STRUCTURAL DESIGN BASIS REPORT

THE PROPOSED CONSTRUCTION OF STILT FLOOR + 5 FLOORS RESIDENTIAL BUILDING WITH 49 DWELLING UNITS (AFFORDABLE HOUSING) AT PUBLIC PURPOSE PLOT-I IN CMDA APPROVED LAYOUT P.P.D/L.O. NO. 38/2017, 5TH MAIN ROAD, ROYAL STAR NAGAR, AYAPAKKAM, CHENNAI-600 077, COMPRISED IN S.NOS. 343/2B1 PART, 343/2E1 PART, 343/2E2 PART, 345/1A PART AND 345/1B PART OF AYAPAKKAM VILLAGE WITHIN THE LIMITS OF VILLIVAKKAM PANCHAYAT UNION.

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STRUCTURAL DESIGN BASIS REPORT

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1) GENERAL PROJECT DETAILS

Structural Design Introduction

The proposed structure is STILT+5 Storey residential apartment building situated at Ayapakkam village,chennai, India. In this brief report we are presenting the data and assumptions related to the project, which has lead to the conceptual design at this preliminary stage. The document attempts to record all inputs assumed in design and will form the basis for all future detailed structural work.

The report most importantly clarifies the load criteria assumed in the design and it is therefore expected that all related consultants, including the architects, would go through the document and refer to it at every stage of detailed design. Recommendations or revisions on assumed parameters are requested at this stage.

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

2. List of References:

IS 456-2000	Plain and reinforced concrete-code of practice
IS 875	Code Of practice for design loads for buildings and structures
Part 1: 1987	dead loads- unit weights of building material and stored material
Part 2: 1987	Imposed loads
Part 3: 1987	Wind loads
IS 1893: 2016	Criteria for earthquake resistant design of structures
IS1904-1986 (Reaffirmed 2006)	Code of practice for design & construction of foundation in soils
IS 4326:1993	Code of practice for earthquake resistant design and construction of buildings
IS 13920: 1993	Code of practice for ductile detailing of reinforced concrete structures subjected to seismic forces
BS 8110 : 1997	Plain and reinforced concrete-code of practice(British standard)
ACI 318	Plain and reinforced concrete-code of practice (American standard)
CP65	Plain and reinforced concrete-code of practice (Singapore standard)
IS 800:1984 & 2007	Code of practice for general construction in steel
IS 1343:2012	Code of practice for pre-stressed concrete (First Revision)
Reynolds Handbook	
IS 3414	Code of practice for joints in the buildings
IS 3370 Part 1 TO 4	Code of practice for liquid retaining structures
BS-8007	Code of practice for liquid retaining structures for crack width calculation
Soil Report	

3. Material, Workmanship, Inspection and Testing:

The proposed RCC structure will consists of concrete and steel reinforcement as the two main materials used for construction of the structure. The specifications for these materials are discussed in this chapter

3.1 Concrete:

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

Pile/Pilecap	M30
Shear wall/lift	M30
Beams/Slabs	M30
Water Tanks	M30

Any other structural member will be in general designed in M30.

3.2 Durability of concrete

The structure is located in Coimbatore, where the climatic conditions are considered as moderate. Concrete grade of submerged structural elements will be a minimum of M20. Nominal covers shall not be less than 30 mm from a durability point of view.

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

Structural Element	Clear Cover in mm
Slabs	25
Beams	30
Shear walls/Shear wall	40
Footings	50
Structural elements under ground	50

3.3 Reinforcement:

The reinforcement shall be high strength deformed steel bars with yield strength of 550 N/mm^2 confirming to IS: 1786.

3.4 Structural Steel

The structural steel to be used shall confirm to IS 800

4) Foundation system:

Pile capacity as per the soil investigation report is 1000 Kn for 500 mm dia. Pile. Depth of the pile 12 m from EGL.

Axial Capacity – 650 KN

Pull out capacity – 250 KN

Lateral Capacity – 18 KN

5) General design considerations:

5.1 Method of Design

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

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

Retaining walls will be designed to resist backfill loads as per the section at the wall. Saturated soil density is 20 KN/m3. The angle of shear resistance is assumed to be 30^{o}. The water pressure due to the static water between the clay and the wall is also considered in design.

5.2 Loads and Forces

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

5.2(a) Dead Loads

The dead loads are calculated on the basis of unit weights of materials given in IS 875 (Part 1) the data provided by consultant and other service consultants will be used for the specific materials/equipment.

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

Reinforced Concrete	25 kN/cum
Plain concrete	24 kN/cum
Brickwork	20 kN/cum
Soil dry	16 kN/cum
Floor finishes	20 kN/cum
Structural steel	78.5 kN/cum
Water	9.81 kN/cum

5.2 b Load Combinations considered:

1. 1.5D+1.5L
2. 1.2D+1.2L+1.2WX
3. 1.2D+1.2L-1.2WX
4. 1.2D+1.2L+1.2WZ
5. 1.2D+1.2L-1.2WZ
6. 0.9D+1.5WX
7. 0.9D-1.5WX
8. 0.9D+1.5WZ
9. 0.9D-1.5WZ
10. 1.5D+1.5WX
11. 1.5D-1.5WX
12. 1.5D+1.5WZ
13. 1.5D-1.5WZ
14. 1.2D+1.2L+1.2SX
15. 1.2D+1.2L-1.2SX
16. 1.2D+1.2L+1.2SZ
17. 1.2D+1.2L-1.2SZ
18. 0.9D+1.5SX
19. 0.9D-1.5SX
20. 0.9D+1.5SZ
21. 0.9D-1.5SZ
22. 1.5D+1.5SX
23. 1.5D-1.5SX
24. 1.5D+1.5SZ
25. 1.5D-1.5SZ
26. 1.2DL+1.2TL
27. 1.2DL+1.2LL+1.2TL
28. 1.2DL+1.2LL+1.2WX+1.2TL
29. 1.2DL+1.2LL +1.2WY+1.2TL
30. 1.2DL+1.2LL +1.2SX+1.2TL
31. 1.2DL+1.2LL +1.2SY+1.2TL

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

1. DL+ LL
2. DL + 0.8 LL ± 0.8WX
3. DL + 0.8 LL ± 0.8WY
4. DL ± WX
5. DL ± WY

6. DL + 0.8 LL ± 0.8SX
7. DL + 0.8 LL ± 0.8SY
8. DL± SX
9. DL± SY

Software's for the analysis & design:

a. ETABS
b. Adapt / Safe
c. Excel program sheet
d. RCDC

6.0 Residential building

6.1 Residential apartment building:

The special features for this building are listed as below.

The proposed building is residential building. Stilt floor is intended for parking, and toilets, drive ways. Above stilt floor typical floors are intended for residential purpose which includes 1st to 5th floors and terrace , LMR floor above it.

6.1a Imposed Loads:

Imposed loads are assumed in accordance with IS 875 part 2, as follows. The table listed below is a summary of these loads.

Sr.No.	Area Description	Floor Finish	Live load	Super imposed dead load	Remark / comment
		kN/sq.m	kN/sq.m		
1	All rooms and kitchens	1	2	-	
2	Staircase	1	3	3	-
3	Lobby/corridor/passage / Balconies	1	3	3	-
4	Toilet	1	2	-	-
5	Terrace	1	2	3	150 mm water proofing considered.

6.1b Analysis Approach

Structural Geometry:

The structure consists of 8 slabs. The slabs with their description, levels, heightsand approximate areas are given in table below:

Floor	Height
Lmr	2.4
Head room	2.75
Terrace	3.05

5th	3.05
4th	3.05
3rd	3.05
2nd	3.05
1st	3.05
Total	23.45

Structural Frames

The proposed building is RCC frame structure, with shear walls & RCC beam framing is proposed for the typical floor system. After taking into considerations the feasibility of particular system, clear height available for particular floor, mobility of the services below slab, cost estimation, provision of openings in the slab, approval of architects, other consultants and client, the final framing system has been arrived.

6.1c Seismic Analysis:

6.1c (i) General Principles and design criteria

The structure is located in the seismic zone III. The design lateral force will calculated as per the method described in the following paragraphs. The structure is primarily shear wall and beam framing system although due considerations will be given to the major suggestions/clauses from IS:13920, the basic frame is assumed to be as column structure, as per Table 7.

6.1c (ii) Design Spectrum

Seismic Analysis (Initial analysis for preliminary shear wall sizing)The design Horizontal seismic coefficient for a structure

Ah= Z I Sa   IS:1893-2016 Clause 6.4.2

2

R g

Where,

Z = Zone factor 0.16 for Zone IV   Table 2

I = Importance Factor (1.5)   Table 6

R =Response reduction factor 5   For Shear wall building from Table 7

Sa/g =Average Response acceleration coefficient

$T = 0.075\ h^{0.75}$ For RC frame building
Clause 7.6 Where,

T is Fundamental natural period h = Height of the structure

$T = 0.075 \times 23.45^{0.75}$

=0.8

Sa/g = 2.45

Design Seismic Base shear $V_b = A_h W$

Where,

W = seismic weight Ah = 0.06

6.1(d) Wind Loads

Wind load for design of structures shall be based on the design wind speed arrived from IS: 875 (Part3)-1987.

The parameters for calculation of design wind speed as per IS: 875 (Part 3)-1987.

Basic wind speed, V_b : 50 m/ sec.

Risk Coefficient, K1 : 1

(If design life of structure taken as 50 yrs.)

Terrain, Height, Structure size factor, K2 : To suit the height of the structure for Terrain category-2 & class c is 1.11

Topography factor, K3. : 1.0.

K4 factor value : 1.0

Design Wind Speed Vz : 55.5 m/s.

Design Wind Pressure Pz : $0.6x\ (55.5)^2 = 1848\ N/m^2$

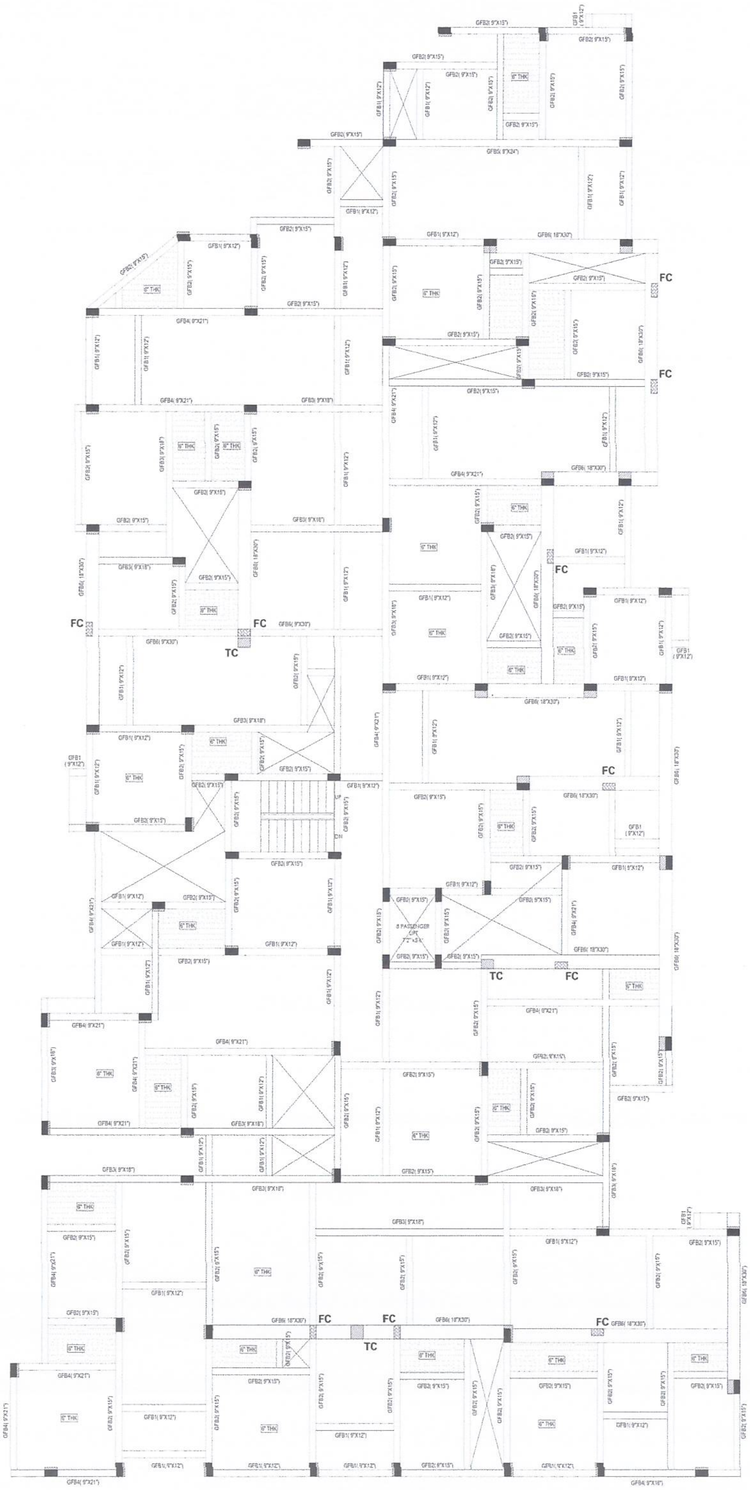
7 Conclusions.

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

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

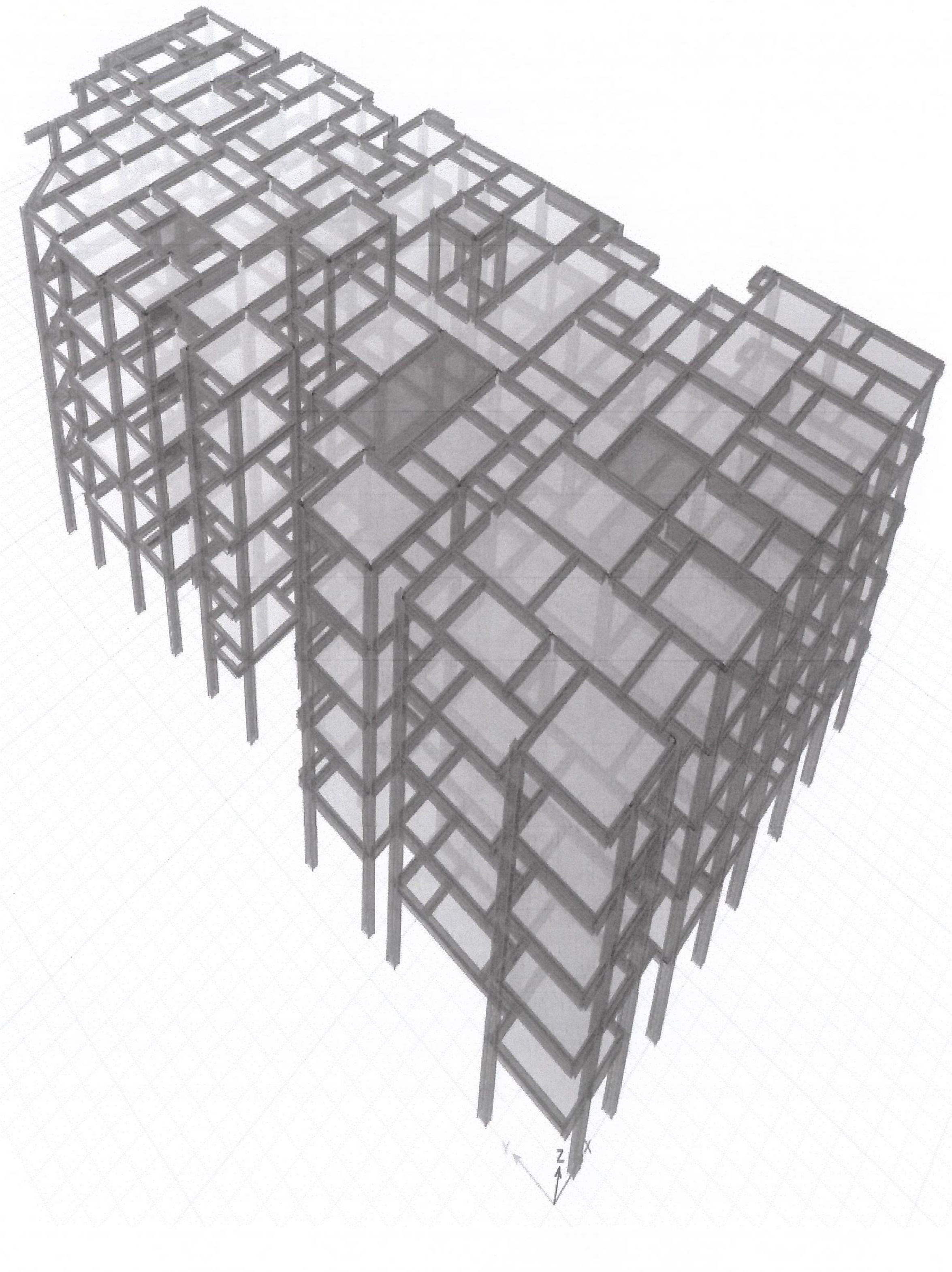
This DBR attempts to briefly cover all design related methods and assumptions at this stage of the project. As the project progresses certain revisions to the DBR might be warranted and such timely revisions of this report will be promptly provided by us.

8.Layout:



GROUND FLOOR ROOF BEAM LAYOUT
(SCALE 1:100)

9. ETAB MODEL:



10 design

10.1 Pile design:

Design Code : IS 456 : 2000 + IS 13920 : 2016

Pile Cap:	**PP81**
Column:	**P81 (300 x 450)**
No. of Piles:	**2**
Piles Dia:	**500**
Concrete Grade:	**M30**
Steel Grade:	**Fe550**
Max load on Pile (Compression):	**800 kN**
Max load on Pile (Tension):	**400 kN**
Max load on Pile (Shear):	**47 kN**

Size (LxBxD)	Bot @ L	Bot @ B	Top @ L	Top @ B	Shear @ L	Shear @ B	SFR
2050 x 800 x 775	T16 @ 125	T16 @ 125	T10 @ 150	T16 @ 125	-	-	3-T10

10.2 COLUMN DESIGN

General Data

Column No.	:	C6	
Level	:	Base To 1ST	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M25	N/sqmm
Grade Of Steel (Main)	=	Fe550	N/sqmm
Grade Of Steel (Shear)	=	Fe550	N/sqmm
Grade Of Steel - Flexural Design	=	Fe550	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	300	mm
Column D	=	450	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	4000	mm
Clear Floor Height @ D	=	3400	mm
No Of Floors	=	2	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	

Code defined D/B ratio	:	4	
D/B Ratio	:	1.67 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C2	
Critical Analysis Load Combination	:	DConS8	
Load Combination	=	[8] : 1.5 (Dead) +1.5 (SDL) -1.5 (WX)	
Critical Location	=	Bottom Joint	
Pu	=	2260.39	kN
Mux	=	-130.06	kNm
Muy	=	-2.44	kNm
Vux	=	-4.15	kN
Vuy	=	-46.23	kN

Effective Length Calculation

Calculation Along Major Axis Of Column

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

	N-m x 10^6	mm	mm	N-m x 10^6	N-m x 10^6	
Bottom	395.508	No Beam	No Beam	-	-	0.943
Top	395.508	2675 x 230 x 600	1750 x 230 x 600	154.766	236.571	0.595

Sway Condition (as per Stability Index) = Sway

Effective Length Factor along Major Axis = 2.43

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	142.383	No Beam	No Beam	-	-	0.798
Top	142.383	No Beam	No Beam	-	-	1

Sway Condition (as per Stability Index) = Sway

Effective Length Factor along Minor axis = 3.67

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**	
	=	**23**	**mm**
Minimum Eccentricity	>	**20**	**mm**
Mminy	=	**Pu x Minimum Eccentricity**	
	=	**51.99**	**kNm**

Slenderness Check

Max Slenderness Ratio(L/B)	=	**8.89**	
	<	**60**	**(Hence Ok)**

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	**2.43**
Slenderness Ratio	=	**Effective Length / D**
	=	**11.02, Column not Slender Along D**

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	**3.67**
Slenderness Ratio	=	**Effective Length / B**

	=	32.62, Column Slender Along B	
Slenderness moment along B	=	(Pu B/ 2000) (Ley/B)^2	
	=	541.24	kNm

Design slenderness moment along B

Puz	=	7200.37	kN
Pb	=	1994.78	kN
Reduction factor 'k' for slenderness moment	=	(Puz - Pu) / (Puz - Pb) < = 1	
	=	0.95 < = 1, Hence k=0.95	
Mslndy	=	k x 541.24	
	=	513.63	kNm

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-130.06	---	-130.06	0	-130.06
Minor Axis - Muy	-2.44	51.99	-51.99	513.63	-565.62

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	=	2260.39	kN
Mux	=	-130.06	kNm
Muy	=	-565.62	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	2.51	
Reinforcement Provided	=	16-T25 + 2-T20	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	77.05	deg
MRes	=	580.38	kNm
MCap	=	606.58	kNm

Capacity Ratio = MRes/ MCap

= 0.96 <= 1

Shear Calculation	Along D	Along B
Critical Analysis Load Combination	DConS11	DConS14
Critical Load Combination	[11] : 0.9 (Dead) +0.9 (SDL) +1.5 (WX)	[14] : 0.9 (Dead) +0.9 (SDL) -1.5 (WY)
Design shear force, Vu (kN)	66.784	-30.3753
Pu (kN)	998.06	1199.38
Deff , Beff (mm)	697.5	397.5
Aeff (sqmm)	313875	298125
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.2128	0.1019
Pt (%)	1.257	1.257
Design shear strength, Tc (N/sqmm)	0.6974	0.6974
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	

	1.3816	1.4828
Shear Strength Enhancement Factor (Tensile Force)	-	-
Shear Strength Enhancement Factor (max)	1.5	1.5
Shear Strength Enhancement Factor	1.3816	1.4828
Enhanced shear strength, Tc-e (N/sqmm)	0.9634	1.034
Design shear check	Tv < Tc x Enhancement factor	Tv < Tc x Enhancement factor
Shear Links Design	Shear Links Not Required	Shear Links Not Required

Design Of Links

Links in the zone where special confining links are not required

Normal Links

Diameter of link = 8 mm

\> Max. longitudinal bar dia / 4

= 6.25 mm

Criterion for spacing of normal links

Min. Longitudinal Bar dia X 16	=	**320**	**mm**
Min. dimension of column	=	**450**	**mm**
Max. 300 mm	=	**300**	**mm**
Provided spacing	=	**200**	**mm**

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	200	---	---	200	---

General Data

Column No.	:	**C6**	
Level	:	**TERRACE To HEAD ROOM**	
Frame Type	=	**Non-Ductile**	
Response Reduction Factor	=	**3**	
Design Code	=	**IS 456 : 2000 + IS 13920 : 2016**	
Grade Of Concrete	=	**M25**	**N/sqmm**

Grade Of Steel (Main)	=	Fe550	N/sqmm
Grade Of Steel (Shear)	=	Fe550	N/sqmm
Grade Of Steel - Flexural Design	=	Fe550	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	300	mm
Column D	=	450	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2400	mm
Clear Floor Height @ D	=	1800	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C2
Critical Analysis Load Combination	:	DConS2
Load Combination	=	[2] : 1.5 (Dead) +1.5 (SDL) +1.5 (Live)

Critical Location	=	Top Joint	
Pu	=	629.27	kN
Mux	=	-114.5	kNm
Muy	=	-13.19	kNm
Vux	=	4.9	kN
Vuy	=	96.03	kN

Effective Length Calculation

Calculation Along Major Axis Of Column

		Beam Sizes		Beam Stiffness		
Joint	Column Stiffness	Beam 1 (Length x Width x Depth)	Beam 2 (Length x Width x Depth)	Beam 1	Beam 2	Beta
	N-m x 10^6	mm	mm	N-m x 10^6	N-m x 10^6	
Bottom	225	2675 x 230 x 600	1750 x 230 x 600	154.766	236.571	0.509
Top	225	2675 x 230 x 600	1750 x 230 x 600	154.766	236.571	0.365

Sway Condition (as per Stability Index) = Sway

Effective Length Factor along Major Axis = 1.4

Calculation Along Minor Axis Of Column

Joint	Column Stiffness	Beam Sizes Beam 1 (Length x Width x Depth)	 Beam 2 (Length x Width x Depth)	Beam Stiffness Beam 1	 Beam 2	Beta
	N-m x 10^6	mm	mm	N-m x 10^6	N-m x 10^6	
Bottom	56.25	No Beam	No Beam	-	-	1
Top	56.25	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 X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	23.6	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	14.85	kNm

Slenderness Check

Max Slenderness Ratio(L/B) = 8

$<$ 60 (Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor = 1.4

Slenderness Ratio = Effective Length / D

= 4.2, Column not Slender Along D

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor = 1

Slenderness Ratio = Effective Length / B

= 8, Column 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	-114.5	14.85	-114.5	0	-114.5
Minor Axis - Muy	-13.19	---	-13.19	0	-13.19

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	=	**629.27**	**kN**
Mux	=	**-114.5**	**kNm**
Muy	=	**-13.19**	**kNm**

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	**0.63**	
Reinforcement Provided	=	**10-T12**	
Load Angle	=	**Tan^{-1}(Muy/Mux)**	
	=	**6.57**	**deg**
MRes	=	**115.26**	**kNm**

MCap = 218.19 kNm

Capacity Ratio = MRes/ MCap

= 0.53 <= 1

Shear Calculation	Along D	Along B
Critical Analysis Load Combination	DConS2	DConS32
Critical Load Combination	[2] : 1.5 (Dead) +1.5 (SDL) +1.5 (Live)	[56] : 0.9 (Dead) +0.9 (SDL) +1.5 (RSYMax)
Design shear force, Vu (kN)	96.0254	6.1496
Pu (kN)	629.27	348.41
Deff , Beff (mm)	554	254
Aeff (sqmm)	166200	152400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.5778	0.0404
Pt (%)	0.314	0.314
Design shear strength, Tc (N/sqmm)	0.4025	0.4025

Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.4543	1.2743
Shear Strength Enhancement Factor (Tensile Force)	-	-
Shear Strength Enhancement Factor (max)	1.5	1.5
Shear Strength Enhancement Factor	1.4543	1.2743
Enhanced shear strength, Tc-e (N/sqmm)	0.5854	0.5129
Design shear check	Tv < Tc x Enhancement factor	Tv < Tc x Enhancement factor
Shear Links Design	Shear Links Not Required	Shear Links Not Required

Design Of Links

Links in the zone where special confining links are not required

Normal Links

Diameter of link = 8 mm

> Max. longitudinal bar dia / 4

	=	3	mm

Criterion for spacing of normal links

Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	300	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	Shear Design	Ductile Design	Normal Zone	Ductile Zone
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

10.3 BEAM DESIGN:

Beam No		:	B1	
Group No		:	G1	
Analysis Reference(Member)	PLINT H	:	B70	
Breadth		:	230	mm
Depth		:	450	mm
Concrete Grade		:	M35	N/sqmm
Grade Of Steel (Main)		:	Fe550	N/sqmm
Grade Of Steel (Shear)		:	Fe550	N/sqmm
Top/Bottom Clear Cover		:	25	mm
Side Clear Cover		:	25	mm
Design Code		:	IS 456 : 2000 + IS 13920 : 2016	
Beam Type		:	Regular Beam	

Flexure Design

	Beam Bottom			Beam Top		
	Left	Mid	Right	Left	Mid	Right
Mud (kNm)	61.95	51.94	11.93	66.62	48.48	39.1
PtClc (%)	0.384	0.319	0.2	0.415	0.296	0.237
AstCalc (sqmm)	348.9	289.36	181.7	377.22	269.08	214.89
Ast Prv (sqmm)	402.12	402.12	402.12	402.12	402.12	402.12
Reinforcement	2-T16	2-T16	2-T16	2-T16	2-T16	2-T16

Shear Design

	Left	Mid	Right
Vut (kN)	45.78	45.05	55.7
Asv Torsion (sqmm/m)	153.96	153.76	184.47
Asv Reqd (sqmm/m)	254.81	254.81	254.81
Asv Prv (sqmm/m)	670.27	670.27	670.27
Reinforcement	2L-T8 @ 150	2L-T8 @ 150	2L-T8 @ 150

SFR : -

10.4SLAB DESIGN

Level: 1ST

Slab No. : S1

Ly = 3.6 m Lx = 2.78 m

Live Load = 1 kN/sqm Imposed Load = 1 kN/sqm

Thickness = 100 mm Span Type = 2-Way Panel Type = 4

Design Code = IS 456 : 2000 + IS 13920 : 2016 Grade of Concrete = M25 Grade of Steel = Fe550

Bottom SS	Bottom LS	Top SS	Top LS	Distribution
T8 @ 200	T8 @ 200	T8 @ 200	T8 @ 200	T8 @ 200

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