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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

(To be furnished while filing application for registration of building)

The detailed engineering and structure design of the proposed building comprising of G+3 floors at S.F.No. 735/1B Part, Ward No. D, Block No. 26, T.S.No. 1/9B, measuring an extent of (1860.00 Sq.mts) Situated in Periyakuppam Village, Thiruvallur Municipality & Taluk, Thiruvallur District has been done by me/us based on the report of geotechnical investigation (soil test) done by Nagadi Consultants Private Limited 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 M25

(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 IS 875 PART (1 To 4) design of earthquake resistant structure as per IS Code No IS1893 – 2016 are carried out

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

Encl: Structural Design Calculation

Stamp and Signature
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PROJECT DESIGN REPORT

THE REVISED CONSTRUCTION OF THE RESIDENTIAL APARTMENT BUILDING AT WARD No.D BLOCK No. 26, T.S.No. 1/9B, PERIYAKUPPAM VILLAGE, THIRUVALLUR MUNICIPALITY & DISTRICT.

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1. PROJECT INFORMATION

1.1	Project Title	:	The Revised Construction of the Residential Apartment Building
1.2	Site location	:	Periyakuppam Village, Thiruvallur Municipality & District
1.3	Survey Nos	:	No.D Block No. 26, T.S.No. 1/9b
1.4	Wind Data		
	a) Basic Wind Speed	:	50 m/sec
	b) Wind Pressure	:	As per IS 875 part-3-1987
1.5	Soil Data		
	a) Depth of foundation	:	2 m from GL
	b) Safe Bearing Capacity	:	170 kN/m^2 (17 t/m^2)
	c) Allowable Settlement	:	50 mm
1.6	Seismic data		
	a) Zone Classification	:	Zone III as per IS 1893-2002
1.7	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+3 Upper floors and the structure is designed as a RCC framed structure.

1.	Type of Structure	:	Apartment
2.	Area of Structure	:	2489.55 m^2
3.	Total Height of Structure	:	12.75 m
4.	Number of floors in the Structure	:	G+3
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

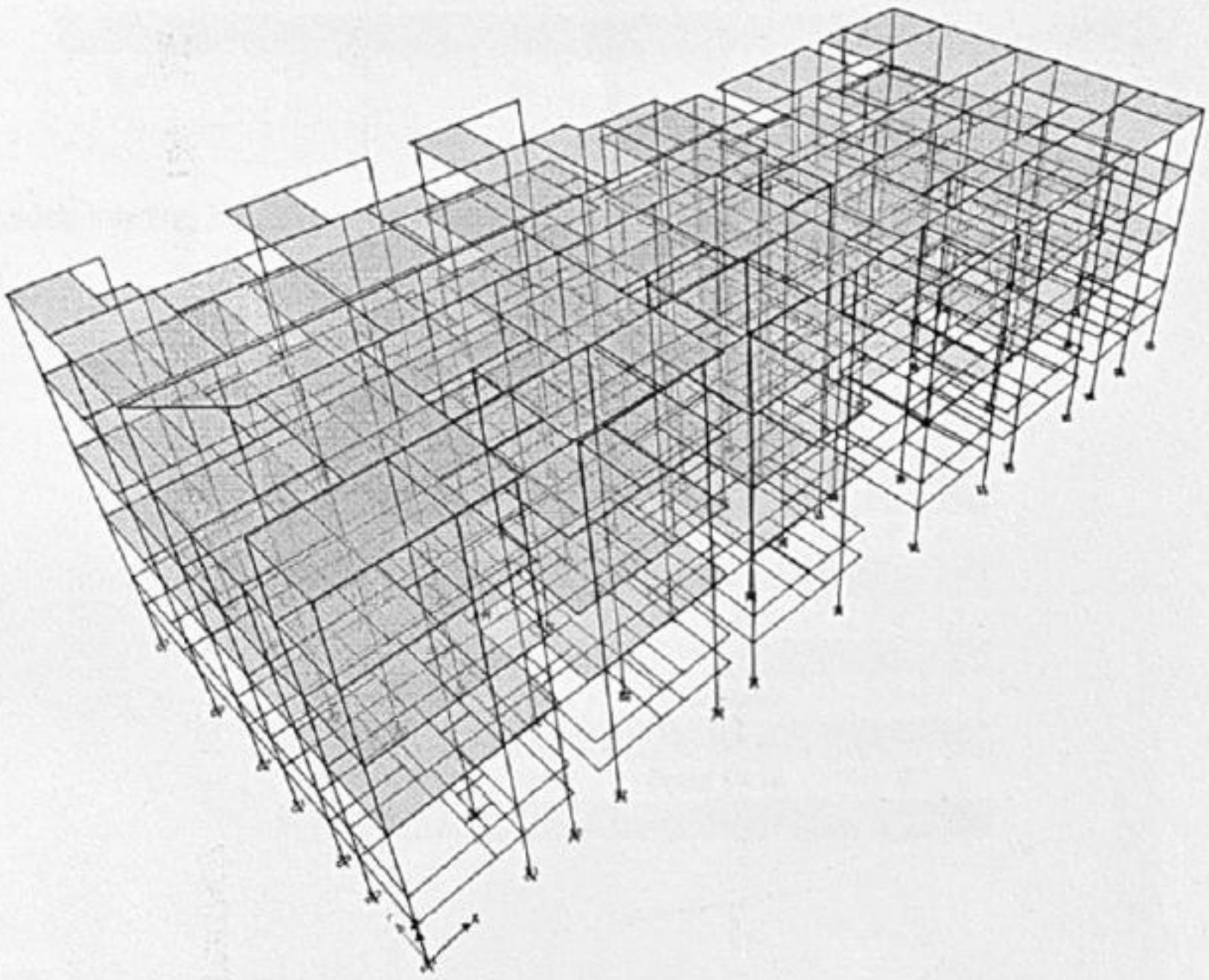
The structure is analyzed as a Space frame structure in ETABS. All Structural members are designed as reinforced concrete elements. Limit State concept of design will be used as per IS: 456-2000 & SP - 16. The detailing of reinforcement shall be done satisfying the requirements of IS: 456-2000, SP-16, 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	TFR	3.05	No	GFR	No	Yellow
T1	SFR	3.05	No	GFR	No	Blue
T1	FFR	3.05	No	GFR	No	Cyan
T1	GFR	3.05	Yes	None	No	Magenta
T1	TB	1.5	No	None	No	Gray8Dark
T1	PB	2	No	None	No	Green

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
FF	No	Super Dead	0
Live	No	Live	0
partition	No	Super Dead	0
ROOF LIVE	No	Roof Live	0
SUNKEN	No	Super Dead	0
WC	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
ROOF LIVE	Linear Static
WC	Linear Static
SUNKEN	Linear Static
partition	Linear Static

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Name	Type
FF	Linear Static

3 Analysis Results

This chapter provides analysis results.

3.1 Structure Results

Table 3.1 - Base Reactions

Output Case	Case Type	Step Type	FX kN	FY kN	FZ kN	MX kN-m	MY kN-m	MZ kN-m	X m	Y m	Z m
Dead	LinStatic		0	0	43894.5151	383852.1986	-932527.3431	0	0	0	0
Live	LinStatic		0	0	4796.1173	42862.7733	-101193.5449	0	0	0	0
ROOF LIVE	LinStatic		0	0	0	0	0	0	0	0	0
WC	LinStatic		0	0	0	0	0	0	0	0	0
SUNKEN	LinStatic		0	0	669.6229	5768.796	-13420.5035	0	0	0	0
partition	LinStatic		0	0	0	0	0	0	0	0	0
FF	LinStatic		0	0	2997.5733	26789.2333	-63245.9656	0	0	0	0
TOTAL	Combination		0	0	57593.6115	505200.3014	-1221426	-5.657E-07	0	0	0
FACTORED	Combination		0	0	78536.743	688909.502	-1665581	-7.714E-07	0	0	0
ENVELOPE	Combination	Max	0	0	78536.743	688909.502	-1221426	-5.657E-07	0	0	0
ENVELOPE	Combination	Min	0	0	57593.6115	505200.3014	-1665581	-7.714E-07	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
TFR	Dead	LinStatic		Y	0.000328	9	14.9954	0.0001	15.7
TFR	Live	LinStatic		Y	4.2E-05	9	14.9954	0.0001	15.7
TFR	SUNKEN	LinStatic		X	3E-06	79	20.011	17.6018	15.7
TFR	SUNKEN	LinStatic		Y	1.2E-05	79	20.011	17.6018	15.7
TFR	FF	LinStatic		Y	2.6E-05	9	14.9954	0.0001	15.7
TFR	TOTAL	Combination		Y	0.000445	9	14.9954	0.0001	15.7
TFR	FACTORED	Combination		Y	0.000607	9	14.9954	0.0001	15.7
TFR	ENVELOPE	Combination	Max	Y	0.000607	9	14.9954	0.0001	15.7
TFR	ENVELOPE	Combination	Min	X	9.4E-05	142	24.0114	14.5539	15.7
TFR	ENVELOPE	Combination	Min	Y	0.000445	9	14.9954	0.0001	15.7
SFR	Dead	LinStatic		X	3E-05	30	0	4.7985	12.65
SFR	Dead	LinStatic		Y	5.7E-05	72	45.0197	17.6018	12.65
SFR	Live	LinStatic		X	6E-06	12	6.0107	0	12.65
SFR	Live	LinStatic		Y	9E-06	59	-8.484E-06	13.3012	12.65
SFR	SUNKEN	LinStatic		Y	5E-06	72	45.0197	17.6018	12.65
SFR	FF	LinStatic		X	4E-06	12	6.0107	0	12.65
SFR	FF	LinStatic		Y	6E-06	59	-8.484E-06	13.3012	12.65
SFR	TOTAL	Combination		X	4.3E-05	30	0	4.7985	12.65
SFR	TOTAL	Combination		Y	7.7E-05	72	45.0197	17.6018	12.65
SFR	FACTORED	Combination		X	5.9E-05	30	0	4.7985	12.65
SFR	FACTORED	Combination		Y	0.000105	72	45.0197	17.6018	12.65
SFR	ENVELOPE	Combination	Max	X	5.9E-05	30	0	4.7985	12.65
SFR	ENVELOPE	Combination	Max	Y	7.7E-05	72	45.0197	17.6018	12.65
SFR	ENVELOPE	Combination	Min	X	4.3E-05	30	0	4.7985	12.65
SFR	ENVELOPE	Combination	Min	Y	0.000105	72	45.0197	17.6018	12.65
FFR	Dead	LinStatic		X	1.9E-05	83	6.0085	17.6018	9.6
FFR	Dead	LinStatic		Y	5.7E-05	72	45.0197	17.6018	9.6
FFR	Live	LinStatic		X	5E-06	11	8.1084	0.0008	9.6

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Story	Output Case	Case Type	Step Type	Direction	Drift	Label	X m	Y m	Z m
FFR	Live	LinStatic		Y	8E-06	85	0	17.6018	9.6
FFR	SUNKEN	LinStatic		Y	4E-06	72	45.0197	17.6018	9.6
FFR	FF	LinStatic		X	3E-06	11	8.1084	0.0008	9.6
FFR	FF	LinStatic		Y	5E-06	85	0	17.6018	9.6
FFR	TOTAL	Combination		X	2.4E-05	83	6.0085	17.6018	9.6
FFR	TOTAL	Combination		Y	7.3E-05	72	45.0197	17.6018	9.6
FFR	FACTORED	Combination		X	3.2E-05	83	6.0085	17.6018	9.6
FFR	FACTORED	Combination		Y	0.0001	72	45.0197	17.6018	9.6
FFR	ENVELOPE	Combination	Max	X	3.2E-05	83	6.0085	17.6018	9.6
FFR	ENVELOPE	Combination	Max	Y	7.3E-05	72	45.0197	17.6018	9.6
FFR	ENVELOPE	Combination	Min	X	2.4E-05	83	6.0085	17.6018	9.6
FFR	ENVELOPE	Combination	Min	Y	0.0001	72	45.0197	17.6018	9.6
GFR	Dead	LinStatic		X	4.6E-05	71	45.0197	14.4322	6.55
GFR	Dead	LinStatic		Y	8.4E-05	63	13.0096	13.0338	6.55
GFR	Live	LinStatic		X	9E-06	30	0	4.7985	6.55
GFR	Live	LinStatic		Y	9E-06	29	7.9941	4.5681	6.55
GFR	SUNKEN	LinStatic		X	3E-06	79	20.011	17.6018	6.55
GFR	SUNKEN	LinStatic		Y	4E-06	23	39.0068	4.5673	6.55
GFR	FF	LinStatic		X	6E-06	30	0	4.7985	6.55
GFR	FF	LinStatic		Y	6E-06	29	7.9941	4.5681	6.55
GFR	TOTAL	Combination		X	4.2E-05	71	45.0197	14.4322	6.55
GFR	TOTAL	Combination		Y	8.5E-05	63	13.0096	13.0338	6.55
GFR	FACTORED	Combination		X	5.7E-05	71	45.0197	14.4322	6.55
GFR	FACTORED	Combination		Y	0.000116	63	13.0096	13.0338	6.55
GFR	ENVELOPE	Combination	Max	X	5.7E-05	71	45.0197	14.4322	6.55
GFR	ENVELOPE	Combination	Max	Y	8.5E-05	63	13.0096	13.0338	6.55
GFR	ENVELOPE	Combination	Min	X	4.2E-05	71	45.0197	14.4322	6.55
GFR	ENVELOPE	Combination	Min	Y	0.000116	63	13.0096	13.0338	6.55
TB	Dead	LinStatic		X	0.000137	71	45.0197	14.4322	3.5
TB	Dead	LinStatic		Y	0.000118	29	7.9941	4.5681	3.5
TB	Live	LinStatic		X	1.2E-05	30	0	4.7985	3.5
TB	Live	LinStatic		Y	1.2E-05	63	13.0096	13.0338	3.5
TB	SUNKEN	LinStatic		X	7E-06	30	0	4.7985	3.5
TB	SUNKEN	LinStatic		Y	4E-06	63	13.0096	13.0338	3.5
TB	FF	LinStatic		X	8E-06	30	0	4.7985	3.5
TB	FF	LinStatic		Y	8E-06	63	13.0096	13.0338	3.5
TB	TOTAL	Combination		X	0.00013	71	45.0197	14.4322	3.5
TB	TOTAL	Combination		Y	0.000139	14	0	0	3.5
TB	FACTORED	Combination		X	0.000177	71	45.0197	14.4322	3.5
TB	FACTORED	Combination		Y	0.00019	14	0	0	3.5
TB	ENVELOPE	Combination	Max	X	0.000153	30	0	4.7985	3.5
TB	ENVELOPE	Combination	Max	Y	0.000139	14	0	0	3.5
TB	ENVELOPE	Combination	Min	X	0.000177	71	45.0197	14.4322	3.5
TB	ENVELOPE	Combination	Min	Y	0.00019	14	0	0	3.5
PB	Dead	LinStatic		X	5.8E-05	71	45.0197	14.4322	2
PB	Dead	LinStatic		Y	6.8E-05	63	13.0096	13.0338	2
PB	Live	LinStatic		Y	5E-06	14	0	0	2
PB	SUNKEN	LinStatic		X	3E-06	80	14.9931	17.6018	2
PB	SUNKEN	LinStatic		Y	2E-06	14	0	0	2
PB	FF	LinStatic		Y	3E-06	14	0	0	2
PB	TOTAL	Combination		X	6.9E-05	71	45.0197	14.4322	2
PB	TOTAL	Combination		Y	8.4E-05	63	13.0096	13.0338	2
PB	FACTORED	Combination		X	9.4E-05	71	45.0197	14.4322	2
PB	FACTORED	Combination		Y	0.000114	63	13.0096	13.0338	2
PB	ENVELOPE	Combination	Max	X	9.4E-05	71	45.0197	14.4322	2
PB	ENVELOPE	Combination	Max	Y	8.4E-05	63	13.0096	13.0338	2

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Story	Output Case	Case Type	Step Type	Direction	Drift	Label	X m	Y m	Z m
PB	ENVELOPE	Combination	Min	X	8.1E-05	30	0	4.7985	2
PB	ENVELOPE	Combination	Min	Y	0.000114	63	13.0096	13.0338	2

Table 3.3 - Story Forces

Story	Output Case	Case Type	Step Type	Location	P kN	VX kN	VY kN	T kN-m	MX kN-m	MY kN-m
TFR	Dead	LinStatic		Top	2378.0072	0	0	0	20651.235	-27612.9214
TFR	Dead	LinStatic		Bottom	2760.5625	0	0	0	23969.9706	-32139.878
TFR	Live	LinStatic		Top	580.5855	0	0	0	5048.2053	-6696.8929
TFR	Live	LinStatic		Bottom	580.5855	0	0	0	5048.2053	-6696.8929
TFR	ROOF LIVE	LinStatic		Top	0	0	0	0	0	0
TFR	ROOF LIVE	LinStatic		Bottom	0	0	0	0	0	0
TFR	WC	LinStatic		Top	0	0	0	0	0	0
TFR	WC	LinStatic		Bottom	0	0	0	0	0	0
TFR	SUNKEN	LinStatic		Top	0	0	0	0	0	0
TFR	SUNKEN	LinStatic		Bottom	0	0	0	0	0	0
TFR	partition	LinStatic		Top	0	0	0	0	0	0
TFR	partition	LinStatic		Bottom	0	0	0	0	0	0
TFR	FF	LinStatic		Top	362.8659	0	0	0	3155.1283	-4185.5581
TFR	FF	LinStatic		Bottom	362.8659	0	0	0	3155.1283	-4185.5581
TFR	TOTAL	Combination		Top	3653.6044	0	0	0	31740.0255	-42344.9096
TFR	TOTAL	Combination		Bottom	4074.4152	0	0	0	35390.6347	-47324.5619
TFR	FACTORED	Combination		Top	4982.1878	0	0	0	43281.853	-57743.0586
TFR	FACTORED	Combination		Bottom	5556.0207	0	0	0	48259.9564	-64533.4936
TFR	ENVELOPE	Combination	Max	Top	4982.1878	0	0	0	43281.853	-42344.9096
TFR	ENVELOPE	Combination	Max	Bottom	5556.0207	0	0	0	48259.9564	-47324.5619
TFR	ENVELOPE	Combination	Min	Top	3653.6044	0	0	0	31740.0255	-57743.0586
TFR	ENVELOPE	Combination	Min	Bottom	4074.4152	0	0	0	35390.6347	-64533.4936
SFR	Dead	LinStatic		Top	9920.1259	0	0	0	86665.6783	-167845.6174
SFR	Dead	LinStatic		Bottom	10668.4055	0	0	0	93195.3703	-184625.3951
SFR	Live	LinStatic		Top	1985.7627	0	0	0	17653.0613	-38195.5711
SFR	Live	LinStatic		Bottom	1985.7627	0	0	0	17653.0613	-38195.5711
SFR	ROOF LIVE	LinStatic		Top	0	0	0	0	0	0
SFR	ROOF LIVE	LinStatic		Bottom	0	0	0	0	0	0
SFR	WC	LinStatic		Top	0	0	0	0	0	0
SFR	WC	LinStatic		Bottom	0	0	0	0	0	0
SFR	SUNKEN	LinStatic		Top	185.2381	0	0	0	1442.9511	-3207.6348
SFR	SUNKEN	LinStatic		Bottom	185.2381	0	0	0	1442.9511	-3207.6348
SFR	partition	LinStatic		Top	0	0	0	0	0	0
SFR	partition	LinStatic		Bottom	0	0	0	0	0	0
SFR	FF	LinStatic		Top	1241.1017	0	0	0	11033.1633	-23872.2319
SFR	FF	LinStatic		Bottom	1241.1017	0	0	0	11033.1633	-23872.2319
SFR	TOTAL	Combination		Top	14665.4513	0	0	0	128474.3395	-256433.1608
SFR	TOTAL	Combination		Bottom	15488.5588	0	0	0	135657.0006	-274890.9162
SFR	FACTORED	Combination		Top	19998.3427	0	0	0	175192.2811	-349681.5828
SFR	FACTORED	Combination		Bottom	21120.762	0	0	0	184986.819	-374851.2494
SFR	ENVELOPE	Combination	Max	Top	19998.3427	0	0	0	175192.2811	-256433.1608
SFR	ENVELOPE	Combination	Max	Bottom	21120.762	0	0	0	184986.819	-274890.9162
SFR	ENVELOPE	Combination	Min	Top	14665.4513	0	0	0	128474.3395	-349681.5828
SFR	ENVELOPE	Combination	Min	Bottom	15488.5588	0	0	0	135657.0006	-374851.2494
FFR	Dead	LinStatic		Top	19995.6965	0	0	0	174824.1063	-394663.6266
FFR	Dead	LinStatic		Bottom	20743.9761	0	0	0	181353.7983	-411443.4043
FFR	Live	LinStatic		Top	3390.94	0	0	0	30257.9173	-69694.558
FFR	Live	LinStatic		Bottom	3390.94	0	0	0	30257.9173	-69694.558
FFR	ROOF LIVE	LinStatic		Top	0	0	0	0	0	0

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Story	Output Case	Case Type	Step Type	Location	P kN	VX kN	VY kN	T kN-m	MX kN-m	MY kN-m
FFR	ROOF LIVE	LinStatic		Bottom	0	0	0	0	0	0
FFR	WC	LinStatic		Top	0	0	0	0	0	0
FFR	WC	LinStatic		Bottom	0	0	0	0	0	0
FFR	SUNKEN	LinStatic		Top	427.4305	0	0	0	3605.8735	-8314.0692
FFR	SUNKEN	LinStatic		Bottom	427.4305	0	0	0	3605.8735	-8314.0692
FFR	partition	LinStatic		Top	0	0	0	0	0	0
FFR	partition	LinStatic		Bottom	0	0	0	0	0	0
FFR	FF	LinStatic		Top	2119.3375	0	0	0	18911.1983	-43559.0988
FFR	FF	LinStatic		Bottom	2119.3375	0	0	0	18911.1983	-43559.0988
FFR	TOTAL	Combination		Top	28526.745	0	0	-5.071E-07	250359.0051	-567854.4878
FFR	TOTAL	Combination		Bottom	29349.8525	0	0	-5.071E-07	257541.6662	-586312.2432
FFR	FACTORED	Combination		Top	38900.1069	0	0	-6.915E-07	341398.6433	-774347.0288
FFR	FACTORED	Combination		Bottom	40022.5262	0	0	-6.915E-07	351193.1812	-799516.6953
FFR	ENVELOPE	Combination	Max	Top	38900.1069	0	0	-5.071E-07	341398.6433	-567854.4878
FFR	ENVELOPE	Combination	Max	Bottom	40022.5262	0	0	-5.071E-07	351193.1812	-586312.2432
FFR	ENVELOPE	Combination	Min	Top	28526.745	0	0	-6.915E-07	250359.0051	-774347.0288
FFR	ENVELOPE	Combination	Min	Bottom	29349.8525	0	0	-6.915E-07	257541.6662	-799516.6953
GFR	Dead	LinStatic		Top	30071.2672	0	0	0	262982.5343	-621481.6357
GFR	Dead	LinStatic		Bottom	30819.5467	0	0	0	269512.2262	-638261.4134
GFR	Live	LinStatic		Top	4796.1173	0	0	0	42862.7733	-101193.5449
GFR	Live	LinStatic		Bottom	4796.1173	0	0	0	42862.7733	-101193.5449
GFR	ROOF LIVE	LinStatic		Top	0	0	0	0	0	0
GFR	ROOF LIVE	LinStatic		Bottom	0	0	0	0	0	0
GFR	WC	LinStatic		Top	0	0	0	0	0	0
GFR	WC	LinStatic		Bottom	0	0	0	0	0	0
GFR	SUNKEN	LinStatic		Top	669.6229	0	0	0	5768.796	-13420.5035
GFR	SUNKEN	LinStatic		Bottom	669.6229	0	0	0	5768.796	-13420.5035
GFR	partition	LinStatic		Top	0	0	0	0	0	0
GFR	partition	LinStatic		Bottom	0	0	0	0	0	0
GFR	FF	LinStatic		Top	2997.5733	0	0	0	26789.2333	-63245.9656
GFR	FF	LinStatic		Bottom	2997.5733	0	0	0	26789.2333	-63245.9656
GFR	TOTAL	Combination		Top	42388.0387	0	0	-5.657E-07	372243.6707	-879275.8147
GFR	TOTAL	Combination		Bottom	43211.1462	0	0	-5.657E-07	379426.3318	-897733.5702
GFR	FACTORED	Combination		Top	57801.871	0	0	-7.714E-07	507605.0054	-1199012
GFR	FACTORED	Combination		Bottom	58924.2903	0	0	-7.714E-07	517399.5434	-1224182
GFR	ENVELOPE	Combination	Max	Top	57801.871	0	0	-5.657E-07	507605.0054	-879275.8147
GFR	ENVELOPE	Combination	Max	Bottom	58924.2903	0	0	-5.657E-07	517399.5434	-897733.5702
GFR	ENVELOPE	Combination	Min	Top	42388.0387	0	0	-7.714E-07	372243.6707	-1199012
GFR	ENVELOPE	Combination	Min	Bottom	43211.1462	0	0	-7.714E-07	379426.3318	-1224182
TB	Dead	LinStatic		Top	37951.8904	0	0	0	331451.6621	-799096.8634
TB	Dead	LinStatic		Bottom	38319.8967	0	0	0	334662.986	-807349.2131
TB	Live	LinStatic		Top	4796.1173	0	0	0	42862.7733	-101193.5449
TB	Live	LinStatic		Bottom	4796.1173	0	0	0	42862.7733	-101193.5449
TB	ROOF LIVE	LinStatic		Top	0	0	0	0	0	0
TB	ROOF LIVE	LinStatic		Bottom	0	0	0	0	0	0
TB	WC	LinStatic		Top	0	0	0	0	0	0
TB	WC	LinStatic		Bottom	0	0	0	0	0	0
TB	SUNKEN	LinStatic		Top	669.6229	0	0	0	5768.796	-13420.5035
TB	SUNKEN	LinStatic		Bottom	669.6229	0	0	0	5768.796	-13420.5035
TB	partition	LinStatic		Top	0	0	0	0	0	0
TB	partition	LinStatic		Bottom	0	0	0	0	0	0
TB	FF	LinStatic		Top	2997.5733	0	0	0	26789.2333	-63245.9656
TB	FF	LinStatic		Bottom	2997.5733	0	0	0	26789.2333	-63245.9656
TB	TOTAL	Combination		Top	51056.7243	0	0	-5.657E-07	447559.7112	-1074653
TB	TOTAL	Combination		Bottom	51461.5312	0	0	-5.657E-07	451092.1675	-1083730
TB	FACTORED	Combination		Top	69622.8058	0	0	-7.714E-07	610308.6971	-1465435

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Story	Output Case	Case Type	Step Type	Location	P kN	VX kN	VY kN	T kN-m	MX kN-m	MY kN-m
TB	FACTORED	Combination		Bottom	70174.8153	0	0	-7.714E-07	615125.683	-1477814
TB	ENVELOPE	Combination	Max	Top	69622.8058	0	0	-5.657E-07	610308.6971	-1074653
TB	ENVELOPE	Combination	Max	Bottom	70174.8153	0	0	-5.657E-07	615125.683	-1083730
TB	ENVELOPE	Combination	Min	Top	51056.7243	0	0	-7.714E-07	447559.7112	-1465435
TB	ENVELOPE	Combination	Min	Bottom	51461.5312	0	0	-7.714E-07	451092.1675	-1477814
PB	Dead	LinStatic		Top	43403.84	0	0	0	379570.4334	-921524.2102
PB	Dead	LinStatic		Bottom	43894.5151	0	0	0	383852.1986	-932527.3431
PB	Live	LinStatic		Top	4796.1173	0	0	0	42862.7733	-101193.5449
PB	Live	LinStatic		Bottom	4796.1173	0	0	0	42862.7733	-101193.5449
PB	ROOF LIVE	LinStatic		Top	0	0	0	0	0	0
PB	ROOF LIVE	LinStatic		Bottom	0	0	0	0	0	0
PB	WC	LinStatic		Top	0	0	0	0	0	0
PB	WC	LinStatic		Bottom	0	0	0	0	0	0
PB	SUNKEN	LinStatic		Top	669.6229	0	0	0	5768.796	-13420.5035
PB	SUNKEN	LinStatic		Bottom	669.6229	0	0	0	5768.796	-13420.5035
PB	partition	LinStatic		Top	0	0	0	0	0	0
PB	partition	LinStatic		Bottom	0	0	0	0	0	0
PB	FF	LinStatic		Top	2997.5733	0	0	0	26789.2333	-63245.9656
PB	FF	LinStatic		Bottom	2997.5733	0	0	0	26789.2333	-63245.9656
PB	TOTAL	Combination		Top	57053.8689	0	0	-5.657E-07	500490.3597	-1209323
PB	TOTAL	Combination		Bottom	57593.6115	0	0	-5.657E-07	505200.3014	-1221426
PB	FACTORED	Combination		Top	77800.7303	0	0	-7.714E-07	682486.8541	-1649076
PB	FACTORED	Combination		Bottom	78536.743	0	0	-7.714E-07	688909.502	-1665581
PB	ENVELOPE	Combination	Max	Top	77800.7303	0	0	-5.657E-07	682486.8541	-1209323
PB	ENVELOPE	Combination	Max	Bottom	78536.743	0	0	-5.657E-07	688909.502	-1221426
PB	ENVELOPE	Combination	Min	Top	57053.8689	0	0	-7.714E-07	500490.3597	-1649076
PB	ENVELOPE	Combination	Min	Bottom	57593.6115	0	0	-7.714E-07	505200.3014	-1665581

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	0.743	1.346	8.459	71.5541
Modal	2	0.607	1.648	10.3548	107.2229
Modal	3	0.535	1.869	11.7427	137.8911
Modal	4	0.236	4.235	26.6118	708.1887
Modal	5	0.196	5.098	32.0346	1026.2129
Modal	6	0.183	5.469	34.3636	1180.8555
Modal	7	0.157	6.361	39.968	1597.4437
Modal	8	0.14	7.153	44.9428	2019.8528
Modal	9	0.135	7.432	46.6972	2180.6318
Modal	10	0.128	7.834	49.2197	2422.5798
Modal	11	0.127	7.856	49.3604	2436.4529
Modal	12	0.121	8.255	51.8684	2690.328

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	0.743	0.0006	0.7288	0	0.0006	0.7288	0	0.2593	0.0002	0.0502
Modal	2	0.607	0.0021	0.0488	0	0.0027	0.7776	0	0.0004	0.0005	0.728
Modal	3	0.535	0.7896	0.0002	0	0.7923	0.7778	0	0.0002	0.2248	0.0025
Modal	4	0.236	0.0001	0.0791	0	0.7925	0.8569	0	0.3283	0.0006	0.019
Modal	5	0.196	0.0004	0.0162	0	0.7929	0.8731	0	0.0531	0.0023	0.0605
Modal	6	0.183	0.0844	0	0	0.8773	0.8731	0	3.217E-05	0.4298	0.0005

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Case	Mode	Period sec	UX	UY	UZ	SumUX	SumUY	SumUZ	RX	RY	RZ
Modal	7	0.157	1.827E-06	0.0125	0	0.8773	0.8856	0	0.0355	3.498E-05	0.021
Modal	8	0.14	1.048E-06	0.0002	0	0.8773	0.8858	0	0.0007	1.009E-06	0.0005
Modal	9	0.135	4.495E-06	0.0009	0	0.8773	0.8867	0	0.0024	6.204E-06	0.001
Modal	10	0.128	0.0032	0.0058	0	0.8805	0.8925	0	0.0117	0.0075	0.0033
Modal	11	0.127	0.0001	0.018	0	0.8806	0.9105	0	0.0362	0.0003	0.0149
Modal	12	0.121	0.0006	0.0001	0	0.8812	0.9106	0	0.0002	0.0014	0.0001

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

Case	Mode	SumRX	SumRY	SumRZ
Modal	1	0.2593	0.0002	0.0502
Modal	2	0.2597	0.0007	0.7782
Modal	3	0.2599	0.2255	0.7806
Modal	4	0.5883	0.2261	0.7997
Modal	5	0.6414	0.2284	0.8602
Modal	6	0.6414	0.6582	0.8606
Modal	7	0.677	0.6582	0.8817
Modal	8	0.6776	0.6582	0.8821
Modal	9	0.6801	0.6582	0.8831
Modal	10	0.6918	0.6657	0.8864
Modal	11	0.728	0.6661	0.9013
Modal	12	0.7282	0.6675	0.9014

Table 3.6 - Modal Load Participation Ratios

Case	ItemType	Item	Static %	Dynamic %
Modal	Acceleration	UX	99.57	88.12
Modal	Acceleration	UY	99.89	91.06
Modal	Acceleration	UZ	0	0

Table 3.7 - Modal Direction Factors

Case	Mode	Period sec	UX	UY	UZ	RZ
Modal	1	0.743	0.001	0.966	0	0.033
Modal	2	0.607	0.003	0.14	0	0.857
Modal	3	0.535	0.997	0.001	0	0.003
Modal	4	0.236	0.001	0.872	0	0.126
Modal	5	0.196	0.006	0.181	0	0.812
Modal	6	0.183	0.994	0.001	0	0.005
Modal	7	0.157	0	0.324	0	0.675
Modal	8	0.14	0.001	0.059	0	0.94
Modal	9	0.135	0.002	0.201	0	0.797
Modal	10	0.128	0.037	0.125	0	0.838
Modal	11	0.127	0.002	0.444	0	0.554
Modal	12	0.121	0.107	0.018	0	0.875

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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 = 3.05 m

Length of long span, L_y = 4.6 m

Width of the supporting beam, = 230 mm

Clear cover to main reinforcement = 20 mm

Assume dia. of reinforcement steel = 10 mm

f_{ck} = 25 N/mm^2

f_y = 500 N/mm^2

SS	10	3.05
LS	15	4.57

Calculations

Assume the thickness of slab as 125 mm ; Effective depth, d = 100 mm

Effective span, l_x = 3.048780487804878 m (or) 2.919 m whichever is le d = 2.919 m

l_y = 4.573170731707317 m (or) 4.443 m whichever is le d = 4.443 m

(l_y / l_x) = 1.52 < 2 ; Here, (l_y / l_x) is less than 2, Hence design the slab as two way slab

Load Calculations

Dead Load of slab	= 0.125 x 25 =	3.13 KN/m^2
Finishes load on slab	=	1.50 KN/m^2
Live Load on slab	=	2.0 KN/m^2
Total Dead load acting on the Structure	=	4.63 KN/m^2
Total live load acting on the Structure	=	2.0 KN/m^2
Factored Design Load	w =	9.95 KN/m^2

Support Condition (Type of panel according to support condition)

Interior Panels

Short span coefficient for (l_y / l_x) = 1.52,

For negative moment, a_x = 0.0536

For positive moment, a_x = 0.0413

For this support condition,

Long span coefficient,

For negative moment, a_y = 0.032

For positive moment, a_y = 0.024

Moment Calculation

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

	M_u KNm	M_u / bd^2 N/mm^2	p_t %	$A_{st, req}$ mm^2
For Short Span,				
At mid span,	3.50	0.35	0.0986	99
At supports,	4.54	0.45	0.1274	127
For Long span,				
At mid span,	2.03	0.25	0.0701	70
At supports,	2.71	0.33	0.0929	93

$A_{st, min}$ = (0.12/100) bD = 150 mm^2

Reinforcement details

Provide Y 10 @ # 150 mm c/c at midspan & supports for short span (A_{st} pro. = 524 mm^2)

Provide Y 10 @ 180 mm c/c at midspan & supports for long span (A_{st} pro. = 436 mm^2)

Check for Deflection

Percentage of tension reinforcement = 0.52 %

$f_s = 0.58 f_y (A_{st\ req} / A_{st\ pro})$ = 54.8

Refer Fig. 4 of IS 456,

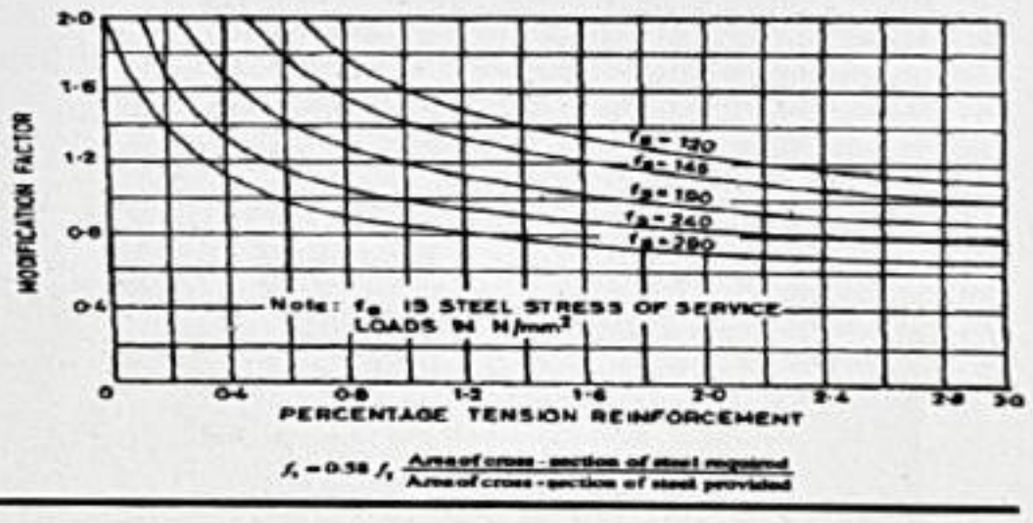
Modification factor = 1.8

Allowable (Span / d_{eff}) ratio = 46.8

Effective depth required = 62 mm

< d prov.

Hence OK



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Beam Design

Beam Data

width	230 mm
depth	450 mm
clear cover to main	25 mm

Material Grades

Concrete	25 MPa
Steel	500 MPa

Moment	200 KN-m

d'	25 mm	*.= cc+ sdia + mdia/2*
eff depth	425 mm	*.= d - d'*

Mu/bd^2	1.50	
xumax	194	*.= (700/(1100 * (0.87 * fy)) * d*
Mulim	138	*.= 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	1.307 %	0.395 %
Area of Steel	1278 sqmm	386 sqmm

Refer Table 45-56 SP 16 pg 81-92

Tension Reinforcement

Type	Bar dia	Nos	Area of Steel
Layer 1	20 mm	3	942 sqmm
Layer 2	16 mm	2	402 sqmm
Layer 3	12 mm	0	0 sqmm
	Total Steel Provided		1345 sqmm

1.376 %

Provided Steel OK

Compression Reinforcement

Type	Bar dia	Nos	Area of Steel
Layer 1	20 mm	0	0 sqmm
Layer 2	16 mm	5	1005 sqmm
Layer 3			0 sqmm
	Total Steel Provided		1005 sqmm

1.028 %

Provided Steel OK

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Column Design

Design Loads

Load	Pu	1350 KN
Moment	Mu	25 KN-m

Column Data

width	b	230 mm
depth	d	450 mm
length	l	3.05 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	1.38 mm	OK
ey	2.11 mm	OK

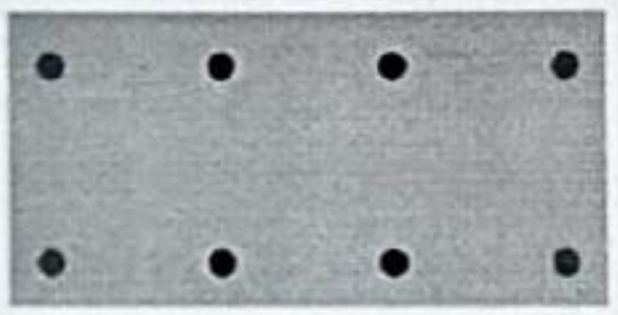
Refer Chart 35 of SP 16, Page no: 120

pt/fck	0.04

pt	1.00%
Ast	1035 sqmm

Number of bars

dia	nos	ast
20 mm	4	1421 sqmm
25 mm	-	3200 sqmm
20 mm	4	1257 sqmm
Total	8	5878 sqmm



Steel provided OK

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Isolated Footing

1 Footing Size Design

Load	Pu	1500 KN
Design Load	P	1100 KN
Moment in x dir	Mux	3 KN-m
Moment in y dir	Muy	1 KN-m
Column size	cx	300 mm
	cy	450 mm
SBC	q	170 KN/sqm
Footing Size required	A req	6.47 sqmm
Footing Size Provided	L	**2.61 meters**
	B	**2.61 meters**
Area Provided	A prvd	6.81 meters
	Zx	2.96
	Zx	2.96
Net upward pressure	Nup	162 KNm2

Footing Size OK

2 Slab Design

	lx	1.155
	ly	1.080
Bending Moment in x dir	Mx	162 KN-m
Bending Moment in y dir	My	142 KN-m
Concrete	fck	20 MPa
Steel	fy	415 MPa
Minimum Depth Required	dmin	243
Depth Provided	D	**600 mm**
Clear Cover	c	50 mm
Effective Cover	d'	56 mm
Effective Depth	d'	544 mm

Area of Steel	Spacing c/c in mm		
	12#	16#	20#
855 sqmm	132 c/c	235 c/c	368 c/c
744 sqmm	152 c/c	270 c/c	422 c/c

Ast across x direction	**12 mm dia @ 125 mm c/c**	**905 sqmm**
Ast across y direction	**12 mm dia @ 125 mm c/c**	**905 sqmm**

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3 **One Way Shear along x direction**

Vu1	388 KN
ζv	0.273 MPa
ζc	0.293 MPa
Vc1	417 KN

One Way Shear Check OK

4 **One Way Shear along y direction**

Vu1	341 KN
ζv	0.240 MPa
ζc	0.276 MPa
Vc1	392 KN

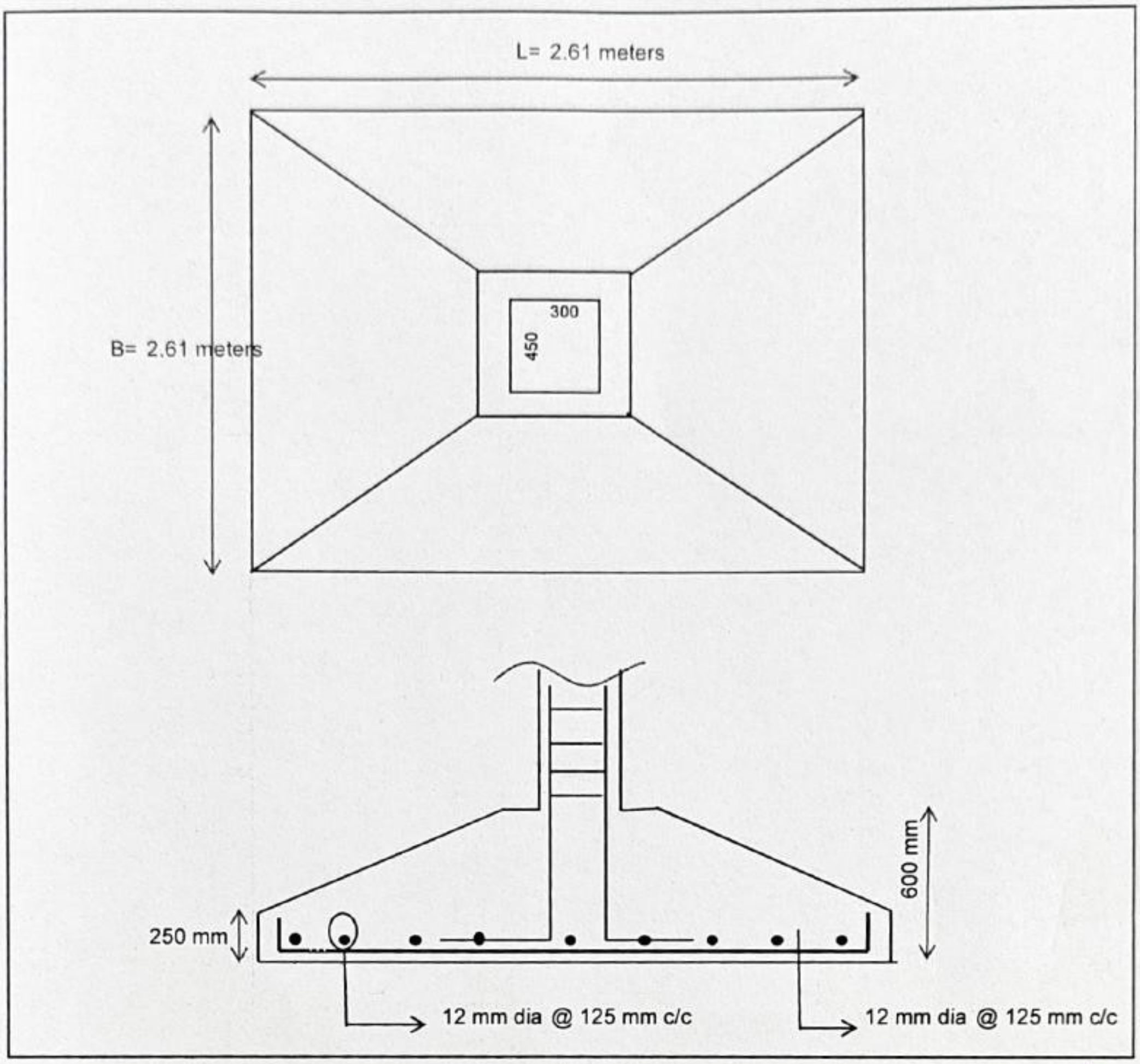
One Way Shear Check OK

5 **Two Way Shear**

Vu2	1454 KN
ζv	0.727 MPa
ks*ζc	1.118 MPa
Vc1	2236 KN

Two Way Shear Check OK

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