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P. Mariappan
B.E., M.Tech., M.I.E., FIV, M.Sc (REAL ESTATE VALUATION)

CONSULTING CIVIL & STRUCTURAL ENGINEER
Chartered Engineer | Registered Engineer Grade-1 | Corporation, CMDA,
DTCP | Collectorate Panel Engineer for Structural Stability for Chennai
Kanchipuram, Thiruvallur, Chengalpattu District

STABILITY CERTIFICATE

Date : 11.01.2025

1. The detailed engineering and structure design of the Existing Building comprising of Stilt + Two Floors in Plot No: R-215part, S.No 196/2part, Kakkalur Village, Thiruvallur Taluk ,Thiruvallur District has been done by us based on the report of geotechnical investigation (soil test) done and considering the functional requirement of the building.

2. It is certified that among other factors, the proposed building has been designed to resist earthquake. I/We have checked various parameters and found that the proposed building would be safe.

3. I/We.further certify that:

   I. The minimum grade of concrete is M20.

   II. The design and analysis has been done using the code of practice for plain and reinforced concrete as per IS 456, design loads as per IS Codes No IS875 (part 1- 5) and design of earthquake resistant structure as per IS Code No IS1893 (part 1- 5).

4. The building will be safe and sound when used for the purpose for which it is designed.

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PROJECT DESIGN REPORT

THE PROPOSED CONSTRUCTION OF COMMERCIAL BUILDING (S+2)(CONVERSION OF PUBLIC PURPOSE SITE TO COMMERCIAL SHOP)IN PLOT NO R-215part, S.NO 196/2part, KAKKALUR VILLAGE, TIRUVALLUR TALUK ,TIRUVALLUR DISTRICT.

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1. PROJECT INFORMATION

1.1	Project Title	:	Proposed Construction Of Commercial Building
1.2	Site location	:	Kakkalur Village, Tiruvallur Taluk ,Tiruvallur District
1.3	Survey Nos	:	PLOT NO R-215part, S.NO 196/2part
1.4	Approach road	:	
1.5	Wind Data		
	a) Basic Wind Speed	:	50 m/sec
	b) Wind Pressure	:	As per IS 875 part-3-1987
1.6	Soil Data		
	a) Depth of foundation	:	2.10 m from GL
	b) Safe Bearing Capacity	:	190 kN/m^2 (19 t/m^2)
	c) Allowable Settlement	:	50 mm
1.7	Seismic data		
	a) Zone Classification	:	Zone III as per IS 1893-2002
1.8	General Condition of site	:	Non-coastal region

2. SCOPE OF WORK

This document presents the overall basics for Analysis and Design of Proposed structure under Indian Standard and other facility requirement with report from `ETABS.

3. GENERAL INFORMATION

The Commercial Building consists of SILT+2 Upper floors and the structure is designed as a RCC framed structure.

1.	Type of Structure	:	Commercial Building
2.	Size of Structure	:	15.28 x 35.88
3.	Total Height of Structure	:	11.6 m
4.	Number of floors in the Structure	:	3 (S+2)
5.	Type of foundation	:	Isolated foundation as per the Geotechnical Report

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4. CODES AND STANDARDS

The following Indian Codes and Standards have followed for Load Calculation and Load Combination in Structural Analysis and for stability, safety& performance in Structural Design.

Structural Load :

IS 875-Part1	:	1987	Code of practice for Dead loads- unit weights of building
IS 875-Part2	:	1987	Code of practice for Imposed loads
IS 875-Part 3	:	2015	Code of practice for Wind loads
IS 875-Part 4	:	1987	Code of practice for Special loads and load combinations
IS 1893-Part 1	:	2002	Earthquake Resistant Design of Structures

RCC:

IS 456	:	2000	Code of practice for Plain and Reinforced Concrete
IS 3370 -Part 1	:	1965	Code of practice for concrete structure storage of liquids - General requirement
IS 3370 -Part 2	:	1965	Code of practice for concrete structure storage of liquids – RCC structure
IS 3370 -Part 3	:	1965	Code of practice for concrete structure storage of liquids – Prestressed Concrete structures
IS 3414	:	1968	Code of practice for design and installation of joints in building
IS 13920	:	1993	Code of practice for ductile detailing of RCC structures subjected to seismic forces

Steel:

IS 800	:	1984	Code of practice for general construction in steel
IS 801	:	1975	Code of practice for cold formed steel structural members
IS 808	:	1989	Code of practice for dimensions for hot rolled steel beam, column, channel and angle sections
IS 1161	:	1998	Code of practice for Steel tubes for structural purposes-specification
IS 2062	:	2006	Code of practice for Steel for structural purposes-specification
IS 4000	:	1992	Code of practice for high strength bolts in steel structures
IS 8640	:	1977	Recommendations for dimensional parameters for industrial building

5. MATERIAL SPECIFICATION

Following materials are generally used in the Design of the various components of the structure for concrete Structure.

1.	Grade of concrete	:	M 25
2.	Grade of steel	:	Fe500

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6. LOADINGS

Different types of loads can cause stress, displacement, deformation on a structure. This results in structural problems and failure. Determining the total load acting on a structure is very important and complex.

DEAD LOAD	:	1) Self-weight of the structure (DL)
		2) Super-Imposed dead load (SIDL)
IMPOSED LOAD	:	1) Live load (LL)
		2) Roof live (LL)

7. LOAD COMBINATIONS

When more than one load type acts on the structure. Building codes usually specify a variety of load combinations together with load factors for each load type in order to ensure the safety of the structure under different maximum expected loading scenarios.

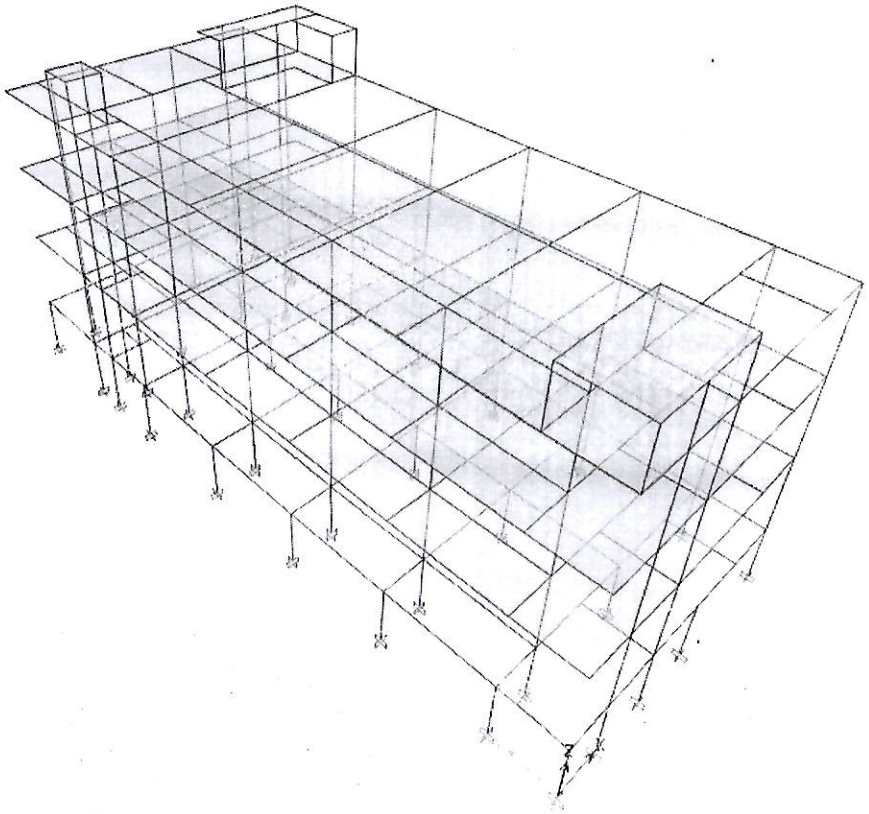
Limit state of Collapse	:	1) 1.5 (DL+SIDL+LL)
		2) 1.2 (DL+SIDL+LL)
Limit state of Serviceability	:	1) 1.0 (DL+SIDL+LL)

8. STRUCTURAL DESCRIPTION

The structure is analyzed as a Space frame structure in ETABS. All Structural members are designed as reinforced concrete elements. Limit State concept of design will be used as per IS: 456-2000 & SP - 16. The detailing of reinforcement shall be done satisfying the requirements of IS: 456-2000, SP-16, IS: 13920, IS: 4326-1993 and SP-34.The slabs and beams are checked for deflection as per IS456:2000. Cover for reinforcement is considered as per Table 16A of NBC, for a fire resistance of 2hrs.

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ETABS®



Summary Report

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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	HEADROOM ROOF	2.5	No	None	No	Blue
T1	SF ROOF BEAM	4.27	No	None	No	Green
T1	FF ROOF BEAM	4.27	No	GF ROOF BEAM	No	Cyan
T1	GF ROOF BEAM	4.27	Yes	None	No	Red
T1	PLINTH BEAM	3	No	None	No	Magenta

2 Loads

This chapter provides loading information as applied to the model.

2.1 Load Patterns

Table 2.1 - Load Pattern Definitions

Name	Is Auto Load	Type	Self Weight Multiplier
~LLRF	Yes	Other	0
Dead	No	Dead	1
floor finish	No	Super Dead	0
floor live	No	Live	0
sunken load	No	Super Dead	0
wall load	No	Super Dead	0

2.2 Functions

2.2.1 Response Spectrum Functions

Table 2.2 - Functions - Response Spectrum - User Defined

Name	Period sec	Value	Damping Ratio
UnifRS	0	1	0.05
UnifRS	1	1	

2.3 Load Cases

Table 2.3 - Load Case Definitions - Summary

Name	Type
Modal	Modal - Eigen
Dead	Linear Static
Live	Linear Static
9" wall load	Linear Static
floor finish for rooms	Linear Static
sunken load	Linear Static

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3 Analysis Results

This chapter provides analysis results.

3.1 Structure Results

Table 3.1 - Base Reactions (Part 1 of 2)

Output Case	Case Type	Step Type	FX kN	FY kN	FZ kN	MX kN-m	MY kN-m	MZ kN-m	X m
Dead	LinStatic		0	0	13261.3076	236368.7672	-97384.7597	0	0
Live	LinStatic		0	0	5152.3882	92501.3234	-38027.9094	0	0
9" wall load	LinStatic		0	0	8397.0348	160640.9986	-56920.7953	0	0
floor finish for rooms	LinStatic		0	0	3207.5995	57415.7811	-23650.2178	0	0
sunken load	LinStatic		0	0	103.1861	3476.1387	-89.256	0	0
AutoSeq	Staged	Max	0	0	13261.3076	236368.7672	-7562.2034	0	0
AutoSeq	Staged	Min	0	0	1049.8883	18997.2105	-97384.7597	0	0
TOTAL	Combination		0	0	33133.6678	605443.31	-237680.2319	0	0
FACTORED	Combination		0	0	45182.2743	825604.5136	-324109.4072	0	0
ENVELOPE	Combination	Max	0	0	45182.2743	825604.5136	-237680.2319	0	0
ENVELOPE	Combination	Min	0	0	33133.6678	605443.31	-324109.4072	0	0

Table 3.1 - Base Reactions (Part 2 of 2)

Y m	Z m
0	0
0	0
0	0
0	0
0	0
0	0
0	0
0	0
0	0
0	0
0	0

3.2 Story Results

Table 3.2 - Story Drifts

Story	Output Case	Case Type	Step Type	Direction	Drift	Label	X m	Y m	Z m
HEADROOM ROOF	Dead	LinStatic		X	0.001772	31	8.255	3.305	18.31
HEADROOM ROOF	Dead	LinStatic		Y	0.000745	12	0	0	18.31
HEADROOM ROOF	Live	LinStatic		X	0.000702	31	8.255	3.305	18.31
HEADROOM ROOF	9" wall load	LinStatic		X	0.002825	31	8.255	3.305	18.31
HEADROOM ROOF	floor finish for rooms	LinStatic		X	0.000562	42	12.99	26.498	18.31
HEADROOM ROOF	floor finish for rooms	LinStatic		Y	0.000336	12	0	0	18.31
HEADROOM ROOF	sunken load	LinStatic		X	1.2E-05	32	1.73	31.2028	18.31
HEADROOM ROOF	sunken load	LinStatic		Y	9.1E-05	32	1.73	31.2028	18.31
HEADROOM ROOF	AutoSeq	Staged	Max	X	0.000501	31	8.255	3.305	18.31
HEADROOM ROOF	AutoSeq	Staged	Min	Y	0.000181	11	0	3.305	18.31
HEADROOM ROOF	TOTAL	Combination		X	0.006287	31	8.255	3.305	18.31
HEADROOM ROOF	FACTORED	Combination		X	0.008573	31	8.255	3.305	18.31
HEADROOM ROOF	ENVELOPE	Combination	Max	X	0.008573	31	8.255	3.305	18.31
HEADROOM ROOF	ENVELOPE	Combination	Max	Y	0.001814	12	0	0	18.31
HEADROOM ROOF	ENVELOPE	Combination	Min	X	0.006287	31	8.255	3.305	18.31
SF ROOF BEAM	Dead	LinStatic		X	0.000472	19	14.72	0	15.81

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Story	Output Case	Case Type	Step Type	Direction	Drift	Label	X m	Y m	Z m
SF ROOF BEAM	Dead	LinStatic		Y	0.000158	5	0	31.2028	15.81
SF ROOF BEAM	Live	LinStatic		X	0.00016	19	14.72	0	15.81
SF ROOF BEAM	Live	LinStatic		Y	6.8E-05	5	0	31.2028	15.81
SF ROOF BEAM	9" wall load	LinStatic		X	0.000591	19	14.72	0	15.81
SF ROOF BEAM	9" wall load	LinStatic		Y	0.000131	5	0	31.2028	15.81
SF ROOF BEAM	floor finish for rooms	LinStatic		X	0.000135	19	14.72	0	15.81
SF ROOF BEAM	floor finish for rooms	LinStatic		Y	5.5E-05	1	0	36.1733	15.81
SF ROOF BEAM	sunken load	LinStatic		X	2E-05	2	2.4284	36.1733	15.81
SF ROOF BEAM	sunken load	LinStatic		Y	1.7E-05	4	14.72	36.1733	15.81
SF ROOF BEAM	AutoSeq	Staged	Max	X	0.000258	19	14.72	0	15.81
SF ROOF BEAM	AutoSeq	Staged	Min	Y	9.3E-05	1	0	36.1733	15.81
SF ROOF BEAM	TOTAL	Combination		X	0.001493	19	14.72	0	15.81
SF ROOF BEAM	TOTAL	Combination		Y	0.000463	5	0	31.2028	15.81
SF ROOF BEAM	FACTORED	Combination		X	0.002036	19	14.72	0	15.81
SF ROOF BEAM	FACTORED	Combination		Y	0.000631	5	0	31.2028	15.81
SF ROOF BEAM	ENVELOPE	Combination	Max	X	0.001493	19	14.72	0	15.81
SF ROOF BEAM	ENVELOPE	Combination	Max	Y	0.000631	5	0	31.2028	15.81
SF ROOF BEAM	ENVELOPE	Combination	Min	X	0.002036	19	14.72	0	15.81
SF ROOF BEAM	ENVELOPE	Combination	Min	Y	0.000463	5	0	31.2028	15.81
FF ROOF BEAM	Dead	LinStatic		X	0.000397	19	14.72	0	11.54
FF ROOF BEAM	Dead	LinStatic		Y	0.000139	5	0	31.2028	11.54
FF ROOF BEAM	Live	LinStatic		X	0.000185	19	14.72	0	11.54
FF ROOF BEAM	Live	LinStatic		Y	7.9E-05	1	0	36.1733	11.54
FF ROOF BEAM	9" wall load	LinStatic		X	0.000678	19	14.72	0	11.54
FF ROOF BEAM	9" wall load	LinStatic		Y	0.000145	5	0	31.2028	11.54
FF ROOF BEAM	floor finish for rooms	LinStatic		X	8.6E-05	45	2.4284	0	11.54
FF ROOF BEAM	floor finish for rooms	LinStatic		Y	3.8E-05	6	0	29.4728	11.54
FF ROOF BEAM	sunken load	LinStatic		X	1.8E-05	2	2.4284	36.1733	11.54
FF ROOF BEAM	sunken load	LinStatic		Y	1.6E-05	4	14.72	36.1733	11.54
FF ROOF BEAM	AutoSeq	Staged	Max	X	0.000208	19	14.72	0	11.54
FF ROOF BEAM	AutoSeq	Staged	Min	X	6.4E-05	44	5.4655	0	11.54
FF ROOF BEAM	AutoSeq	Staged	Min	Y	8.7E-05	1	0	36.1733	11.54
FF ROOF BEAM	TOTAL	Combination		X	0.00148	19	14.72	0	11.54
FF ROOF BEAM	TOTAL	Combination		Y	0.00045	5	0	31.2028	11.54
FF ROOF BEAM	FACTORED	Combination		X	0.002019	19	14.72	0	11.54
FF ROOF BEAM	FACTORED	Combination		Y	0.000614	5	0	31.2028	11.54
FF ROOF BEAM	ENVELOPE	Combination	Max	X	0.00148	19	14.72	0	11.54
FF ROOF BEAM	ENVELOPE	Combination	Max	Y	0.000614	5	0	31.2028	11.54
FF ROOF BEAM	ENVELOPE	Combination	Min	X	0.002019	19	14.72	0	11.54
FF ROOF BEAM	ENVELOPE	Combination	Min	Y	0.00045	5	0	31.2028	11.54
GF ROOF BEAM	Dead	LinStatic		X	0.000221	18	14.72	3.305	7.27
GF ROOF BEAM	Dead	LinStatic		Y	0.000123	33	5.2635	31.2028	7.27
GF ROOF BEAM	Live	LinStatic		X	9.8E-05	18	14.72	3.305	7.27
GF ROOF BEAM	Live	LinStatic		Y	7.4E-05	33	5.2635	31.2028	7.27
GF ROOF BEAM	9" wall load	LinStatic		X	0.000407	18	14.72	3.305	7.27
GF ROOF BEAM	9" wall load	LinStatic		Y	0.000117	1	0	36.1733	7.27
GF ROOF BEAM	floor finish for rooms	LinStatic		X	4.1E-05	18	14.72	3.305	7.27
GF ROOF BEAM	floor finish for rooms	LinStatic		Y	3.2E-05	44	5.4655	0	7.27
GF ROOF BEAM	sunken load	LinStatic		X	1.6E-05	1	0	36.1733	7.27
GF ROOF BEAM	sunken load	LinStatic		Y	9E-06	1	0	36.1733	7.27
GF ROOF BEAM	AutoSeq	Staged	Max	Y	0.000143	44	5.4655	0	7.27
GF ROOF BEAM	AutoSeq	Staged	Min	X	0.000247	18	14.72	3.305	7.27
GF ROOF BEAM	TOTAL	Combination		X	0.000845	18	14.72	3.305	7.27
GF ROOF BEAM	TOTAL	Combination		Y	0.000366	33	5.2635	31.2028	7.27
GF ROOF BEAM	FACTORED	Combination		X	0.001152	18	14.72	3.305	7.27
GF ROOF BEAM	FACTORED	Combination		Y	0.0005	33	5.2635	31.2028	7.27

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Story	Output Case	Case Type	Step Type	Direction	Drift	Label	X m	Y m	Z m
GF ROOF BEAM	ENVELOPE	Combination	Max	X	0.000845	18	14.72	3.305	7.27
GF ROOF BEAM	ENVELOPE	Combination	Max	Y	0.0005	33	5.2635	31.2028	7.27
GF ROOF BEAM	ENVELOPE	Combination	Min	X	0.001152	18	14.72	3.305	7.27
PLINTH BEAM	Dead	LinStatic		Y	0.000366	33	5.2635	31.2028	7.27
PLINTH BEAM	Dead	LinStatic		X	5.8E-05	44	5.4655	0	3
PLINTH BEAM	Live	LinStatic		Y	7.3E-05	33	5.2635	31.2028	3
PLINTH BEAM	Live	LinStatic		X	3.3E-05	15	14.72	20.718	3
PLINTH BEAM	9" wall load	LinStatic		Y	5.5E-05	33	5.2635	31.2028	3
PLINTH BEAM	9" wall load	LinStatic		X	0.000117	44	5.4655	0	3
PLINTH BEAM	floor finish for rooms	LinStatic		Y	3.5E-05	24	2.4284	9.156	3
PLINTH BEAM	floor finish for rooms	LinStatic		X	1.5E-05	15	14.72	20.718	3
PLINTH BEAM	sunken load	LinStatic		Y	2.1E-05	44	5.4655	0	3
PLINTH BEAM	AutoSeq	Staged	Max	X	8E-06	2	2.4284	36.1733	3
PLINTH BEAM	AutoSeq	Staged	Max	Y	7.7E-05	15	14.72	20.718	3
PLINTH BEAM	AutoSeq	Staged	Min	X	3.5E-05	44	5.4655	0	3
PLINTH BEAM	AutoSeq	Staged	Min	Y	8.9E-05	24	2.4284	9.156	3
PLINTH BEAM	TOTAL	Combination		X	0.00011	44	5.4655	0	3
PLINTH BEAM	TOTAL	Combination		Y	0.000224	44	5.4655	0	3
PLINTH BEAM	FACTORED	Combination		X	0.000178	38	5.2635	36.1733	3
PLINTH BEAM	FACTORED	Combination		Y	0.000306	44	5.4655	0	3
PLINTH BEAM	ENVELOPE	Combination	Max	X	0.000243	38	5.2635	36.1733	3
PLINTH BEAM	ENVELOPE	Combination	Max	Y	0.000224	44	5.4655	0	3
PLINTH BEAM	ENVELOPE	Combination	Min	X	0.000178	38	5.2635	36.1733	3
PLINTH BEAM	ENVELOPE	Combination	Min	Y	0.000306	44	5.4655	0	3
					0.000243	38	5.2635	36.1733	3

Table 3.3 - Story Forces (Part 1 of 2)

Story	Location	Output Case	Case Type	Step Type	P kN	VX kN	VY kN	T kN-m
HEADROOM ROOF	Top	Dead	LinStatic		256.6904	0	0	0
HEADROOM ROOF	Bottom	Dead	LinStatic		365.9081	0	0	0
HEADROOM ROOF	Top	Live	LinStatic		70.7056	0	0	0
HEADROOM ROOF	Bottom	Live	LinStatic		70.7056	0	0	0
HEADROOM ROOF	Top	9" wall load	LinStatic		145.5922	0	0	0
HEADROOM ROOF	Bottom	9" wall load	LinStatic		145.5922	0	0	0
HEADROOM ROOF	Top	floor finish for rooms	LinStatic		102.8748	0	0	0
HEADROOM ROOF	Bottom	floor finish for rooms	LinStatic		102.8748	0	0	0
HEADROOM ROOF	Top	sunken load	LinStatic		0	0	0	0
HEADROOM ROOF	Bottom	sunken load	LinStatic		0	0	0	0
HEADROOM ROOF	Top	AutoSeq	Staged	Max	256.6904	0	0	0
HEADROOM ROOF	Bottom	AutoSeq	Staged	Max	365.9081	0	0	0
HEADROOM ROOF	Top	AutoSeq	Staged	Min	0	0	0	0
HEADROOM ROOF	Bottom	AutoSeq	Staged	Min	0	0	0	0
HEADROOM ROOF	Top	TOTAL	Combination		633.4492	0	0	0
HEADROOM ROOF	Bottom	TOTAL	Combination		753.5887	0	0	0
HEADROOM ROOF	Top	FACTORED	Combination		863.7943	0	0	0
HEADROOM ROOF	Bottom	FACTORED	Combination		1027.6209	0	0	0
HEADROOM ROOF	Top	ENVELOPE	Combination	Max	863.7943	0	0	0
HEADROOM ROOF	Bottom	ENVELOPE	Combination	Max	1027.6209	0	0	0
HEADROOM ROOF	Top	ENVELOPE	Combination	Min	633.4492	0	0	0
HEADROOM ROOF	Bottom	ENVELOPE	Combination	Min	753.5887	0	0	0
SF ROOF BEAM	Top	Dead	LinStatic		3847.0702	0	0	0
SF ROOF BEAM	Bottom	Dead	LinStatic		4314.4118	0	0	0
SF ROOF BEAM	Top	Live	LinStatic		950.9623	0	0	0
SF ROOF BEAM	Bottom	Live	LinStatic		950.9623	0	0	0

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Story	Location	Output Case	Case Type	Step Type	P kN	VX kN	VY kN	T kN-m
SF ROOF BEAM	Top	9" wall load	LinStatic		1591.3638	0	0	0
SF ROOF BEAM	Bottom	9" wall load	LinStatic		1591.3638	0	0	0
SF ROOF BEAM	Top	floor finish for rooms	LinStatic		1550.3343	0	0	0
SF ROOF BEAM	Bottom	floor finish for rooms	LinStatic		1550.3343	0	0	0
SF ROOF BEAM	Top	sunken load	LinStatic		34.3954	0	0	0
SF ROOF BEAM	Bottom	sunken load	LinStatic		34.3954	0	0	0
SF ROOF BEAM	Top	AutoSeq	Staged	Max	3847.0702	0	0	0
SF ROOF BEAM	Bottom	AutoSeq	Staged	Max	4314.4118	0	0	0
SF ROOF BEAM	Top	AutoSeq	Staged	Min	0	0	0	0
SF ROOF BEAM	Bottom	AutoSeq	Staged	Min	0	0	0	0
SF ROOF BEAM	Top	TOTAL	Combination		8771.5386	0	0	0
SF ROOF BEAM	Bottom	TOTAL	Combination		9285.6144	0	0	0
SF ROOF BEAM	Top	FACTORED	Combination		11961.189	0	0	0
SF ROOF BEAM	Bottom	FACTORED	Combination		12662.2014	0	0	0
SF ROOF BEAM	Top	ENVELOPE	Combination	Max	11961.189	0	0	0
SF ROOF BEAM	Bottom	ENVELOPE	Combination	Max	12662.2014	0	0	0
SF ROOF BEAM	Top	ENVELOPE	Combination	Min	8771.5386	0	0	0
SF ROOF BEAM	Bottom	ENVELOPE	Combination	Min	9285.6144	0	0	0
FF ROOF BEAM	Top	Dead	LinStatic		7795.574	0	0	0
FF ROOF BEAM	Bottom	Dead	LinStatic		8262.9156	0	0	0
FF ROOF BEAM	Top	Live	LinStatic		3051.6753	0	0	0
FF ROOF BEAM	Bottom	Live	LinStatic		3051.6753	0	0	0
FF ROOF BEAM	Top	9" wall load	LinStatic		4306.8455	0	0	0
FF ROOF BEAM	Bottom	9" wall load	LinStatic		4306.8455	0	0	0
FF ROOF BEAM	Top	floor finish for rooms	LinStatic		2378.9669	0	0	0
FF ROOF BEAM	Bottom	floor finish for rooms	LinStatic		2378.9669	0	0	0
FF ROOF BEAM	Top	sunken load	LinStatic		68.7907	0	0	0
FF ROOF BEAM	Bottom	sunken load	LinStatic		68.7907	0	0	0
FF ROOF BEAM	Top	AutoSeq	Staged	Max	7795.574	0	0	0
FF ROOF BEAM	Bottom	AutoSeq	Staged	Max	8262.9156	0	0	0
FF ROOF BEAM	Top	AutoSeq	Staged	Min	0	0	0	0
FF ROOF BEAM	Bottom	AutoSeq	Staged	Min	0	0	0	0
FF ROOF BEAM	Top	TOTAL	Combination		19362.0376	0	0	0
FF ROOF BEAM	Bottom	TOTAL	Combination		19876.1133	0	0	0
FF ROOF BEAM	Top	FACTORED	Combination		26402.7785	0	0	0
FF ROOF BEAM	Bottom	FACTORED	Combination		27103.7909	0	0	0
FF ROOF BEAM	Top	ENVELOPE	Combination	Max	26402.7785	0	0	0
FF ROOF BEAM	Bottom	ENVELOPE	Combination	Max	27103.7909	0	0	0
FF ROOF BEAM	Top	ENVELOPE	Combination	Min	19362.0376	0	0	0
FF ROOF BEAM	Bottom	ENVELOPE	Combination	Min	19876.1133	0	0	0
GF ROOF BEAM	Top	Dead	LinStatic		11744.0777	0	0	0
GF ROOF BEAM	Bottom	Dead	LinStatic		12211.4193	0	0	0
GF ROOF BEAM	Top	Live	LinStatic		5152.3882	0	0	0
GF ROOF BEAM	Bottom	Live	LinStatic		5152.3882	0	0	0
GF ROOF BEAM	Top	9" wall load	LinStatic		7022.3272	0	0	0
GF ROOF BEAM	Bottom	9" wall load	LinStatic		7022.3272	0	0	0
GF ROOF BEAM	Top	floor finish for rooms	LinStatic		3207.5995	0	0	0
GF ROOF BEAM	Bottom	floor finish for rooms	LinStatic		3207.5995	0	0	0
GF ROOF BEAM	Top	sunken load	LinStatic		103.1861	0	0	0
GF ROOF BEAM	Bottom	sunken load	LinStatic		103.1861	0	0	0
GF ROOF BEAM	Top	AutoSeq	Staged	Max	11744.0777	0	0	0
GF ROOF BEAM	Bottom	AutoSeq	Staged	Max	12211.4193	0	0	0
GF ROOF BEAM	Top	AutoSeq	Staged	Min	0	0	0	0
GF ROOF BEAM	Bottom	AutoSeq	Staged	Min	0	0	0	0
GF ROOF BEAM	Top	TOTAL	Combination		29952.5365	0	0	0
GF ROOF BEAM	Bottom	TOTAL	Combination		30466.6123	0	0	0

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Story	Location	Output Case	Case Type	Step Type	P kN	VX kN	VY kN	T kN-m
GF ROOF BEAM	Top	FACTORED	Combination		40844.368	0	0	0
GF ROOF BEAM	Bottom	FACTORED	Combination		41545.3804	0	0	0
GF ROOF BEAM	Top	ENVELOPE	Combination	Max	40844.368	0	0	0
GF ROOF BEAM	Bottom	ENVELOPE	Combination	Max	41545.3804	0	0	0
GF ROOF BEAM	Top	ENVELOPE	Combination	Min	29952.5365	0	0	0
GF ROOF BEAM	Bottom	ENVELOPE	Combination	Min	30466.6123	0	0	0
PLINTH BEAM	Top	Dead	LinStatic		12877.4359	0	0	0
PLINTH BEAM	Bottom	Dead	LinStatic		13261.3076	0	0	0
PLINTH BEAM	Top	Live	LinStatic		5152.3882	0	0	0
PLINTH BEAM	Bottom	Live	LinStatic		5152.3882	0	0	C
PLINTH BEAM	Top	9" wall load	LinStatic		8397.0348	0	0	0
PLINTH BEAM	Bottom	9" wall load	LinStatic		8397.0348	0	0	0
PLINTH BEAM	Top	floor finish for rooms	LinStatic		3207.5995	0	0	0
PLINTH BEAM	Bottom	floor finish for rooms	LinStatic		3207.5995	0	0	0
PLINTH BEAM	Top	sunken load	LinStatic		103.1861	0	0	0
PLINTH BEAM	Bottom	sunken load	LinStatic		103.1861	0	0	0
PLINTH BEAM	Top	AutoSeq	Staged	Max	12877.4359	0	0	0
PLINTH BEAM	Bottom	AutoSeq	Staged	Max	13261.3076	0	0	0
PLINTH BEAM	Top	AutoSeq	Staged	Min	666.0166	0	0	0
PLINTH BEAM	Bottom	AutoSeq	Staged	Min	1049.8883	0	0	0
PLINTH BEAM	Top	TOTAL	Combination		32711.409	0	0	0
PLINTH BEAM	Bottom	TOTAL	Combination		33133.6678	0	0	0
PLINTH BEAM	Top	FACTORED	Combination		44606.4669	0	0	0
PLINTH BEAM	Bottom	FACTORED	Combination		45182.2743	0	0	0
PLINTH BEAM	Top	ENVELOPE	Combination	Max	44606.4669	0	0	0
PLINTH BEAM	Bottom	ENVELOPE	Combination	Max	45182.2743	0	0	0
PLINTH BEAM	Top	ENVELOPE	Combination	Min	32711.409	0	0	0
PLINTH BEAM	Bottom	ENVELOPE	Combination	Min	33133.6678	0	0	0

Table 3.3 - Story Forces (Part 2 of 2)

Story	Location	MX kN-m	MY kN-m
HEADROOM ROOF	Top	4612.1212	-1803.0656
HEADROOM ROOF	Bottom	6639.3052	-2464.9115
HEADROOM ROOF	Top	1747.3418	-225.8672
HEADROOM ROOF	Bottom	1747.3418	-225.8672
HEADROOM ROOF	Top	2845.4346	-1045.7452
HEADROOM ROOF	Bottom	2845.4346	-1045.7452
HEADROOM ROOF	Top	1662.7177	-692.9118
HEADROOM ROOF	Bottom	1662.7177	-692.9118
HEADROOM ROOF	Top	0	0
HEADROOM ROOF	Bottom	0	0
HEADROOM ROOF	Top	4612.1212	0
HEADROOM ROOF	Bottom	6639.3052	0
HEADROOM ROOF	Top	0	-1803.0656
HEADROOM ROOF	Bottom	0	-2464.9115
HEADROOM ROOF	Top	11954.3768	-4144.3486
HEADROOM ROOF	Bottom	14184.2793	-4872.3791
HEADROOM ROOF	Top	16301.4229	-5651.3845
HEADROOM ROOF	Bottom	19342.199	-6644.1534
HEADROOM ROOF	Top	16301.4229	-4144.3486
HEADROOM ROOF	Bottom	19342.199	-4872.3791
HEADROOM ROOF	Top	11954.3768	-5651.3845
HEADROOM ROOF	Bottom	14184.2793	-6644.1534
SF ROOF BEAM	Top	68490.6944	-27805.6242

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Story	Location	MX kN-m	MY kN-m
SF ROOF BEAM	Bottom	76883.3891	-31584.1264
SF ROOF BEAM	Top	17341.6125	-6724.7729
SF ROOF BEAM	Bottom	17341.6125	-6724.7729
SF ROOF BEAM	Top	29965.4418	-10611.7853
SF ROOF BEAM	Bottom	29965.4418	-10611.7853
SF ROOF BEAM	Top	27768.7193	-11401.1933
SF ROOF BEAM	Bottom	27768.7193	-11401.1933
SF ROOF BEAM	Top	1158.7129	-29.752
SF ROOF BEAM	Bottom	1158.7129	-29.752
SF ROOF BEAM	Top	68490.6944	0
SF ROOF BEAM	Bottom	76883.3891	0
SF ROOF BEAM	Top	0	-27805.6242
SF ROOF BEAM	Bottom	0	-31584.1264
SF ROOF BEAM	Top	159197.699	-62230.4404
SF ROOF BEAM	Bottom	168429.6631	-66386.7929
SF ROOF BEAM	Top	217087.7714	-84859.6915
SF ROOF BEAM	Bottom	229676.8134	-90527.4448
SF ROOF BEAM	Top	217087.7714	-62230.4404
SF ROOF BEAM	Bottom	229676.8134	-66386.7929
SF ROOF BEAM	Top	159197.699	-84859.6915
SF ROOF BEAM	Bottom	168429.6631	-90527.4448
FF ROOF BEAM	Top	138734.7782	-56924.8391
FF ROOF BEAM	Bottom	147127.4729	-60703.3413
FF ROOF BEAM	Top	54921.4679	-22376.3412
FF ROOF BEAM	Bottom	54921.4679	-22376.3412
FF ROOF BEAM	Top	81646.3023	-30273.6761
FF ROOF BEAM	Bottom	81646.3023	-30273.6761
FF ROOF BEAM	Top	42592.2502	-17525.7055
FF ROOF BEAM	Bottom	42592.2502	-17525.7055
FF ROOF BEAM	Top	2317.4258	-59.504
FF ROOF BEAM	Bottom	2317.4258	-59.504
FF ROOF BEAM	Top	138734.7782	0
FF ROOF BEAM	Bottom	147127.4729	0
FF ROOF BEAM	Top	0	-56924.8391
FF ROOF BEAM	Bottom	0	-60703.3413
FF ROOF BEAM	Top	352233.4469	-139876.0724
FF ROOF BEAM	Bottom	361465.411	-144032.4249
FF ROOF BEAM	Top	480318.3367	-190740.0987
FF ROOF BEAM	Bottom	492907.3786	-196407.8521
FF ROOF BEAM	Top	480318.3367	-139876.0724
FF ROOF BEAM	Bottom	492907.3786	-144032.4249
FF ROOF BEAM	Top	352233.4469	-190740.0987
FF ROOF BEAM	Bottom	361465.411	-196407.8521
GF ROOF BEAM	Top	208978.8621	-86044.054
GF ROOF BEAM	Bottom	217371.5567	-89822.5562
GF ROOF BEAM	Top	92501.3234	-38027.9094
GF ROOF BEAM	Bottom	92501.3234	-38027.9094
GF ROOF BEAM	Top	133327.1627	-49935.5668
GF ROOF BEAM	Bottom	133327.1627	-49935.5668
GF ROOF BEAM	Top	57415.7811	-23650.2178
GF ROOF BEAM	Bottom	57415.7811	-23650.2178
GF ROOF BEAM	Top	3476.1387	-89.256
GF ROOF BEAM	Bottom	3476.1387	-89.256
GF ROOF BEAM	Top	208978.8621	0
GF ROOF BEAM	Bottom	217371.5567	0
GF ROOF BEAM	Top	0	-86044.054

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Story	Location	MX kN-m	MY kN-m
GF ROOF BEAM	Bottom	0	-89822.5562
GF ROOF BEAM	Top	545269.1948	-217521.7044
GF ROOF BEAM	Bottom	554501.1589	-221678.0569
GF ROOF BEAM	Top	743548.902	-296620.506
GF ROOF BEAM	Bottom	756137.9439	-302288.2593
GF ROOF BEAM	Top	743548.902	-217521.7044
GF ROOF BEAM	Bottom	756137.9439	-221678.0569
GF ROOF BEAM	Top	545269.1948	-296620.506
GF ROOF BEAM	Bottom	554501.1589	-302288.2593
PLINTH BEAM	Top	229593.4229	-94511.018
PLINTH BEAM	Bottom	236368.7672	-97384.7597
PLINTH BEAM	Top	92501.3234	-38027.9094
PLINTH BEAM	Bottom	92501.3234	-38027.9094
PLINTH BEAM	Top	160640.9986	-56920.7953
PLINTH BEAM	Bottom	160640.9986	-56920.7953
PLINTH BEAM	Top	57415.7811	-23650.2178
PLINTH BEAM	Bottom	57415.7811	-23650.2178
PLINTH BEAM	Top	3476.1387	-89.256
PLINTH BEAM	Bottom	3476.1387	-89.256
PLINTH BEAM	Top	229593.4229	-4688.4617
PLINTH BEAM	Bottom	236368.7672	-7562.2034
PLINTH BEAM	Top	12221.8662	-94511.018
PLINTH BEAM	Bottom	18997.2105	-97384.7597
PLINTH BEAM	Top	597990.4313	-234519.1161
PLINTH BEAM	Bottom	605443.31	-237680.2319
PLINTH BEAM	Top	815441.4972	-319798.7946
PLINTH BEAM	Bottom	825604.5136	-324109.4072
PLINTH BEAM	Top	815441.4972	-234519.1161
PLINTH BEAM	Bottom	825604.5136	-237680.2319
PLINTH BEAM	Top	597990.4313	-319798.7946
PLINTH BEAM	Bottom	605443.31	-324109.4072

3.3 Modal Results

Table 3.4 - Modal Periods And Frequencies

Case	Mode	Period sec	Frequency cyc/sec	CircFreq rad/sec	Eigenvalue rad2/sec2
Modal	1	1.129	0.886	5.5658	30.9786
Modal	2	0.925	1.081	6.7907	46.1141
Modal	3	0.862	1.16	7.2887	53.1249
Modal	4	0.338	2.958	18.5873	345.4896
Modal	5	0.274	3.655	22.9653	527.4043
Modal	6	0.256	3.912	24.579	604.128
Modal	7	0.179	5.589	35.117	1233.204
Modal	8	0.16	6.27	39.3926	1551.7801
Modal	9	0.157	6.372	40.0344	1602.7531
Modal	10	0.144	6.944	43.6279	1903.3937
Modal	11	0.138	7.259	45.6115	2080.4134
Modal	12	0.129	7.733	48.5862	2360.6225

Table 3.5 - Modal Participating Mass Ratios (Part 1 of 2)

Case	Mode	Period sec	UX	UY	UZ	SumUX	SumUY	SumUZ	RX	RY	RZ
Modal	1	1.129	0.0015	0.8547	0	0.0015	0.8547	0	0.151	0.0003	0.0127
Modal	2	0.925	0.8607	0.0031	0	0.8622	0.8578	0	0.0004	0.1355	0.0175

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Case	Mode	Period sec	UX	UY	UZ	SumUX	SumUY	SumUZ	RX	RY	RZ
Modal	3	0.862	0.0205	0.0115	0	0.8826	0.8694	0	0.0015	0.0027	0.8401
Modal	4	0.338	0.0002	0.0739	0	0.8828	0.9433	0	0.6079	0.0012	0.0013
Modal	5	0.274	0.0552	0.0006	0	0.938	0.9439	0	0.0058	0.5164	0.0147
Modal	6	0.256	0.0127	0.0006	0	0.9506	0.9444	0	0.0053	0.1268	0.0576
Modal	7	0.179	4.53E-05	0.016	0	0.9507	0.9605	0	0.0405	0.0001	0.0001
Modal	8	0.16	2.364E-05	0.0022	0	0.9507	0.9627	0	0.0112	4.303E-06	2.47E-05
Modal	9	0.157	4.936E-06	0.0084	0	0.9507	0.9711	0	0.0377	2.879E-05	0.0003
Modal	10	0.144	0.0064	0.0001	0	0.9571	0.9712	0	0.0001	0.0165	0.0059
Modal	11	0.138	0.0002	0.0001	0	0.9573	0.9713	0	0.0019	0.0005	0.0001
Modal	12	0.129	0.005	1.342E-05	0	0.9623	0.9713	0	1.368E-05	0.0146	0.0068

Table 3.5 - Modal Participating Mass Ratios (Part 2 of 2)

Case	Mode	SumRX	SumRY	SumRZ
Modal	1	0.151	0.0003	0.0127
Modal	2	0.1515	0.1358	0.0302
Modal	3	0.1529	0.1384	0.8703
Modal	4	0.7608	0.1396	0.8716
Modal	5	0.7666	0.6561	0.8863
Modal	6	0.7719	0.7829	0.9439
Modal	7	0.8124	0.783	0.944
Modal	8	0.8236	0.783	0.9441
Modal	9	0.8613	0.7831	0.9444
Modal	10	0.8614	0.7996	0.9503
Modal	11	0.8633	0.8	0.9504
Modal	12	0.8633	0.8147	0.9572

Table 3.6 - Modal Load Participation Ratios

Case	ItemType	Item	Static %	Dynamic %
Modal	Acceleration	UX	99.98	96.23
Modal	Acceleration	UY	99.99	97.13
Modal	Acceleration	UZ	0	0

Table 3.7 - Modal Direction Factors

Case	Mode	Period sec	UX	UY	UZ	RZ
Modal	1	1.129	0.002	0.984	0	0.014
Modal	2	0.925	0.976	0.003	0	0.021
Modal	3	0.862	0.023	0.013	0	0.964
Modal	4	0.338	0.002	0.983	0	0.015
Modal	5	0.274	0.806	0.009	0	0.185
Modal	6	0.256	0.205	0.009	0	0.786
Modal	7	0.179	0.003	0.905	0	0.091
Modal	8	0.16	0.011	0.101	0	0.887
Modal	9	0.157	0.003	0.757	0	0.24
Modal	10	0.144	0.534	0.023	0	0.443
Modal	11	0.138	0.014	0.402	0	0.584
Modal	12	0.129	0.482	0.005	0	0.512

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DESIGN OF FLOOR SLAB

Design Data

Dimensions of the slab (c/c distance b/w supports),

Length of short span, L_x = 5.49 m

Length of long span, L_y = 6.1 m

f_{ck} = 20 N/mm²

f_y = 500 N/mm²

SS	18	5.49
LS	20	6.1

Width of the supporting beam, = 230 mm

Clear cover to main reinforcement = 20 mm

Assume dia. of reinforcement steel = 10 mm

Calculations

Assume the thickness of slab as 150 mm ; Effective depth, d = 125 mm

Effective span, l_x = 5.48780487804878 m (or) 5.383 m whichever is lesser = 5.383 m

l_y = 6.09756097560976 m (or) 5.993 m whichever is lesser = 5.993 m

(l_y / l_x) = 1.11 < 2 ; Here, (l_y / l_x) is less than 2, Hence design the slab as two way slab

Load Calculations

Dead Load of slab	= 0.15 x 25 =	3.75 KN/m²
Finishes load on slab	=	1.50 KN/m²
Live Load on slab	=	5.0 KN/m²
Total Dead load acting on the Structure	=	5.25 KN/m²
Total live load acting on the Structure	=	5.0 KN/m²
Factored Design Load	w =	15.38 KN/m²

Support Condition

(Type of panel according to support condition)

Two Adjacent Edges Discontinuous

Short span coefficient for (l_y / l_x) = 1.11,

For negative moment, a_x = 0.0537

For positive moment, a_x = 0.0405

For this support condition,

Long span coefficient,

For negative moment, a_y = 0.047

For positive moment, a_y = 0.035

Moment Calculation

Max. BM per unit width, $M_x = a_x w l_x^2$ & $M_y = a_y w l_x^2$

$A_{st,min}$ = (0.12/100) bD = 180 mm²

	M_u KNm	M_u / bd^2 N/mm²	p_t %	$A_{st,req}$ mm²
For Short Span,				
At mid span,	18.05	1.16	0.3464	433
At supports,	23.93	1.53	0.47	588
For Long span,				
At mid span,	15.60	1.18	0.3529	441
At supports,	20.95	1.58	0.4873	609

Reinforcement details

Provide Y 12 @ ## 125 mm c/c at midspan & supports for short span (A_{st} pro. = 905 mm²)

Provide Y 12 @ 175 mm c/c at midspan & supports for long span (A_{st} pro. = 646 mm²)



Check for Deflection

Percentage of tension reinforcement = 0.72 %

$f_s = 0.58 f_y (A_{st\,req} / A_{st\,pro})$ = 139

Refer Fig. 4 of IS 456,

Modification factor = 1.75

Allowable (Span / d_{eff}) ratio = 45.5

Effective depth required = 118 mm

< d prov.

Hence OK

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Beam Design

Beam Data

width	350 mm
depth	762 mm
clear cover to main	25 mm

d'	25 mm	= cc+ sdia + mdia/2
eff depth	737 mm	= d - d'

Material Grades

Concrete	25 MPa
Steel	500 MPa

Moment	1440 KN-m

Mu/bd^2	1.50	
xumax	336	= (700/(1100 * (0.87 * fy)) * d
Mulim	686	= 0.36*fck*b*xumax*(d-(0.42*xumax))
$Mulim/bd^2$	3.33	

Beam is designed as Doubly Reinforced Beam

Area of Steel	Tension (Ast)	Compr (Asc)
Percentage	1.800 %	1.840 %
Area of Steel	5025 sqmm	5075 sqmm

Refer Table 45-56 SP 16 Pg 81-92

Side Face bars are required

Tension Reinforcement

Type	Bar dia	Nos	Area of Steel	
Layer 1	25 mm	6	2945 sqmm	
Layer 2	25 mm	6	2945 sqmm	
Layer 3	12 mm	0	0 sqmm	
		Total Steel Provided	5890 sqmm	2.103 %
		Provided Steel OK		

Compression Reinforcement

Type	Bar dia	Nos	Area of Steel	
Layer 1	25 mm	6	2945 sqmm	
Layer 2	25 mm	6	2945 sqmm	
Layer 3			0 sqmm	
		Total Steel Provided	5890 sqmm	2.103 %
		Provided Steel OK		

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Column Design

Design Loads

Load	Pu	3500 KN
Moment	Mu	71 KN-m

Column Data

width	b	450 mm
depth	d	600 mm
length	l	4.20 meters

Grade

Concrete	fck	25 MPa
Steel	fy	500 MPa

Pu/(fckbd)	0.52
Mu/(fckbd^2)	0.02
d'/d	0.05

Minimum eccentricity

ex	2.34 mm	OK
ey	2.84 mm	OK

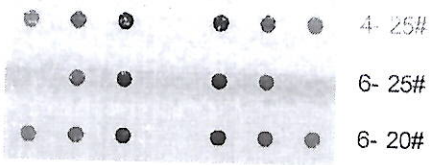
Refer Chart 35 of SP 16, Page no: 120

pt/fck	0.14

pt	2.20%
Ast	5940 sqmm

Number of bars

dia	nos	ast
25 mm	4	1963 sqmm
25 mm	6	2944 sqmm
20 mm	6	1885 sqmm
Total	16	6791 sqmm



Steel provided OK

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Isolated Footing

1 Footing Size Design

Load	Pu	2700 KN
Design Load	P	2700 KN
Moment in x dir	Mux	71 KN-m
Moment in y dir	Muy	1 KN-m
Column size	cx	450 mm
	cy	600 mm
SBC	q	190 KN/sqm
Footing Size required	A req	14.21 sqmm
Footing Size Provided	L	4.00 meters
	B	4.00 meters
Area Provided	A prvd	16.00 meters
	Zx	2.50
	Zx	2.50
Net upward pressure	Nup	188 KNm2

Footing Size OK

2 Slab Design

	lx	1.775
	ly	1.700
Bending Moment in x dir	Mx	444 KN-m
Bending Moment in y dir	My	408 KN-m
Concrete	fck	25 MPa
Steel	fy	500 MPa
Minimum Depth Required	dmin	366
Depth Provided	D	980 mm
Clear Cover	c	50 mm
Effective Cover	d'	58 mm
Effective Depth	d'	922 mm

Area of Steel	Spacing c/c in mm		
	12#	16#	20#
1136 sqmm	100 c/c	177 c/c	277 c/c
1106 sqmm	102 c/c	182 c/c	284 c/c

Minimum Ast required across y direcion

Ast across x direction	16 mm dia @ 125 mm c/c	1608 sqmm
Ast across y direction	16 mm dia @ 125 mm c/c	1608 sqmm

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3 **One Way Shear along x direction**

Vu1	963 KN
ζv	0.261 MPa
ζc	0.266 MPa
Vc1	982 KN

One Way Shear Check OK

4 **One Way Shear along y direction**

Vu1	878 KN
ζv	0.238 MPa
ζc	0.263 MPa
Vc1	970 KN

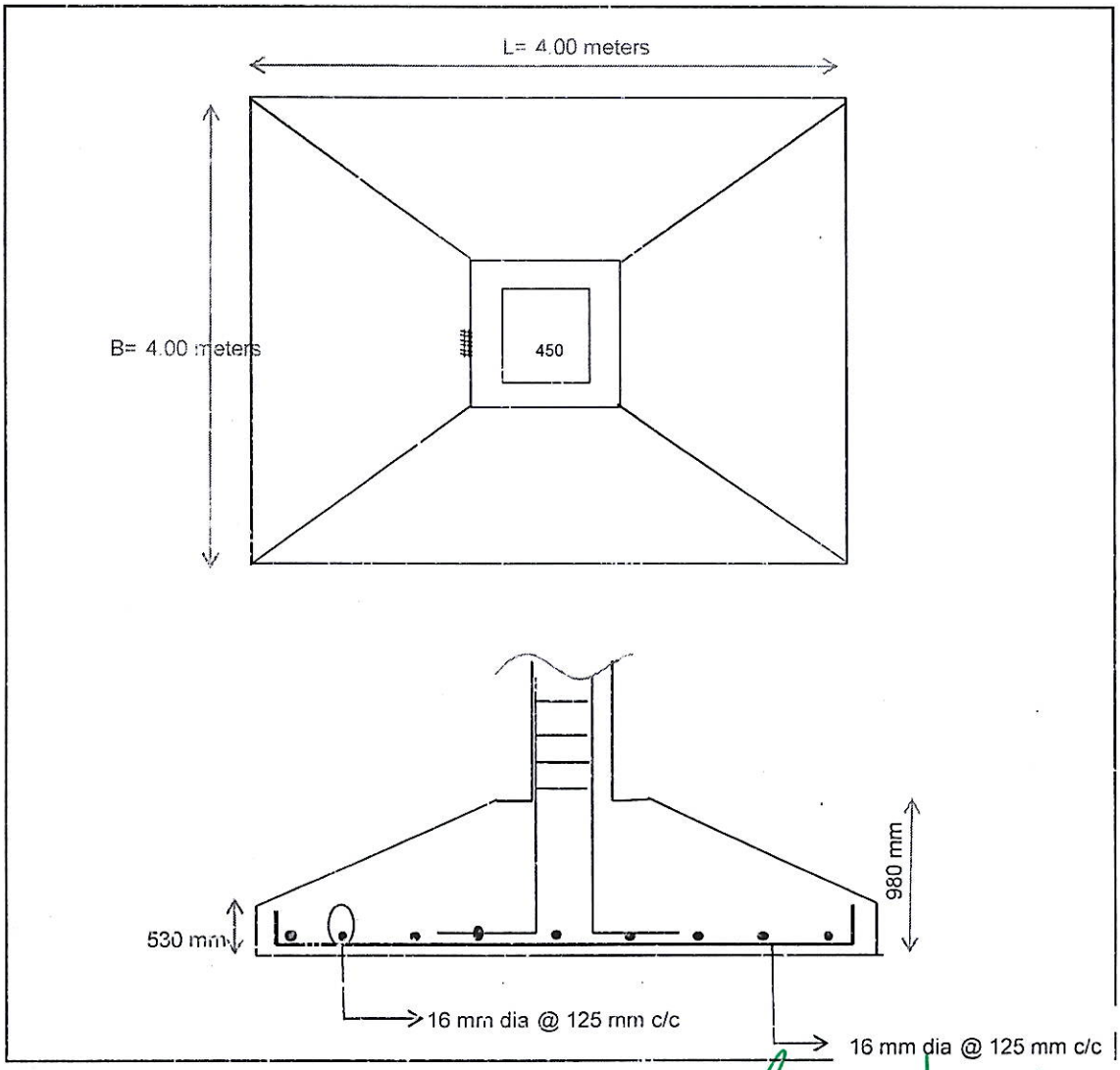
One Way Shear Check OK

5 **Two Way Shear**

Vu2	3925 KN
ζv	0.735 MPa
ks*ζc	1.250 MPa
Vc1	6671 KN

Two Way Shear Check OK

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