	1.054
9TH	COMB102	Combination	Max	Y	0.011271	0.007969	1.414
8TH	COMB102	Combination	Max	X	0.023069	0.021932	1.052
8TH	COMB102	Combination	Max	Y	0.009174	0.006498	1.412
7TH	COMB102	Combination	Max	X	0.019486	0.018564	1.05
7TH	COMB102	Combination	Max	Y	0.007283	0.005173	1.408
6TH	COMB102	Combination	Max	X	0.016017	0.015297	1.047
6TH	COMB102	Combination	Max	Y	0.005607	0.004001	1.401
5TH	COMB102	Combination	Max	X	0.012653	0.012138	1.042
5TH	COMB102	Combination	Max	Y	0.004123	0.002969	1.389
4TH	COMB102	Combination	Max	X	0.009423	0.009127	1.032
4TH	COMB102	Combination	Max	Y	0.002795	0.002048	1.365
3RD	COMB102	Combination	Max	X	0.006804	0.006564	1.037
3RD	COMB102	Combination	Max	Y	0.003258	0.002122	1.535
2ND	COMB102	Combination	Max	X	0.004338	0.004253	1.02
2ND	COMB102	Combination	Max	Y	0.001745	0.00124	1.407
1ST	COMB102	Combination	Max	X	0.002709	0.002617	1.035
1ST	COMB102	Combination	Max	Y	0.001362	0.000958	1.421
GROUND	COMB102	Combination	Max	X	0.000665	0.000584	1.139
GROUND	COMB102	Combination	Max	Y	0.000528	0.000408	1.294
BASEMENT1	COMB102	Combination	Max	X	0.000389	0.000335	1.164
BASEMENT1	COMB102	Combination	Max	Y	0.000313	0.000231	1.353
ROOF	COMB102	Combination	Min	X	0.112608	0.093154	1.209
34TH	COMB102	Combination	Min	X	0.10888	0.09051	1.203
33RD	COMB102	Combination	Min	X	0.105267	0.087884	1.198
32ND	COMB102	Combination	Min	X	0.101677	0.08523	1.193
31ST	COMB102	Combination	Min	X	0.098078	0.082532	1.188
30TH	COMB102	Combination	Min	X	0.094454	0.079778	1.184
29TH	COMB102	Combination	Min	X	0.090792	0.076961	1.18
28TH	COMB102	Combination	Min	X	0.087084	0.074076	1.176
27TH	COMB102	Combination	Min	X	0.083324	0.071121	1.172
26TH-R	COMB102	Combination	Min	X	0.079512	0.068095	1.168
25TH	COMB102	Combination	Min	X	0.075648	0.065	1.164
24TH	COMB102	Combination	Min	X	0.071746	0.061848	1.16
23RD	COMB102	Combination	Min	X	0.067807	0.05863	1.157
22ND	COMB102	Combination	Min	X	0.063836	0.055344	1.153
21ST	COMB102	Combination	Min	X	0.05984	0.052	1.151
20TH	COMB102	Combination	Min	X	0.055826	0.048606	1.149
19TH	COMB102	Combination	Min	X	0.051804	0.045172	1.147
18TH	COMB102	Combination	Min	X	0.047784	0.041721	1.145
17TH-R	COMB102	Combination	Min	X	0.04378	0.038274	1.144
17TH-R	COMB102	Combination	Min	Y	0.01275	0.003984	3.201
16TH	COMB102	Combination	Min	X	0.039807	0.034844	1.142
16TH	COMB102	Combination	Min	Y	0.011782	0.003827	3.078
15TH	COMB102	Combination	Min	X	0.035881	0.03144	1.141

Output Case	Case Type	Step Type	FX kN	FY kN	FZ kN	MX kN-m	MY kN-m
15TH	COMB102	Combination	Min	Y	0.010814	0.003651	2.962
14TH	COMB102	Combination	Min	X	0.032021	0.028082	1.14
14TH	COMB102	Combination	Min	Y	0.00985	0.003458	2.848
13TH	COMB102	Combination	Min	X	0.02825	0.024792	1.139
13TH	COMB102	Combination	Min	Y	0.008897	0.003238	2.747
12TH	COMB102	Combination	Min	X	0.024592	0.021592	1.139
12TH	COMB102	Combination	Min	Y	0.007959	0.003002	2.652
11TH	COMB102	Combination	Min	X	0.021076	0.018507	1.139
11TH	COMB102	Combination	Min	Y	0.007042	0.00276	2.551
10TH	COMB102	Combination	Min	X	0.017733	0.015567	1.139
10TH	COMB102	Combination	Min	Y	0.006153	0.002507	2.454
9TH	COMB102	Combination	Min	X	0.014599	0.012804	1.14
9TH	COMB102	Combination	Min	Y	0.005297	0.002244	2.36
8TH	COMB102	Combination	Min	X	0.011714	0.010255	1.142
8TH	COMB102	Combination	Min	Y	0.004478	0.001976	2.267
7TH	COMB102	Combination	Min	X	0.009122	0.007963	1.145
7TH	COMB102	Combination	Min	Y	0.003706	0.001706	2.173
6TH	COMB102	Combination	Min	X	0.006873	0.005983	1.149
6TH	COMB102	Combination	Min	Y	0.002974	0.001433	2.075
5TH	COMB102	Combination	Min	X	0.005018	0.004374	1.147
5TH	COMB102	Combination	Min	Y	0.002266	0.001156	1.961
4TH	COMB102	Combination	Min	X	0.003626	0.003217	1.127
4TH	COMB102	Combination	Min	Y	0.001579	0.000892	1.77
3RD	COMB102	Combination	Min	X	0.002931	0.002596	1.129
3RD	COMB102	Combination	Min	Y	0.001623	0.000911	1.782
2ND	COMB102	Combination	Min	X	0.002284	0.002031	1.125
2ND	COMB102	Combination	Min	Y	0.000878	0.000524	1.675
1ST	COMB102	Combination	Min	X	0.001416	0.001292	1.095
1ST	COMB102	Combination	Min	Y	0.001275	0.000711	1.794
GROUND	COMB102	Combination	Min	X	0.000441	0.000391	1.128
GROUND	COMB102	Combination	Min	Y	0.000447	0.000279	1.604
BASEMENT1	COMB102	Combination	Min	X	0.000327	0.000284	1.152
BASEMENT1	COMB102	Combination	Min	Y	0.000321	0.000223	1.441
ROOF	COMB103	Combination	Max	X	0.126699	0.113668	1.115
ROOF	COMB103	Combination	Max	Y	0.103593	0.073146	1.416
34TH	COMB103	Combination	Max	X	0.123444	0.111037	1.112
34TH	COMB103	Combination	Max	Y	0.09952	0.070407	1.414
33RD	COMB103	Combination	Max	X	0.120179	0.108347	1.109
33RD	COMB103	Combination	Max	Y	0.095545	0.067675	1.412
32ND	COMB103	Combination	Max	X	0.116885	0.105606	1.107
32ND	COMB103	Combination	Max	Y	0.091615	0.06495	1.411
31ST	COMB103	Combination	Max	X	0.113548	0.102803	1.105
31ST	COMB103	Combination	Max	Y	0.087719	0.06223	1.41
30TH	COMB103	Combination	Max	X	0.110155	0.099931	1.102
30TH	COMB103	Combination	Max	Y	0.083845	0.059507	1.409
29TH	COMB103	Combination	Max	X	0.106699	0.096984	1.1
29TH	COMB103	Combination	Max	Y	0.079989	0.056777	1.409
28TH	COMB103	Combination	Max	X	0.103172	0.093957	1.098
28TH	COMB103	Combination	Max	Y	0.076145	0.054051	1.409
27TH	COMB103	Combination	Max	X	0.099572	0.090848	1.096
27TH	COMB103	Combination	Max	Y	0.072313	0.05133	1.409
26TH-R	COMB103	Combination	Max	X	0.095896	0.087657	1.094

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SHEAR WALL DESIGN

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COLUMN DESIGN CALCULATIONS

Project Name	:	ALTIS-CLUSTER1
Client Name	:	ALTIS
Engineer Name	:	Rameshkumar P
Design File	:	F:\Altis\Design\CLUSTER1-WALL DESIGN -24-01-2025.rcdx
Analysis File	:	D:\PROJECTS\RESIDENTIAL\PROPOSAL\BUR-PRO1\ETABS\CLUSTER1\RCDC\ETABS INPUT FILE\CLUSTER1-ULS-MODIFIER-WITH DIAPHRAGM-R16-24-01-2025.accdb
Analysis Last Modified	:	24-01-2025 20:57:57

Definitions Of Terms:

All forces in units kN and m

All reinforcement details like area, spacing are mm

Grade Of steel for 6 mm dia. bars is Fe250. It is irrespective of the grade of steel defined by user in column design.

Neutral axis angle for resultant design moment is with respect to local major axis.

1	β	=	Stiffness proportion factor at joint (column stiffness/sum of stiffness of all members connected at joint)
2	Δu	=	Elastically computed first order lateral deflection.(Relative deflections)
3	ε1	=	Strain at level considered, Calculated ignoring the stiffening of the concrete in tension zone
4	εm	=	Average steel strain at level considered
5	acr	=	Distance from the point considered to the surface of the nearest longitudinal bar
6	Ag	=	Gross area of the column cross section
7	Aeff	=	Effective area of column / wall considered for shear check in sqmm
8	Ak	=	Area of confined concrete core
9	Ash	=	Area of link cross section
10	b	=	Effective Width of Column in mm
11	beff	=	Effective Width of Column in mm
12	B	=	Width / Smaller Dimension of Column in mm
13	d	=	Effective Depth of Column in mm
14	deff	=	Effective Depth of Column in mm
15	D	=	Depth / Larger Dimension of Column OR Diameter of Circular Column in mm
16	Dk	=	Diameter Of core measured to the outside of circular link
17	Ec	=	Modulus of elasticity of concrete
18	Es	=	Modulus of elasticity of steel
19	FcPerm	=	Permissible Stress in Concrete required in N/ (sqmm)
20	Fst	=	Stress in steel
21	FstPerm	=	Permissible Stress in Steel required in N/ (sqmm)
22	Fck	=	Characteristic compressive strength of concrete cube in N/sqmm
23	Fy	=	Yield Stress Of Steel in N/sqmm
24	h	=	Longer dimension of rectangular link measured to its outer face
25	Hu	=	Total lateral force acting within the story(Story shear)
26	Hs	=	Height of the story (Floor height)
27	k	=	Reduction factor for slenderness moments
28	Max	=	Additional moment due to slenderness about major axis (Along D)
29	May	=	Additional moment due to slenderness about minor axis (Along B)
30	Mminx	=	Moment due to minimum eccentricity along D
31	Mminy	=	Moment due to minimum eccentricity along B
32	Muv	=	Moment capacity of web portion of wall as per clause 9.4.2 and Annes A of IS 13920 - 2016
33	Mux	=	Factored moment Along D (Momemt About Major Axis)
34	Muy	=	Factored moment Along B (Momemt About Minor Axis)
35	MCap	=	Moment capacity of section for NA angle at design Pu

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36	MRes	=	Resultant design moment at angle to local major axis
37	Pb	=	Axial capacity of column along B as defined in 39.7.1.1
38	Pd	=	Axial capacity of column along D as defined in 39.7.1.1
39	Pu	=	Factored axial force
40	Puz	=	Axial load on column as defined in 39.6
41	Pu_Total	=	Sum of Axial loads on all column in the story (Gravity Load)
42	Q	=	Stability Index (factor for checking sway/ non sway condition for a given story)
43	S	=	Link Spacing
44	Shear Strength Enhancement Factor	=	Multiplying factor for shear strength of concrete as per 40.2.2
45	Vur	=	Factored resultant shear force acting on the column
46	Vux	=	Factored shear force Along B
47	Vuy	=	Factored shear force Along D
48	Wcr	=	Surface Crack Width
49	WcrPerm	=	Permissible Crack Width required in mm
50	β	=	It is a Neutral Axis angle corresponding to load angle to find out MCap

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Code References:

IS 456

	ELEMENT		CLAUSE / table
1	Max area of reinforcement	:	26.5.3.1-a & b
2	Min area of reinforcement	:	26.5.3.1-a & b
3	Min number of bars	:	26.5.3.1-c
4	Minimum Eccentricity Calc	:	25.4 & 39.2
5	Effective Length	:	25.2
6	Slenderness Moments	:	25.3 & 39.7
7	Design for axial loads	:	39.3
8	Design for axial loads And uniaxial bending	:	39.5
9	Design for axial loads And Biaxial bending	:	39.6
10	Design of horizontal links	:	26.5.3.2
11	Design shear strength	:	40.2
12	Stiffness Proportion Factor, β	:	E-1
13	Stability(Index, Q)	:	E -2
14	Crack width calculation	:	3.8
15	Multiplying factor to Beam Stiffness for effective length calculation	:	SP 24 1983 APPENDIX D

IS 13920 - 2016

	ELEMENT		CLAUSE / table
1	Spacing of special confining reinforcement	:	10.4 and 7.6
2	C/s area of special confining reinforcement	:	7.6.1
3	Applicability of boundary element	:	10.4.1
4	Muv-Moment Capacity of Web	:	Annex
5	Additional Compressive Force in BE	:	10.4.2
6	Check for BE in tension and compression	:	10.4.2.1 and 10.4.3
7	Shear include due to Beam	:	7.5

8	Minimum Flexural Strength of Column	:	7.2
9	Shear Check at Column Joint	:	9.1
10	Length of wall to thickness ratio	:	10.1.3
11	Type of wall & Minimum reinforcement	:	10.1.4
12	Largest diameter of longitudinal steel bar	:	10.1.8
13	Shear reinforcement in RC wall	:	10.2.3
14	Special confinement reinforcement in Boundary Element	:	10.4.4
15	Minimum vertical reinforcement across horizontal construction joint	:	10.7

Sway Calculation (Stability Index)

For Global-X Direction

Level	Load Name	Storey Height (m)	Gravity Load P (kN)	Relative Displacements (mm)	Storey Shear (kN)	Stability Index	Sway Condition
		A	B	C	D	B x C / (A x D)	
BASE to BASEMENT1	WINDX	4.5	1266977.754	0.109	6976.622	0.004	Non Sway
BASEMENT1 to GROUND	WINDX	3.95	1154316.905	0.263	6976.623	0.011	Non Sway
GROUND to 1ST	WINDX	6	935854.439	1.848	6879.022	0.042	Sway
1ST to 2ND	WINDX	3.3	819536.135	1.744	6740.322	0.064	Sway
2ND to 3RD	WINDX	3.3	795061.706	1.852	6631.622	0.067	Sway
3RD to 4TH	WINDX	3.3	731404.819	2.006	6514.524	0.068	Sway
4TH to 5TH	WINDX	3.3	707873.667	2.559	6390.423	0.086	Sway
5TH to 6TH	WINDX	3.3	685637.268	3.237	6259.822	0.107	Sway
6TH to 7TH	WINDX	3.3	663400.869	3.707	6123.722	0.122	Sway
7TH to 8TH	WINDX	3.3	641164.469	4.064	5982.321	0.132	Sway
8TH to 9TH	WINDX	3.3	618928.07	4.341	5835.82	0.14	Sway
9TH to 10TH	WINDX	3.3	596691.671	4.558	5684.717	0.145	Sway
10TH to 11TH	WINDX	3.3	574455.272	4.742	5529.015	0.149	Sway
11TH to 12TH	WINDX	3.3	552218.872	4.876	5368.812	0.152	Sway
12TH to 13TH	WINDX	3.3	529982.473	4.969	5204.41	0.153	Sway
13TH to 14TH	WINDX	3.3	507746.073	5.027	5035.606	0.154	Sway
14TH to 15TH	WINDX	3.3	485509.674	5.055	4862.403	0.153	Sway
15TH to 16TH	WINDX	3.3	463273.274	5.059	4684.601	0.152	Sway
16TH to 17TH-R	WINDX	3.3	441034.999	5.038	4502.295	0.15	Sway
17TH-R to 18TH	WINDX	3.3	418407.897	4.997	4315.091	0.147	Sway
18TH to 19TH	WINDX	3.3	396169.623	4.938	4123.086	0.144	Sway
19TH to 20TH	WINDX	3.3	373931.349	4.862	3925.882	0.14	Sway
20TH to 21ST	WINDX	3.3	351693.074	4.772	3723.178	0.137	Sway
21ST to 22ND	WINDX	3.3	329454.799	4.67	3514.774	0.133	Sway
22ND to 23RD	WINDX	3.3	307216.525	4.559	3299.971	0.129	Sway
23RD to 24TH	WINDX	3.3	284978.251	4.44	3078.963	0.125	Sway
24TH to 25TH	WINDX	3.3	262739.976	4.315	2851.258	0.12	Sway
25TH to 26TH-R	WINDX	3.3	240501.702	4.184	2617.054	0.117	Sway
26TH-R to 27TH	WINDX	3.3	217876.475	4.037	2376.546	0.112	Sway
27TH to 28TH	WINDX	3.3	195640.075	3.89	2130.639	0.108	Sway
28TH to 29TH	WINDX	3.3	173403.675	3.744	1880.132	0.105	Sway
29TH to 30TH	WINDX	3.3	151167.276	3.603	1626.525	0.101	Sway
30TH to 31ST	WINDX	3.3	128930.876	3.468	1371.312	0.099	Sway
31ST to 32ND	WINDX	3.3	106694.477	3.343	1116.102	0.097	Sway
32ND to 33RD	WINDX	3.3	84458.077	3.231	861.692	0.096	Sway
33RD to 34TH	WINDX	3.3	62221.677	3.138	608.982	0.097	Sway
34TH to ROOF	WINDX	3.3	39992.677	3.06	361.97	0.102	Sway
ROOF to UPPER ROOF	WINDX	3.3	5259.497	2.742	0	14050.045	Sway

For Global-Y Direction

Level	Load Name	Storey Height (m)	Gravity Load P (kN)	Relative Displacements (mm)	Storey Shear (kN)	Stability Index	Sway Condition
		A	B	C	D	B x C / (A x D)	
BASE to BASEMENT1	WINDY	4.5	1266977.754	0.433	8996.972	0.014	Non Sway
BASEMENT1 to GROUND	WINDY	3.95	1154316.905	0.905	8996.972	0.029	Non Sway
GROUND to 1ST	WINDY	6	935854.439	2.924	8857.972	0.051	Sway
1ST to 2ND	WINDY	3.3	819536.135	2.465	8655.972	0.071	Sway
2ND to 3RD	WINDY	3.3	795061.706	2.34	8497.972	0.066	Sway
3RD to 4TH	WINDY	3.3	731404.819	2.339	8327.968	0.062	Sway
4TH to 5TH	WINDY	3.3	707873.667	2.599	8147.968	0.068	Sway
5TH to 6TH	WINDY	3.3	685637.268	3.41	7958.968	0.089	Sway
6TH to 7TH	WINDY	3.3	663400.869	4.042	7762.968	0.105	Sway
7TH to 8TH	WINDY	3.3	641164.469	4.561	7559.968	0.117	Sway
8TH to 9TH	WINDY	3.3	618928.07	4.99	7349.968	0.127	Sway
9TH to 10TH	WINDY	3.3	596691.671	5.345	7133.969	0.135	Sway
10TH to 11TH	WINDY	3.3	574455.272	5.657	6912.969	0.142	Sway
11TH to 12TH	WINDY	3.3	552218.872	5.915	6686.969	0.148	Sway
12TH to 13TH	WINDY	3.3	529982.473	6.119	6455.97	0.152	Sway
13TH to 14TH	WINDY	3.3	507746.073	6.276	6219.971	0.155	Sway
14TH to 15TH	WINDY	3.3	485509.674	6.391	5979.971	0.157	Sway
15TH to 16TH	WINDY	3.3	463273.274	6.469	5734.972	0.158	Sway
16TH to 17TH-R	WINDY	3.3	441034.999	6.514	5486.972	0.159	Sway
17TH-R to 18TH	WINDY	3.3	418407.897	6.531	5233.972	0.158	Sway
18TH to 19TH	WINDY	3.3	396169.623	6.524	4977.973	0.157	Sway
19TH to 20TH	WINDY	3.3	373931.349	6.494	4717.973	0.156	Sway
20TH to 21ST	WINDY	3.3	351693.074	6.444	4454.974	0.154	Sway
21ST to 22ND	WINDY	3.3	329454.799	6.378	4187.976	0.152	Sway
22ND to 23RD	WINDY	3.3	307216.525	6.298	3917.977	0.15	Sway
23RD to 24TH	WINDY	3.3	284978.251	6.207	3644.978	0.147	Sway
24TH to 25TH	WINDY	3.3	262739.976	6.108	3367.978	0.144	Sway
25TH to 26TH-R	WINDY	3.3	240501.702	6.001	3087.979	0.142	Sway
26TH-R to 27TH	WINDY	3.3	217876.475	5.877	2804.981	0.138	Sway
27TH to 28TH	WINDY	3.3	195640.075	5.751	2519.983	0.135	Sway
28TH to 29TH	WINDY	3.3	173403.675	5.623	2231.984	0.132	Sway
29TH to 30TH	WINDY	3.3	151167.276	5.497	1940.986	0.13	Sway
30TH to 31ST	WINDY	3.3	128930.876	5.374	1646.988	0.127	Sway
31ST to 32ND	WINDY	3.3	106694.477	5.257	1350.99	0.126	Sway
32ND to 33RD	WINDY	3.3	84458.077	5.148	1051.993	0.125	Sway
33RD to 34TH	WINDY	3.3	62221.677	5.049	750.995	0.127	Sway
34TH to ROOF	WINDY	3.3	39992.677	4.945	445.997	0.134	Sway
ROOF to UPPER ROOF	WINDY	3.3	5259.497	4.192	0	3839642.395	Sway

General Data

Wall No.	:	P41-X	
Frame Type	=	Non-Ductile	
Level	:	BASE To BASEMENT1	
Design Code	=	IS 456 - 2000 + IS 13920 - 2016	
Grade Of Concrete	=	M60	N/sqmm
Grade Of Steel (Main)	=	Fe550	N/sqmm
Grade Of Steel (Shear)	=	Fe415	N/sqmm
Grade Of Steel - Flexural Design	=	Fe550	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Wall B	=	700	mm

Wall D	=	4550	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	4500	mm
Clear Floor Height @ D	=	3900	mm
No Of Floors	=	1	
No Of Walls In Group	=	1	
Wall Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	6.5 >= 4 Hence, Design as Wall	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	P41-X	
Load Combination	=	[1] : 1.5 (DEAD) +1.5 (DI) +1.5 (LL1) +1.5 (LL2) +1.5 (LL3)	
Critical Location	=	Bottom Joint	
Pu	=	46781.88	kN
Mux	=	136.27	kNm
Muy	=	124.66	kNm
Vux	=	80.3	kN
Vuy	=	66.25	kN

Effective Length Calculation

Calculation Along Major Axis Of Column

Joint	Column Stiffness	Beam Sizes		Beam Stiffness		Beta
		Beam 1 (Length x Width x Depth)	Beam 2 (Length x Width x Depth)	Beam 1	Beam 2	
	N-m x 10^6	mm	mm	N-m x 10^6	N-m x 10^6	
Bottom	189166.44	No Beam	No Beam	-	-	1
Top	189166.44	2000 x 600 x 600	6250 x 1000 x 600	638.937	340.766	0.998

Sway Condition (as per Stability Index)	=	Non Sway
Effective Length Factor along Major Axis	=	1

Calculation Along Minor Axis Of Column

Joint	Column Stiffness	Beam Sizes		Beam Stiffness		Beta
		Beam 1 (Length x Width x Depth)	Beam 2 (Length x Width x Depth)	Beam 1	Beam 2	
	N-m x 10^6	mm	mm	N-m x 10^6	N-m x 10^6	
Bottom	4477.312	No Beam	No Beam	-	-	1
Top	4477.312	No Beam	No Beam	-	-	1

Sway Condition (as per Stability Index)	=	Non Sway
Effective Length Factor along Minor axis	=	1

Minimum Eccentricity Check

Since Axial Force is compressive, Min. Eccentricity check to be performed

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	32.33	mm
Minimum Eccentricity	>	20	mm

Mminy	=	Pu x Minimum Eccentricity	
	=	1512.61	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	6.43	
	<	60	(Hence Ok)
Column Is Unbraced Along D			
Slenderness Check Along D:			
Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	0.86, Wall not Slender Along D	
Column Is Unbraced Along B			
Slenderness Check Along B:			
Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	6.43, Wall Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	136.27	---	136.27	0	136.27
Minor Axis - Muy	124.66	1512.61	1512.61	0	1512.61

Where

A	=	Moments directly from analysis
B	=	Moments due to minimum eccentricity
C	=	Maximum of analysis moment and min. eccentricity = Max (A,B)
E	=	Moment due to slenderness effect
F	=	Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	46781.88	kN
Mux	=	136.27	kNm
Muy	=	1512.61	kNm

Interaction Principle (Discrete Action)

Moment Capacity Check

Pt Calculated	=	0.42	
Reinforcement Provided	=	32-T16 + 24-T16 + 26-T10	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	84.85	deg
Corresponding NA angle (β)	=	90.13	deg
MRes	=	1518.74	kNm
MCap	=	8504.5	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.18 <= 1	

Wall Configuration

	Z1	Z2	Mid	Z2	Z1
Length (mm)	700	700	1750	700	700
Reinforcement	16-T16	12-T16	26-T10	12-T16	16-T16
Ast provided	3216.99	2412.74	2042.04	2412.74	3216.99
Pt as % of entire wall	0.1 %	0.08 %	0.06 %	0.08 %	0.1 %
Pt as % of zone	0.66 %	0.49 %	0.17 %	0.49 %	0.66 %

Design Of Shear

Shear Calculation	**Along D**	**Along B**
Critical Load Combination	[10] : 1.5 (DEAD) +1.5 (DI) +1.5 (SPECXMax)	[4] : 1.2 (DEAD) +1.2 (DI) +1.2 (LL1) +1.2 (LL2) +1.2 (LL3) +1.2 (SPECYMax)
Design shear force, Vu (kN)	594.2384	103.4067
Design shear stress, Tv (N/sqmm)	Vu / (B x 0.8 x D)	Vu / (B x 0.8 x D)
	0.2332	0.0406
Pt (%)	0.209	0.209
Height of Wall, Hw (mm)	3900	4500
Length of Wall, Lw (mm)	4550	700
Hw/Lw	0.8571	6.4286
	<= 1	> 1
Thus Shear Strength,Tc	3.0-(Hw/Lw) x K1 x SquareRoot(Fck)	K2 x SquareRoot(Fck)*(Hw/Lw + 1)/(Hw/Lw - 1)
K1	0.2	-
K2	-	0.045
Tc (N/sqmm)	3.3197	0.477
Tcmin	K3 x SquareRoot(Fck)	
K3	-	0.15
Tcmin (N/sqmm)	-	1.1619
Hence Design Tc (N/sqmm)	-	1.1619
Tcmax	0.17 x Fck	
	10.2	10.2
	Tc < Tcmax	Tc < Tcmax
Thus, Tc (N/sqmm)	3.3197	1.1619
	Since, Tv < Tc	Since, Tv < Tc
Shear Links Design	**Shear Links Not Required**	**Shear Links Not Required**

Design Of Links

Main Links

Links in the zone where special confining links are not required

Normal Links

Diameter of main horizontal steel	=	12	mm
Thus, Spacing	=	125	mm
Spacing of horizontal reinforcement is minimum of following			
D / 5	=	910	mm
3 x B	=	2100	mm
Maximum	=	450	mm
Spacing considered	=	125	mm

Table For Links

	Required			Provided	
	Normal Design	Shear Design	Ductile Design	Normal Zone	Ductile Zone
Link Dia.	12	---	---	12	---

Spacing	125	---	---	125	---

Secondary Links:
Other link T8@125c/c

General Data

Wall No.	:	P41-X	
Frame Type	=	Non-Ductile	
Level	:	BASEMENT1 To GROUND	
Design Code	=	IS 456 - 2000 + IS 13920 - 2016	
Grade Of Concrete	=	M60	N/sqmm
Grade Of Steel (Main)	=	Fe550	N/sqmm
Grade Of Steel (Shear)	=	Fe415	N/sqmm
Grade Of Steel - Flexural Design	=	Fe550	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Wall B	=	700	mm
Wall D	=	4550	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	3950	mm
Clear Floor Height @ D	=	3250	mm
No Of Floors	=	1	
No Of Walls In Group	=	1	
Wall Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	6.5 >= 4 Hence, Design as Wall	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	P41-X	
Load Combination	=	[14] : 1.5 (DEAD) +1.5 (DI) +1.5 (WINDX)	
Critical Location	=	Top Joint	
Pu	=	36841.38	kN
Mux	=	15215.59	kNm
Muy	=	898.23	kNm
Vux	=	-296	kN
Vuy	=	-3185.75	kN

Effective Length Calculation

Calculation Along Major Axis Of Column

Joint	Column Stiffness	Beam Sizes		Beam Stiffness		Beta
		Beam 1 (Length x Width x Depth)	Beam 2 (Length x Width x Depth)	Beam 1	Beam 2	
	N-m x 10^6	mm	mm	N-m x 10^6	N-m x 10^6	
Bottom	215506.071	2000 x 600 x 600	6250 x 1000 x 600	638.937	340.766	0.998
Top	215506.071	2000 x 1000 x 700	6250 x 1000 x 700	1691.013	541.124	0.994

Sway Condition (as per Stability Index) = Non Sway

Effective Length Factor along Major Axis = 1

Calculation Along Minor Axis Of Column

Joint	Column Stiffness	Beam Sizes		Beam Stiffness		Beta
		Beam 1 (Length x Width x Depth)	Beam 2 (Length x Width x Depth)	Beam 1	Beam 2	
	N-m x 10^6	mm	mm	N-m x 10^6	N-m x 10^6	
Bottom	5100.735	No Beam	No Beam	-	-	1
Top	5100.735	No Beam	No Beam	-	-	1

Sway Condition (as per Stability Index) = Non Sway

Effective Length Factor along Minor axis = 1

Minimum Eccentricity Check

Since Axial Force is compressive, Min. Eccentricity check to be performed

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity = Unsupported Length / 500 + B / 30

= 31.23 mm

Minimum Eccentricity > 20 mm

Mminy = Pu x Minimum Eccentricity

= 1150.68 kNm

Slenderness Check

Max Slenderness Ratio(L/B) = 5.64

< 60 (Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor = 1

Slenderness Ratio = Effective Length / D

= 0.71, Wall not Slender Along D

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor = 1

Slenderness Ratio = Effective Length / B

= 5.64, Wall Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	MsIndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	15215.59	---	15215.59	0	15215.59
Minor Axis - Muy	898.23	1150.68	1150.68	0	1150.68

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	36841.38	kN
Mux	=	15215.59	kNm
Muy	=	1150.68	kNm

Interaction Principle (Discrete Action)

Moment Capacity Check

Pt Calculated	=	0.42	
Reinforcement Provided	=	32-T16 + 24-T16 + 26-T10	
Load Angle	=	$Tan^{-1}(Muy/Mux)$	
	=	4.32	deg
Corresponding NA angle (β)	=	74.01	deg
MRes	=	15259.04	kNm
MCap	=	44637.72	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.34 <= 1	

Wall Configuration

	Z1	Z2	Mid	Z2	Z1
Length (mm)	700	700	1750	700	700
Reinforcement	16-T16	12-T16	26-T10	12-T16	16-T16
Ast provided	3216.99	2412.74	2042.04	2412.74	3216.99
Pt as % of entire wall	0.1 %	0.08 %	0.06 %	0.08 %	0.1 %
Pt as % of zone	0.66 %	0.49 %	0.17 %	0.49 %	0.66 %

Design Of Shear

Shear Calculation	Along D	Along B
Critical Load Combination	[14] : 1.5 (DEAD) +1.5 (DI) +1.5 (WINDX)	[8] : 1.2 (DEAD) +1.2 (DI) +1.2 (LL1) +1.2 (LL2) +1.2 (LL3) +1.2 (WINDY)
Design shear force, Vu (kN)	-3185.7467	-450.5503
Design shear stress, Tv (N/sqmm)	Vu / (B x 0.8 x D)	Vu / (B x 0.8 x D)
	1.2503	0.1768
Pt (%)	0.209	0.209
Height of Wall, Hw (mm)	3250	3950
Length of Wall, Lw (mm)	4550	700
Hw/Lw	0.7143	5.6429
	<= 1	> 1
Thus Shear Strength,Tc	3.0-(Hw/Lw) x K1 x SquareRoot(Fck)	K2 x SquareRoot(Fck)*(Hw/Lw + 1)/(Hw/Lw - 1)
K1	0.2	-
K2	-	0.045
Tc (N/sqmm)	3.541	0.4987
Tcmin	K3 x SquareRoot(Fck)	
K3	-	0.15
Tcmin (N/sqmm)	-	1.1619
Hence Design Tc (N/sqmm)	-	1.1619
Tcmax	0.17 x Fck	
	10.2	10.2
	Tc < Tcmax	Tc < Tcmax
Thus, Tc (N/sqmm)	3.541	1.1619
	Since, Tv < Tc	Since, Tv < Tc
Shear Links Design	**Shear Links Not Required**	**Shear Links Not Required**

Design Of Links

Main Links

Links in the zone where special confining links are not required

Normal Links

Diameter of main horizontal steel	=	12	mm
Thus, Spacing	=	125	mm
Spacing of horizontal reinforcement is minimum of following			
D / 5	=	910	mm
3 x B	=	2100	mm
Maximum	=	450	mm
Spacing considered	=	125	mm

Table For Links

	Required			Provided	
	Normal Design	Shear Design	Ductile Design	Normal Zone	Ductile Zone
Link Dia.	12	---	---	12	---
Spacing	125	---	---	125	---

Secondary Links:

Other link T8@125c/c

General Data

Wall No.	:	P41-X	
Frame Type	=	Non-Ductile	
Level	:	GROUND To 1ST	
Design Code	=	IS 456 - 2000 + IS 13920 - 2016	
Grade Of Concrete	=	M60	N/sqmm
Grade Of Steel (Main)	=	Fe550	N/sqmm
Grade Of Steel (Shear)	=	Fe415	N/sqmm
Grade Of Steel - Flexural Design	=	Fe550	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Wall B	=	700	mm
Wall D	=	4550	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	6000	mm
Clear Floor Height @ D	=	5200	mm
No Of Floors	=	1	
No Of Walls In Group	=	1	
Wall Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	6.5 >= 4 Hence, Design as Wall	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	P41-X	
Load Combination	=	[14] : 1.5 (DEAD) +1.5 (DI) +1.5 (WINDX)	
Critical Location	=	Bottom Joint	
Pu	=	35238.98	kN
Mux	=	16706.76	kNm
Muy	=	189.32	kNm
Vux	=	112.65	kN
Vuy	=	951.99	kN

Effective Length Calculation

Calculation Along Major Axis Of Column

Joint	Column Stiffness	Beam Sizes		Beam Stiffness		Beta
		Beam 1 (Length x Width x Depth)	Beam 2 (Length x Width x Depth)	Beam 1	Beam 2	
	N-m x 10^6	mm	mm	N-m x 10^6	N-m x 10^6	
Bottom	141874.83	2000 x 1000 x 700	6250 x 1000 x 700	1691.013	541.124	0.994
Top	141874.83	2000 x 600 x 800	6250 x 600 x 800	1514.516	484.645	0.995

Sway Condition (as per Stability Index)	=	Sway	
Effective Length Factor along Major Axis	=	1	

Calculation Along Minor Axis Of Column

Joint	Column Stiffness	Beam Sizes		Beam Stiffness		Beta
		Beam 1 (Length x Width x Depth)	Beam 2 (Length x Width x Depth)	Beam 1	Beam 2	
	N-m x 10^6	mm	mm	N-m x 10^6	N-m x 10^6	
Bottom	3357.984	No Beam	No Beam	-	-	1
Top	3357.984	No Beam	No Beam	-	-	1

Sway Condition (as per Stability Index)	=	Sway	
Effective Length Factor along Minor axis	=	1	

Minimum Eccentricity Check

Since Axial Force is compressive, Min. Eccentricity check to be performed

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	35.33	mm
Minimum Eccentricity	>	20	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	1245.11	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	8.57	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	1.14, Wall not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	

Slenderness Ratio	=	Effective Length / B	
	=	8.57, Wall Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	16706.76	---	16706.76	0	16706.76
Minor Axis - Muy	189.32	1245.11	1245.11	0	1245.11

Where

A	=	Moments directly from analysis
B	=	Moments due to minimum eccentricity
C	=	Maximum of analysis moment and min. eccentricity = Max (A,B)
E	=	Moment due to slenderness effect
F	=	Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	35238.98	kN
Mux	=	16706.76	kNm
Muy	=	1245.11	kNm

Interaction Principle (Discrete Action)

Moment Capacity Check

Pt Calculated	=	0.42	
Reinforcement Provided	=	32-T16 + 24-T16 + 26-T10	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	4.26	deg
Corresponding NA angle (β)	=	73.77	deg
MRes	=	16753.09	kNm
MCap	=	44619.08	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.38 <= 1	

Wall Configuration

	Z1	Z2	Mid	Z2	Z1
Length (mm)	700	700	1750	700	700
Reinforcement	16-T16	12-T16	26-T10	12-T16	16-T16
Ast provided	3216.99	2412.74	2042.04	2412.74	3216.99
Pt as % of entire wall	0.1 %	0.08 %	0.06 %	0.08 %	0.1 %
Pt as % of zone	0.66 %	0.49 %	0.17 %	0.49 %	0.66 %

Design Of Shear

Shear Calculation	Along D	Along B
Critical Load Combination	[15] : 1.5 (DEAD) +1.5 (DI) -1.5 (WINDX)	[16] : 1.5 (DEAD) +1.5 (DI) +1.5 (WINDY)
Design shear force, Vu (kN)	-1104.2181	133.0522
Design shear stress, Tv (N/sqmm)	Vu / (B x 0.8 x D)	Vu / (B x 0.8 x D)
	0.4334	0.0522

Pt (%)	0.209	0.209
Height of Wall, Hw (mm)	5200	6000
Length of Wall, Lw (mm)	4550	700
Hw/Lw	1.1429	8.5714
	> 1	> 1
Thus Shear Strength,Tc	K2 x SquareRoot(Fck)*(Hw/Lw + 1)/(Hw/Lw - 1)	
K1	-	-
K2	0.045	0.045
Tc (N/sqmm)	5.2285	0.4406
Tcmin	K3 x SquareRoot(Fck)	
K3	0.15	0.15
Tcmin (N/sqmm)	1.1619	1.1619
Hence Design Tc (N/sqmm)	5.2285	1.1619
Tcmax	0.17 x Fck	
	10.2	10.2
	Tc < Tcmax	Tc < Tcmax
Thus, Tc (N/sqmm)	5.2285	1.1619
	Since, Tv < Tc	Since, Tv < Tc
Shear Links Design	**Shear Links Not Required**	**Shear Links Not Required**

Design Of Links

Main Links

Links in the zone where special confining links are not required

Normal Links

Diameter of main horizontal steel	=	12	mm
Thus, Spacing	=	125	mm
Spacing of horizontal reinforcement is minimum of following			
D / 5	=	910	mm
3 x B	=	2100	mm
Maximum	=	450	mm
Spacing considered	=	125	mm

Table For Links

	Required			Provided	
	Normal Design	Shear Design	Ductile Design	Normal Zone	Ductile Zone
Link Dia.	12	---	---	12	---
Spacing	125	---	---	125	---

Secondary Links:

Other link T8@125c/c

General Data

Wall No.	:	P41-X	
Frame Type	=	Non-Ductile	
Level	:	1ST To 2ND	
Design Code	=	IS 456 - 2000 + IS 13920 - 2016	
Grade Of Concrete	=	M60	N/sqmm
Grade Of Steel (Main)	=	Fe550	N/sqmm

Grade Of Steel (Shear)	=	Fe415	N/sqmm
Grade Of Steel - Flexural Design	=	Fe550	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Wall B	=	700	mm
Wall D	=	4550	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	3300	mm
Clear Floor Height @ D	=	2700	mm
No Of Floors	=	1	
No Of Walls In Group	=	1	
Wall Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	6.5 >= 4 Hence, Design as Wall	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	P41-X	
Load Combination	=	[14] : 1.5 (DEAD) +1.5 (DI) +1.5 (WINDX)	
Critical Location	=	Bottom Joint	
Pu	=	33293.33	kN
Mux	=	13468.85	kNm
Muy	=	211.72	kNm
Vux	=	-113.67	kN
Vuy	=	1551.71	kN

Effective Length Calculation

Calculation Along Major Axis Of Column

Joint	Column Stiffness	Beam Sizes		Beam Stiffness		Beta
		Beam 1 (Length x Width x Depth)	Beam 2 (Length x Width x Depth)	Beam 1	Beam 2	
	N-m x 10^6	mm	mm	N-m x 10^6	N-m x 10^6	
Bottom	257954.236	2000 x 600 x 800	6250 x 600 x 800	1514.516	484.645	0.995
Top	257954.236	2000 x 450 x 600	6250 x 450 x 600	479.202	153.345	0.999

Sway Condition (as per Stability Index)	=	Sway
Effective Length Factor along Major Axis	=	1

Calculation Along Minor Axis Of Column

Joint	Column Stiffness	Beam Sizes		Beam Stiffness		Beta
		Beam 1 (Length x Width x Depth)	Beam 2 (Length x Width x Depth)	Beam 1	Beam 2	
	N-m x 10^6	mm	mm	N-m x 10^6	N-m x 10^6	
Bottom	6105.426	No Beam	No Beam	-	-	1
Top	6105.426	No Beam	No Beam	-	-	1

Sway Condition (as per Stability Index)	=	Sway
Effective Length Factor along Minor axis	=	1

Minimum Eccentricity Check

Since Axial Force is compressive, Min. Eccentricity check to be performed

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :			
Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	29.93	mm
Minimum Eccentricity	>	20	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	996.58	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	4.71	
	<	60	(Hence Ok)
Column Is Unbraced Along D			
Slenderness Check Along D:			
Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	0.59, Wall not Slender Along D	
Column Is Unbraced Along B			
Slenderness Check Along B:			
Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	4.71, Wall Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	13468.85	---	13468.85	0	13468.85
Minor Axis - Muy	211.72	996.58	996.58	0	996.58

Where

A	=	Moments directly from analysis
B	=	Moments due to minimum eccentricity
C	=	Maximum of analysis moment and min. eccentricity = Max (A,B)
E	=	Moment due to slenderness effect
F	=	Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	33293.33	kN
Mux	=	13468.85	kNm
Muy	=	996.58	kNm

Interaction Principle (Discrete Action)

Moment Capacity Check

Pt Calculated	=	0.42	
Reinforcement Provided	=	32-T16 + 24-T16 + 26-T10	
Load Angle	=	$Tan^{-1}(Muy/Mux)$	
	=	4.23	deg
Corresponding NA angle (β)	=	73.57	deg
MRes	=	13505.67	kNm

MCap	=	44352.38	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.3 <= 1	

Wall Configuration

	Z1	Z2	Mid	Z2	Z1
Length (mm)	700	700	1750	700	700
Reinforcement	16-T16	12-T16	26-T10	12-T16	16-T16
Ast provided	3216.99	2412.74	2042.04	2412.74	3216.99
Pt as % of entire wall	0.1 %	0.08 %	0.06 %	0.08 %	0.1 %
Pt as % of zone	0.66 %	0.49 %	0.17 %	0.49 %	0.66 %

Design Of Shear

Shear Calculation	Along D	Along B
Critical Load Combination	[14] : 1.5 (DEAD) +1.5 (DI) +1.5 (WINDX)	[13] : 1.5 (DEAD) +1.5 (DI) -1.5 (SPECYMax)
Design shear force, Vu (kN)	1551.7087	-131.0281
Design shear stress, Tv (N/sqmm)	Vu / (B x 0.8 x D)	Vu / (B x 0.8 x D)
	0.609	0.0514
Pt (%)	0.209	0.209
Height of Wall, Hw (mm)	2700	3300
Length of Wall, Lw (mm)	4550	700
Hw/Lw	0.5934	4.7143
	<= 1	> 1
Thus Shear Strength,Tc	3.0-(Hw/Lw) x K1 x SquareRoot(Fck)	K2 x SquareRoot(Fck)*(Hw/Lw + 1)/(Hw/Lw - 1)
K1	0.2	-
K2	-	0.045
Tc (N/sqmm)	3.7283	0.5363
Tcmin	K3 x SquareRoot(Fck)	
K3	-	0.15
Tcmin (N/sqmm)	-	1.1619
Hence Design Tc (N/sqmm)	-	1.1619
Tcmax	0.17 x Fck	
	10.2	10.2
	Tc < Tcmax	Tc < Tcmax
Thus, Tc (N/sqmm)	3.7283	1.1619
	Since, Tv < Tc	Since, Tv < Tc
Shear Links Design	**Shear Links Not Required**	**Shear Links Not Required**

Design Of Links

Main Links

Links in the zone where special confining links are not required

Normal Links

Diameter of main horizontal steel	=	12	mm
Thus, Spacing	=	125	mm
Spacing of horizontal reinforcement is minimum of following			
D / 5	=	910	mm
3 x B	=	2100	mm
Maximum	=	450	mm
Spacing considered	=	125	mm

Table For Links

	Required			Provided	
	Normal Design	Shear Design	Ductile Design	Normal Zone	Ductile Zone
Link Dia.	12	---	---	12	---
Spacing	125	---	---	125	---

Secondary Links:
Other link T8@125c/c

General Data

Wall No.	:	P41-X	
Frame Type	=	Non-Ductile	
Level	:	2ND To 3RD	
Design Code	=	IS 456 - 2000 + IS 13920 - 2016	
Grade Of Concrete	=	M60	N/sqmm
Grade Of Steel (Main)	=	Fe550	N/sqmm
Grade Of Steel (Shear)	=	Fe415	N/sqmm
Grade Of Steel - Flexural Design	=	Fe550	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Wall B	=	700	mm
Wall D	=	4550	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2600	mm
Clear Floor Height @ D	=	2700	mm
No Of Floors	=	1	
No Of Walls In Group	=	1	
Wall Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	6.5 >= 4 Hence, Design as Wall	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	P41-X	
Load Combination	=	[14] : 1.5 (DEAD) +1.5 (DI) +1.5 (WINDX)	
Critical Location	=	Bottom Joint	
Pu	=	32832.15	kN
Mux	=	8951.83	kNm
Muy	=	562.91	kNm
Vux	=	-105.74	kN
Vuy	=	1242	kN

Effective Length Calculation

Calculation Along Major Axis Of Column

Joint	Column Stiffness	Beam Sizes		Beam Stiffness		Beta
		Beam 1 (Length x Width x Depth)	Beam 2 (Length x Width x Depth)	Beam 1	Beam 2	

	N-m x 10^6	mm	mm	N-m x 10^6	N-m x 10^6	
Bottom	257954.236	2000 x 450 x 600	6250 x 450 x 600	479.202	153.345	0.999
Top	257954.236	2000 x 600 x 600	6250 x 1000 x 700	638.937	541.124	0.998

Sway Condition (as per Stability Index) = Sway

Effective Length Factor along Major Axis = 1

Calculation Along Minor Axis Of Column

Joint	Column Stiffness	Beam Sizes		Beam Stiffness		Beta
		Beam 1 (Length x Width x Depth)	Beam 2 (Length x Width x Depth)	Beam 1	Beam 2	
	N-m x 10^6	mm	mm	N-m x 10^6	N-m x 10^6	
Bottom	6105.426	No Beam	No Beam	-	-	1
Top	6105.426	No Beam	4700 x 1000 x 700	-	719.58	0.944

Sway Condition (as per Stability Index) = Sway

Effective Length Factor along Minor axis = 1

Minimum Eccentricity Check

Since Axial Force is compressive, Min. Eccentricity check to be performed

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity = Unsupported Length / 500 + B / 30

= 28.53 mm

Minimum Eccentricity > 20 mm

Mminy = Pu x Minimum Eccentricity

= 936.81 kNm

Slenderness Check

Max Slenderness Ratio(L/B) = 3.71

< 60 (Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor = 1

Slenderness Ratio = Effective Length / D

= 0.59, Wall not Slender Along D

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor = 1

Slenderness Ratio = Effective Length / B

= 3.71, Wall Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	8951.83	---	8951.83	0	8951.83
Minor Axis - Muy	562.91	936.81	936.81	0	936.81

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	32832.15	kN
Mux	=	8951.83	kNm
Muy	=	936.81	kNm

Interaction Principle (Discrete Action)

Moment Capacity Check

Pt Calculated	=	0.42	
Reinforcement Provided	=	32-T16 + 24-T16 + 26-T10	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	5.97	deg
Corresponding NA angle (β)	=	77.89	deg
MRes	=	9000.72	kNm
MCap	=	40207.71	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.22 <= 1	

Wall Configuration

	Z1	Z2	Mid	Z2	Z1
Length (mm)	700	700	1750	700	700
Reinforcement	16-T16	12-T16	26-T10	12-T16	16-T16
Ast provided	3216.99	2412.74	2042.04	2412.74	3216.99
Pt as % of entire wall	0.1 %	0.08 %	0.06 %	0.08 %	0.1 %
Pt as % of zone	0.66 %	0.49 %	0.17 %	0.49 %	0.66 %

Design Of Shear

Shear Calculation	Along D	Along B
Critical Load Combination	[14] : 1.5 (DEAD) +1.5 (DI) +1.5 (WINDX)	[13] : 1.5 (DEAD) +1.5 (DI) -1.5 (SPECYMax)
Design shear force, Vu (kN)	1242	-108.1762
Design shear stress, Tv (N/sqmm)	Vu / (B x 0.8 x D)	Vu / (B x 0.8 x D)
	0.4874	0.0425
Pt (%)	0.209	0.209
Height of Wall, Hw (mm)	2700	2600
Length of Wall, Lw (mm)	4550	700
Hw/Lw	0.5934	3.7143
	<= 1	> 1
Thus Shear Strength,Tc	3.0-(Hw/Lw) x K1 x SquareRoot(Fck)	K2 x SquareRoot(Fck)*(Hw/Lw + 1)/(Hw/Lw - 1)
K1	0.2	-
K2	-	0.045
Tc (N/sqmm)	3.7283	0.6054
Tcmin	K3 x SquareRoot(Fck)	
K3	-	0.15
Tcmin (N/sqmm)	-	1.1619
Hence Design Tc (N/sqmm)	-	1.1619
Tcmax	0.17 x Fck	
	10.2	10.2

	Tc < Tcmax	Tc < Tcmax
Thus, Tc (N/sqmm)	3.7283	1.1619
	Since, Tv < Tc	Since, Tv < Tc
Shear Links Design	**Shear Links Not Required**	**Shear Links Not Required**

Design Of Links

Main Links

Links in the zone where special confining links are not required

Normal Links

Diameter of main horizontal steel	=	12	mm
Thus, Spacing	=	125	mm
Spacing of horizontal reinforcement is minimum of following			
D / 5	=	910	mm
3 x B	=	2100	mm
Maximum	=	450	mm
Spacing considered	=	125	mm

Table For Links

	Required			Provided	
	Normal Design	Shear Design	Ductile Design	Normal Zone	Ductile Zone
Link Dia.	12	---	---	12	---
Spacing	125	---	---	125	---

Secondary Links:

Other link T8@125c/c

General Data

Wall No.	:	P41-X	
Frame Type	=	Non-Ductile	
Level	:	3RD To 4TH	
Design Code	=	IS 456 - 2000 + IS 13920 - 2016	
Grade Of Concrete	=	M60	N/sqmm
Grade Of Steel (Main)	=	Fe550	N/sqmm
Grade Of Steel (Shear)	=	Fe415	N/sqmm
Grade Of Steel - Flexural Design	=	Fe550	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Wall B	=	700	mm
Wall D	=	4550	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	3275	mm
No Of Floors	=	1	
No Of Walls In Group	=	1	
Wall Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	6.5 >= 4 Hence, Design as Wall	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	P41-X	
Load Combination	=	[10] : 1.5 (DEAD) +1.5 (DI) +1.5 (SPECXMax)	
Critical Location	=	Bottom Joint	
Pu	=	30840.15	kN
Mux	=	9398.71	kNm
Muy	=	-1834.57	kNm
Vux	=	-560.9	kN
Vuy	=	2680.93	kN

Effective Length Calculation

Calculation Along Major Axis Of Column

Joint	Column Stiffness	Beam Sizes		Beam Stiffness		Beta
		Beam 1 (Length x Width x Depth)	Beam 2 (Length x Width x Depth)	Beam 1	Beam 2	
	N-m x 10^6	mm	mm	N-m x 10^6	N-m x 10^6	
Bottom	257954.236	2000 x 600 x 600	6250 x 1000 x 700	638.937	541.124	0.998
Top	257954.236	2000 x 200 x 750	2000 x 25 x 25	415.974	0.002	0.998

Sway Condition (as per Stability Index)	=	Sway	
Effective Length Factor along Major Axis	=	1	

Calculation Along Minor Axis Of Column

Joint	Column Stiffness	Beam Sizes		Beam Stiffness		Beta
		Beam 1 (Length x Width x Depth)	Beam 2 (Length x Width x Depth)	Beam 1	Beam 2	
	N-m x 10^6	mm	mm	N-m x 10^6	N-m x 10^6	
Bottom	6105.426	No Beam	4700 x 1000 x 700	-	719.58	0.944
Top	6105.426	6200 x 200 x 750	No Beam	134.185	-	0.979

Sway Condition (as per Stability Index)	=	Sway	
Effective Length Factor along Minor axis	=	1	

Minimum Eccentricity Check

Since Axial Force is compressive, Min. Eccentricity check to be performed

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	158.22	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	4879.43	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	3.64	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	0.72, Wall not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / B
	=	3.64, Wall Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	9398.71	4879.43	9398.71	0	9398.71
Minor Axis - Muy	-1834.57	---	-1834.57	0	-1834.57

Where

A	=	Moments directly from analysis
B	=	Moments due to minimum eccentricity
C	=	Maximum of analysis moment and min. eccentricity = Max (A,B)
E	=	Moment due to slenderness effect
F	=	Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	30840.15	kN
Mux	=	9398.71	kNm
Muy	=	-1834.57	kNm

Interaction Principle (Discrete Action)

Moment Capacity Check

Pt Calculated	=	0.42	
Reinforcement Provided	=	32-T16 + 24-T16 + 26-T10	
Load Angle	=	$Tan^{-1}(Muy/Mux)$	
	=	11.04	deg
Corresponding NA angle (β)	=	81.34	deg
MRes	=	9576.08	kNm
MCap	=	29942.43	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.32 <= 1	

Wall Configuration

	Z1	Z2	Mid	Z2	Z1
Length (mm)	700	700	1750	700	700
Reinforcement	16-T16	12-T16	26-T10	12-T16	16-T16
Ast provided	3216.99	2412.74	2042.04	2412.74	3216.99
Pt as % of entire wall	0.1 %	0.08 %	0.06 %	0.08 %	0.1 %
Pt as % of zone	0.66 %	0.49 %	0.17 %	0.49 %	0.66 %

Design Of Shear

Shear Calculation	Along D	Along B

Critical Load Combination	[12] : 1.5 (DEAD) +1.5 (DI) +1.5 (SPECYMax)	[13] : 1.5 (DEAD) +1.5 (DI) -1.5 (SPECYMax)
Design shear force, Vu (kN)	2706.394	-609.965
Design shear stress, Tv (N/sqmm)	Vu / (B x 0.8 x D)	Vu / (B x 0.8 x D)
	1.0622	0.2394
Pt (%)	0.209	0.209
Height of Wall, Hw (mm)	3275	2550
Length of Wall, Lw (mm)	4550	700
Hw/Lw	0.7198	3.6429
	<= 1	> 1
Thus Shear Strength,Tc	3.0-(Hw/Lw) x K1 x SquareRoot(Fck)	K2 x SquareRoot(Fck)*(Hw/Lw + 1)/(Hw/Lw - 1)
K1	0.2	-
K2	-	0.045
Tc (N/sqmm)	3.5325	0.6124
Tcmin	K3 x SquareRoot(Fck)	
K3	-	0.15
Tcmin (N/sqmm)	-	1.1619
Hence Design Tc (N/sqmm)	-	1.1619
Tcmax	0.17 x Fck	
	10.2	10.2
	Tc < Tcmax	Tc < Tcmax
Thus, Tc (N/sqmm)	3.5325	1.1619
	Since, Tv < Tc	Since, Tv < Tc
Shear Links Design	**Shear Links Not Required**	**Shear Links Not Required**

Design Of Links

Main Links

Links in the zone where special confining links are not required

Normal Links

Diameter of main horizontal steel	=	12	mm
Thus, Spacing	=	125	mm
Spacing of horizontal reinforcement is minimum of following			
D / 5	=	910	mm
3 x B	=	2100	mm
Maximum	=	450	mm
Spacing considered	=	125	mm

Table For Links

	Required			Provided	
	Normal Design	Shear Design	Ductile Design	Normal Zone	Ductile Zone
Link Dia.	12	---	---	12	---
Spacing	125	---	---	125	---

Secondary Links:

Other link T8@125c/c

General Data

Wall No.	:	P41-X
Frame Type	=	Non-Ductile

Level	:	4TH To 5TH	
Design Code	=	IS 456 - 2000 + IS 13920 - 2016	
Grade Of Concrete	=	M60	N/sqmm
Grade Of Steel (Main)	=	Fe550	N/sqmm
Grade Of Steel (Shear)	=	Fe415	N/sqmm
Grade Of Steel - Flexural Design	=	Fe550	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Wall B	=	350	mm
Wall D	=	1700	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	3300	mm
Clear Floor Height @ D	=	2450	mm
No Of Floors	=	1	
No Of Walls In Group	=	1	
Wall Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	4.86 >= 4 Hence, Design as Wall	

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Flexural Design (Analysis Forces)

Analysis Reference No.	=	P41-X-1	
Load Combination	=	[15] : 1.5 (DEAD) +1.5 (DI) -1.5 (WINDX)	
Critical Location	=	Top Joint	
Pu	=	17936.57	kN
Mux	=	-747.28	kNm
Muy	=	-63.98	kNm
Vux	=	65.96	kN
Vuy	=	255.67	kN

Effective Length Calculation

Calculation Along Major Axis Of Column

Joint	Column Stiffness	Beam Sizes		Beam Stiffness		Beta
		Beam 1 (Length x Width x Depth)	Beam 2 (Length x Width x Depth)	Beam 1	Beam 2	
	N-m x 10^6	mm	mm	N-m x 10^6	N-m x 10^6	
Bottom	6727.059	No Beam	2000 x 25 x 25	-	0.002	0.998
Top	6727.059	900 x 200 x 850	1400 x 200 x 850	1345.634	865.051	0.859

Sway Condition (as per Stability Index)	=	Sway
Effective Length Factor along Major Axis	=	1

Calculation Along Minor Axis Of Column

Joint	Column Stiffness	Beam Sizes		Beam Stiffness		Beta
		Beam 1 (Length x Width x Depth)	Beam 2 (Length x Width x Depth)	Beam 1	Beam 2	
	N-m x 10^6	mm	mm	N-m x 10^6	N-m x 10^6	
Bottom	285.144	No Beam	No Beam	-	-	0.979
Top	285.144	No Beam	No Beam	-	-	1

Sway Condition (as per Stability Index)	=	Sway
Effective Length Factor along Minor axis	=	1



our services doesn't just end there

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Property Buying Assistance, Property Selling Support, Market Price Analysis, Owner Outreach and Negotiation.

Legal & Documentation Services

Certified EC, Patta, legal opinions, property verification, due diligence, litigation solutions, and legal heir certificates.

Property Development & Approvals

Building plan approvals, construction, layout and sub-division approvals, zone conversion, and occupancy certification.

NRI & Investment Services

Escrow Services, Rentals, Litigation Solutions, Property Valuation and Property Management

Compliance & Special Services

Demolition, Vaasthu checks, regularization of unauthorized buildings, and office space solutions.



empowering your real estate decisions with smart tools

Property Valuation & Cost Estimation

Guideline Value, Apartment Composite Value, Stamp Duty & Registration Fees Calculator, Building Value Calculator, Capital Gains Calculator, Area Unit Converter, Length Unit Converter

Ownership, Compliance & Legal Verification

Encumbrance Certificate (EC) Search, Find Your SRO, Temple Property Check, WAQF Property Check, View Patta/Chitta, View FMB, Patta Analyzer, EC Analyzer

Zoning & Land Use Analysis

Land Use Zone Finder, CRZ Zone Check, Aquifer Zone Check, CBA Check, EWS Check, Road Width Check, Proposed Road Widening Check, FSI Calculator

Property Documentation & Workflow Tools

Forms & Templates, Document Generator, Document Translation, Dictionary

Vastu & Property Management Tools

Home Vastu Shastra, Plot Vastu Shastra, Property Management

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