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DHANAA SUNDARARAJULU AND ASSOCIATES

Survey, Quantity Survey & Structural Engineering Consultant

DSA

Er. G. DHANA LAKSHMI, CEng.,
M.Tech(Struct.,)B Tech(Civil), AMIA Struct E, AMIE,
Registered Structural Engineer- (CMDA, GCC.,)

Plot No.1&2, Kabilar Street, Senthil Nagar,
Thirumullaivoyal, Chennai – 600 062,
Mob.: 98406 22035, Email: dhanastructural@gmail.com
dhanaasassociates@gmail.com

Structural Stability Certificate

It is certified that the Proposed Residential Apartment Building Stilt floor + 5 floors, Residential building with 49 dwelling units and (Affordable Housing) at Multi Industrial Nagar Road, Gerugambakkam Chennai, Comprised in Old Sno 45/2, New S.no. 45/2A Part (as per document) S.No. 45/2A2 (as per Patta) of Gergambakkam Village with in the limits of Kundrathur Panchayat Union. It has been designed as a RCC structure to withstand the Dead Load, Imposed Load and Wind Load / Earthquake loads ensuring Structural Safety and serviceability as per the norms and guidelines prescribed in the following codes of Bureau of Indian Standards.

1. IS:456-2000 Code of Practice for Plain and Reinforced concrete.

2. IS:875-1987 Code of Practice for Design loads for Buildings and Structures.

3. IS:1893-2002 Criteria for Earthquake resistant design of Structures Part- 1 general Provisions and Buildings.

4. IS:4326-1993 Code of Practice for Earthquake resistant design & Construction of Buildings.

5. IS:13920-1993 Code of Practice for Ductile detailing of RCC structures subjected to seismic forces and

6. National Building code of India – 2005

It is further certified that the above structures shall be constructed from foundation to roof as per structural designs and detailing of reinforcements furnished in our drawings.

Hence, I hereby certify that the Building will be structurally safe and sound for occupation.

Er. G. DHANALAKSHMI, M.Tech., (Struct.),
B.Tech (Civil), AMIA Struct E., AMIE., C.Engg.
RSE No. SE/Gr-II / 2023 / 02 / 333
Plot No. 1&2, Prabhu Homes, F3, 1st Floor,
Kabilar Street, Senthil Nagar,
Thirumullaivoyal, Chennai - 600 062.
Ph:9840622035. E-mail: dhanastructural@gmail.com

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STABILITY CERTIFICATE

PROPERTY AT:

REPORT FOR THE PROPOSED CONSTRUCTION OF AFFORDABLE HOUSING (STILT + 05) AT SURVEY No. 45 / 2A2, MULTI INDUSTRIAL ROAD, GERUGAMBAKKAM VILLAGE, KUNDRATHUR TALUK, KANCHIPURAM DISTRICT

PREPARED BY : **DHANAA SUNDARARAJULU AND ASSOCIATES**
Survey, Quantity Survey & Structural Engineering Consultant

Plot No.1&2, Kabilar Street, Senthil Nagar,
Thirumullaivoyal, Chennai – 600 062. **Mob.:** 98406 22035,
Email: dhanastructural@gmail.com
dhanaasassociates@gmail.com

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INTRODUCTION

The Report has been prepared for the Proposed Construction of Affordable Housing at Survey No.45 / 2A2, Multi Industrial Road, Gerugambakkam Village, Kundrathur Taluk, Kanchipuram District. This Report deals with the Detailed Analysis and Design of Residential Building.

GEOMETRY

The Proposed Building is a R.C.C Framed Structure. The building consists of Stilt + Five Floors only. The usage of the building is enabled for Residential purpose.

MATERIAL

Reinforced Cement Concrete

Grade of Concrete - M 30 (Deign Mix) for Pile, Pile Caps and Columns.

Grade of Concrete - M 25 (Deign Mix) for RCC Beams, Slabs, etc.,

Grade of steel – Fe 500

Er. G. DHANALAKSHMI, M.Tech., (Struct.),
B.Tech (Civil), AMIA Struct E., AMIE., C.Engg.
RSE No. SE/Gr-II / 2023 / 02 / 333
Plot No. 1&2, Prabhu Homes, F3, 1st Floor,
Kabilar Street, Senthil Nagar,
Thirumullaivoyal, Chennai - 600 062.
Ph:9840622035, E-mail: dhanastructural@gmail.com

LOADINGS

a. Dead Load

Unit weight of Concrete	=	25 kN/m^3
Unit weight of Block Work	=	22 kN/m^3 (8" / 4" Block)
Unit weight of Aerocon Block	=	6.5 kN/m^3
Weathering Course	=	1.5 kN/m^2

b. Live Load

Live Load on Floor	=	2.00 kN/m^2

c. Seismic Load

Seismic loads are considered as per IS 1893 2002.

Seismic Zone	- III
Zone Factor	- 0.16
Importance Factor	- 1
Soil Type	- Medium Type II
Response Reduction factor	- 1.5

All other Dead & Live loads are given as gravity loads. The detailing of reinforcement is done as per IS 456-2000, IS 13920:1993 and SP 34. The entire structure is analyzed for each load and Load combinations.

LOAD COMBINATIONS

1. 1.5 Dead Load + 1.5 Live Load
2. 0.9 Dead Load + 1.5 Earthquake X
3. 0.9 Dead Load + 1.5 Earthquake -X
4. 0.9 Dead Load + 1.5 Earthquake Z
5. 0.9 Dead Load + 1.5 Earthquake -Z

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6. 0.9 Dead Load + 1.5 Windload X
7. 0.9 Dead Load + 1.5 Windload -X
8. 0.9 Dead Load + 1.5 Windload Z
9. 0.9 Dead Load + 1.5 Windload -Z

Loads due to Slab

Self-Weight of Slab	-	(0.13 * 2500)	-	325 kg / sq m
Live Load	-		-	200 kg / sq m
Floor Finish	-		-	100 kg / sq m
Unforeseen Load	-		-	75 kg / sq m
Total Load	-		-	**700 kg / sq m**

ANALYSIS

The entire analysis is carried out using finite element method using the program of Staad pro package for Residential building as per approval drawing. The beams and columns are modeled as frame elements and the slabs are modeled as shell element. The columns are assumed to be Fixed at the base. Seismic Analysis is carried out for seismic forces corresponding to **Zone III** of seismic zones of India maps per IS 1893 -2002. Auto generation of lateral loads is done by the program itself for the corresponding seismic factors.

LOAD CASES :

1. Dead Load (DL) : Loads from Self weight of Slab, Beams, Walls, Staircase and Water Tank are taken as Dead Load of the structure.
2. Live Load (LL) : The live load of this structure is calculated as per IS:875 (part 2) for all types of Residential building should be taken as **2 kn/sqm.**

COVER FOR REINFORCEMENT:

Cover for reinforcement is considered as per table 16A of NBC, for a fire resistance of 2 hrs

1. Pile Foundation = 50 mm
2. Pile Cap = 60 mm
3. Columns = 40 mm
4. Roof Slabs = 20 mm
5. Roof Beams = 30 mm

Design for Stilt + Five Floors Only.

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RSE No. SE/Gr-II / 2023 / 02 / 333
Plot No. 1&2, Prabhu Homes, F3, 1st Floor,
Kabilar Street, Senthil Nagar,
Thirumullaivoyal, Chennai - 600 062.
Ph:984[illegible]035, E-mail: dhanastructural@gmail.com

Codes Referred:

- I.S. 875 - 1987 CODES OF PRACTICES for design loads (Part 1,2 & 3)
- I.S. 456 - 2000 & SP – 16 CODES OF PRACTICES for Plain and Reinforced Concrete
- I.S. 1786 - 1985 CODE PF PRACTICES specified for high strength deformed steel bars & wires for concrete reinforcement.
- I.S. 1904. 1986 CODE OF PRACTICES for design of construction of foundation in soils.
- IS 13920:1993 CODE OF PRACTICES for Ductile Detailing
- IS 1893-2002 CODE OF PRACTICES for Earthquake Resistant

DESIGN CONCEPT:

- 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 465-2000
- SP-16, IS: 13920 and SP-34
- The slabs and beams are checked for deflection as per IS 456-2000
- Cover for reinforcement is considered as per Table 16A of NBC, for a Fire resistance of 2 Hrs.

PREAMBLE :

1. I hereby certify that the Structural Design Calculation is done for Critical Pile, Pile Cap, Columns, Beams and Slabs for the building.
2. The usage of the building is for Residential Purpose.
3. The building is designed for Stilt + Five Floors Only.
4. The Super Structure is built with 200 mm thick outer walls and 100 mm thick inner walls.

Er. G. DHANALAKSHMI, M.Tech., (Struct.),
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RSE No. SE/Gr-II / 2023 / 02 / 333
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Kabilar Street, Senthil Nagar,
Thirumullaivoyal, Chennai - 600 062.
Ph:9840622035, E-mail: dhanastructural@gmail.com

DHANAA SUNDARARAJULU AND ASSOCIATES

Structural Engineering Consultant

DSA

Er. G. DHANA LAKSHMI, CEng.,
M.Tech(Struct.,)B Tech(Civil), AMIA Struct E, AMIE,
Registered Structural Engineer- (CMDA, GCC,)

Plot No.1&2, Kabilar Street, Senthil Nagar,
Thirumullaivoyal, Chennai – 600 062,
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dhanaasassociates@gmail.com

STATEMENT ACCOMPANYING FORM –"A"

1.	Applicant	: **M/s.GT PROPERTIES**
2.	Door No./S.No of the building	: No.45 / 2A2,
3.	Name &Location: Street/Ward No.	: Multi Industrial Road, Gerugambakkam Village, Kundrathur Taluk, Kanchipuram District.
4.	Year of Construction	: Proposed Construction
5.	Approximate Cost of construction as per Current rates for Residential Apartment	: **Rs.6,94,00,000/-**
6.	Purpose for which the Building is Being used Or proposed to be used	: Enabled for Residential purpose
7.	Purpose for which the Building has (in there to) been used	: Enabled for Residential purpose

8. Details of Construction of the Building (particulars) of the foundation, soil Specification of the various parts as under.

(i) Foundation : Bored Cast-in-situ Pile Foundation connected with Pile Caps and Columns

Er. G. DHANALAKSHMI, M.Tech., (Struct.),
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Plot No. 1&2, Prabhu Homes, F3, 1st Floor,
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(ii)	Basement	: Yes, R.C.C. Framed Structure with Block Masonry 1: 5
(iii)	Superstructure	: R.C.C. Framed Structure with Block Masonry
(iv)	Floor and Roof are to be given	: Beams & Slabs are provided
(v)	Period for which the license required	: Three Years (Proposed Building) **(11.02.2022 to 10.02.2025)**
(vi)	Structural Fitness	: Structural Safe and Sound

Date: 19/10/2024

Signature of the Engineer

Er. G. DHANALAKSHMI, M.Tech., (Struct.),
B.Tech (Civil), AMIA Struct E., AMIE., C.Engg.
RSE No. SE/Gr-II / 2023 / 02 / 333
Plot No. 1&2, Prabhu Homes, F3, 1st Floor,
Kabilar Street, Senthil Nagar,
Thirumullaivoyal, Chennai - 600 062.
Ph:9840622035, E-mail: dhanastructural@gmail.com

9.(a) "CERTIFIED that no addition or alteration has been made to the existing or portion of a building for which this application has been made. I undertake to obtain a fresh license in case any addition of alteration is made to the existing or portion of building. I also undertake to obtain fresh license if the purpose for which the license was granted for the use of the building or a portion of the building originally is changed or altered subsequently.

For GT PROPERTIES

Authorised Signatory

Date:

Signature of the Owner of the Building

DHANAA SUNDARARAJULU AND ASSOCIATES

Structural Engineering Consultant

DSA

Er. G. DHANA LAKSHMI, CEng.,
M.Tech(Struct.,)B Tech(Civil), AMIA Struct E, AMIE,
Registered Structural Engineer- (CMDA, GCC,)

Plot No.1&2, Kabilar Street, Senthil Nagar,
Thirumullaivoyal, Chennai – 600 062,
Mob.: 98406 22035, Email: dhanastructural@gmail.com
dhanaasassociates@gmail.com

FORM-B

[Form of certificate of structural soundness under sub-section(4) of the Tamil Nadu Public Buildings(Licensing) Act,1965(Tamil Nadu Act XIII of 1965) referred to in rule 4 of the Tamil Nadu Public Buildings (Licensing) Rules,1966.]

I certified that I have gone through the Plan of the Proposed Affordable Housing of the Public building mentioned in the statement and furnish below its Salient Technical Features.

STATEMENT TO ACCOMPANY THE CERTIFICATE OF STRUCTURAL SOUNDNESS

1.	Location of the Building	:	No.45 / 2A2, Multi Industrial Road, Gerugambakkam Village, Kundrathur Taluk, Kanchipuram District.
2.	Age of the Building	:	Proposed Building
3.	Purpose for which the Building is to be proposed	:	Proposed Construction of Residential Building and it is Enable for Residential Purpose.
4.	The Period for which the building will be structural sound	:	60 Years
5.	Remarks	:	Designed as per latest design codes of IS - 456 and IS 13920 : 1993 are followed with SP – 16 Design Aid Books for the purpose of Calculations. It is designed by us. It will be safe and stable against all possible Dead loads, live loads and other combination of loads as per IS Code, the Structure is intended to carry.

Er. G. DHANALAKSHMI, M.Tech., (Struct.),
B.Tech (Civil), AMIA Struct E., AMIE., C.Engg.
RSE No. SE/Gr-II / 2023 / 02 / 333
Plot No. 1&2, Prabhu Homes, F3, 1st Floor,
Kabilar Street, Senthil Nagar,
Thirumullaivoyal, Chennai - 600 062.
Ph:9840622035, E-mail: dhanastructural@gmail.com

DHANAA SUNDARARAJULU AND ASSOCIATES

Structural Engineering Consultant

DSA

Er. G. DHANA LAKSHMI, CEng.,
M.Tech(Struct.,)B Tech(Civil), AMIA Struct E, AMIE,
Registered Structural Engineer- (CMDA, GCC,)

Plot No.1&2, Kabilar Street, Senthil Nagar,
Thirumullaivoyal, Chennai – 600 062,
Mob.: 98406 22035, Email: dhanastructural@gmail.com
dhanaasassociates@gmail.com

FORM –C

[Form of Opinion under sub-section I of Section 5 of the Tamil Nadu Public Buildings (Licensing) Act,1965(Tamil Nadu Act XIII of 1965) referred to in rule 5 of the Tamil Nadu Public Buildings (Licensing) Rules,1966.]

I have gone through the Plan of the Proposed Construction of Affordable Housing specified in the statement below and I have satisfied myself that the Proposed Building is Structurally Sound if it is Constructed as per Structural Design and Plan prepared and supervised by the Qualified Structural Engineer and to be used as Public Building for the purpose noted in the statement, the structural – Soundness of the Building has been verified, taking into account, the loading as per the latest Indian Standard 875, I am therefore the opinion that the License may be granted for the period from **11.02.2022 to 10.02.2025 (Three Years)** inclusive.

Signature of the Engineer

Er. G. DHANALAKSHMI, M.Tech., (Struct.),
B.Tech (Civil), AMIA Struct E., AMIE., C.Engg.
RSE No. SE/Gr-II / 2023 / 02 / 333
Plot No. 1&2, Prabhu Homes, F3, 1st Floor,
Kabilar Street, Senthil Nagar,
Thirumullaivoyal, Chennai - 600 062.
Ph:9840622035, E-mail: dhanastructural@gmail.com

1. FOUNDATION :

a)	Depth below Ground Level	:	23.00 m from existing Ground Level Pile Foundation with Pile Cap
b)	Nature of soil met with at foundation level	:	Silty Fine Sand
c)	Pressure at Foundation	:	Vide Soil Report by M/s. Con-Tech Research Lab Report No. CTRL/M/s.GT
d)	Probable safe bearing capacity of the Strata met with foundation		PROPERTIES/118/2021-2022

Er. G. DHANALAKSHMI, M.Tech., (Struct.),
B.Tech (Civil), AMIA Struct E., AMIE., C.Engg.
RSE No. SE/Gr-II / 2023 / 02 / 333
Plot No. 1&2, Prabhu Homes, F3, 1st Floor,
Kabilar Street, Senthil Nagar,
Thirumullaivoyal, Chennai - 600 062.
[illegible]5, E-mail: dhanastructural@gmail.com

e) Load to be transmitted by column to Foundation : **300 t (Critical)**

Diameter of Pile **450mm & 600 mm** considered for this project

Load carrying capacity of single pile for **450** mm diameter - **110 t**

Load carrying capacity of single pile for **600** mm diameter - **160 t**

2. SUPERSTRUCTURES :

I)	Maximum Compressive stress in the most Critical Section of masonry	:	5 kg/sq.cm
	Permissible maximum compressive stress in Masonry (BW in CM 1:6, 20cm thick), for (the crushing strength of 80 kg / cm^2) as per Table 4 of IS 1905	:	7 kg/sq.cm
II)	Maximum Compressive stress in the most Critical Section of concrete for M 25 Grade	:	a) Bending : 6 N/mm^2 (60 kg/cm^2) b) Direct : 4 N/mm^2 (40 kg/cm^2)
	Maximum Permissible compressive stress for concrete M25 Grade as per Table 21 of IS 456-2000	:	a) Bending : 8.5 N/mm^2 (85 kg/cm^2) b) Direct : 6 N/mm^2 (60 kg/cm^2)

The Structural Soundness of the Proposed Construction of Residential Building loading as per latest Indian Standards (Latest Version and other relevant Indian Standard Code of Practice and I declare that the Proposed Building is Structurally Sound if it is constructed as per Plan and Structural Design prepared by the Qualified Structural Engineer and his regular supervision and to be used as Public Building for the purpose noted in the statement. A License may be granted for the period from **11.02.2022** to **10.02.2025** (Three Years) inclusive.

Signature of the Engineer

Er. G. DHANALAKSHMI, M.Tech., (Struct.)
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DECLARATION

I, G. DHANA LAKSHMI, M.Tech. (Struct.,) Daughter of C. Ganesan, Plot No. 1 & 2, Kabilar Street, Senthil Nagar, Thirumullaivoyal, Chennai – 600 062 do hereby declare that I possess the Qualification and experience specified in the Table to Rule II, of the Tamil Nādu Public Buildings (Licensing Rules,1966) for issuing the Certificate of Structural Soundness of the Buildings covered by the Certificate.

Signature of the Engineer

Er. G. DHANALAKSHMI, M.Tech., (Struct.),
B.Tech (Civil), AMIA Struct E., AMIE., C.Engg.
RSE No. SE/Gr-II / 2023 / 02 / 333
Plot No. 1&2, Prabhu Homes, F3, 1st Floor,
Kabilar Street, Senthil Nagar,
Thirumullaivoyal, Chennai - 600 062.
Ph:9840622035, E-mail: dhanastructural@gmail.com

1.	Name & Address	:	Er. G. DHANA LAKSHMI, C.ENG., B.Tech.(Civil),M.Tech. (Struct.,) Plot No. 1 & 2, Kabilar Street, Senthil Nagar, Thirumullaivoyal, Chennai – 600 062.
2.	Educational Qualification	:	B.Tech.(Civil), M.Tech.(Struct.,)
3.	No. of Years of Experience & Nature there of	:	18 Years of experience in the Engineering field of Civil, Structural and Construction Engineering and Management

Signature of the Engineer

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B.Tech (Civil), AMIA Struct E., AMIE., C.Engg.
RSE No. SE/Gr-II / 2023 / 02 / 333
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1. DESIGN OF PILE FOUNDATION :

Load carrying capacity of 600 mm dia pile = 160 t (or) 1600 kn (For Single Pile)

(As per soil report)

As per **IS :2911(Part1/Section 1) : 2010,** The design of the reinforcing cage varies depending upon the installation condition, the nature of the sub soil and the nature of load to be transmitted by the shaft axial or otherwise.

The minimum area of longitudinal reinforcement of any type of grade with in the pile shaft be 0.4% of the Cross Sectional area of the Pile Shaft. The minimum reinforcement shall be provided throughout the length of the shaft

$$\frac{3.14 \times (600)^2}{4} \times \frac{0.8}{100} = 2261 \text{ mm}^2$$

Provide 12 Nos of Y 16 mm dia bars.

Provide 8mm dia, helical binder @ 150mm c/c.

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2. DESIGN OF PILE CAP
Two pile Group

Total Axial Load	**300**	**T**
Load Carring Capacity for dia pile	**160**	**T**
Dia of pile	**600**	**MM**
Fck	**30**	**MM**
clear cover	**60**	**MM**
Dia of rod	**20**	**MM**
Fy	**415**	

No. of Piles	1.88			
say	2	Piles (Manual Entry)		
C/C Spacing Btw 2 piles should not less than 2.5 times the diameter of the shaft as per (IS Code Pg*11				
ie 2.5*dia of pile	1500	MM		
Load on each pile in Ton	150	T		
Load on each pile in KN	1500	KN		
Add 10% for self wt of pile cap	150	KN		
Total Load	**1650**	KN		
Factor load =1.5*Total Load	2475	KN		
Factored Moment Mu=Factor load*center to certer pile	1485	KNm		
depth	631	MM		
To arrest punching shear =d*2	1263	MM		
Say D	1200	(Manual Entry)		
Eff depth = D-60-(dia of rod/2)	1130	MM		
Ast=((Factor Moment)/(.875*Fy*.8*Eff depth))	4524	SQM		
Provide	14.41	Y	20	
Final Result	**15**	**Y**	**20**	

Provide Y 20 @ 5" c/c

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3. DESIGN OF REINFORCED CONCRETE COLUMN

Column size = 300 mm x 750 mm (or) 12" x 2'-6"

Grade of concrete = M 25

Grade of steel = Fe 415

Column load from Staad Analysis,

P_u = 300 t (or) 3000 kn

M_{ux} = -2.549 knm

M_{uz} = -5.742 knm

d^1/D = 40 / 750 = 0.053 (say 0.15)

$$\frac{P_u}{Fck \times b \times d} = \frac{300 \times 10^3}{25 \times 300 \times 750} = 0.053$$

$$\frac{M_{uz}}{Fck \times b \times d^2} = \frac{5.742 \times 10^6}{25 \times 300 \times (750)^2} = 1.36 \times 10^{-3}$$

As per reference from chart 45, from SP 16 for percentage of steel.

Therefore, percentage of steel, P = 3.80%

Area of steel, Ast = 8550 mm^2

Provide 25 mm diameter bars of 18 Nos

Lateral Ties :

Spacing of the lateral ties should be minimum of the following:

a. Least lateral dimension = 300 mm

b. 16 d = 16 x 25 = 400 mm

Therefore, Provide lateral ties Y 10 @ 125 mm c/c

Result :

Size or the Column : 300 mm x 750 mm

Longitudinal Main Reinforcement : 18 Nos 25 mm Dia Rods

Ties : Y 10 @ 125 mm c/c (2 Ties + 4 Links)

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3. DESIGN OF REINFORCED CONCRETE BEAM

SL.No	*Decription*		Nos	Length	Breadth	Depth	Density	**Total Kg**	Remarks
	S/W of Beam	1	1	5.33	0.23	0.45	2500	1379	
	B/w of load	1	1	3.3	0.20	3.05	2200	4429	
		1	1	2.34	0.10	3.05	2200	1570	
	R/S of load	0.75	1	5.05	1.55	-	700	4109	
		1	1	1.58	0.66	-	1160	1210	
	Total							**12697**	Kg
	Point Load - 1								
	S/W of Beam	1	1	5.38	0.23	0.45	2500	1392	
	B/w of load	1	1	5.38	0.20	3.05	2200	7220	
	R/S of load	1	0.50	1.32	0.66	-	1160	505	
		1	0.50	1.32	0.66	-	1160	505	
		1	1	2.51	1.55	-	700	2723	
	Total							9623	
							P1	**4811**	Kg
	Point Load - 2								
	S/W of Beam	1	1	0	0.23	0.45	2500	0	
	B/w of load	1	1	0	0.23	3.05	2000	0	
		1	1	0	0.12	3.05	2000	0	
	R/S of load	1	1	0.00	0.00	-	700	0	
		1	1	0.00	0.00	-	700	0	
	Total							0	
							P2	**0**	Kg
	Point Load -3								
	S/W of Beam	1	1	0	0.23	0.45	2500	0	
	B/w of load	1	1	0	0.23	3.05	2000	0	
	R/S of load	1	1	0.00	0.00	-	700	0	
	Total							0	
							P3	**0**	Kg
	Main Beam		**12697**	Kg					
	Point Load - 1		**4811**	Kg					
	Point Load - 2		**0**	Kg					
	Point Load - 3		**0**	Kg					
				FS	**MB**	**P1**	**P2**	**P3**	
				1.5	5640	4131	0	0	**14656**
	Mu		=	**14656**	Kg.m				
	Ast		=	**1091**	mm^2		Nos	**3.48**	**314**
d =	465							Dia	20
	Provide @		***3.48***	*20*	***Size***	***230***	***505***	125	380
			NOS	DIA		mm	mm	Slab Thick	BD

Provide 4 - Y 20

Er. G. DHANALAKSHMI, M.Tech., (Struct.),
B.Tech (Civil), AMIA Struct E., AMIE., C.Engg.
RSE No. SE/Gr-II / 2023 / 02 / 333
Plot No. 1&2, Prabhu Homes, F3, 1st Floor,
Kabilar Street, Senthil Nagar,
Thirumullaivoyal, Chennai - 600 062.
Ph:9840622035, E-mail: dhanastructural@gmail.com

5. DESIGN OF REINFORCED CONCRETE SLAB :

DATA: Floor — Stilt Floor

S. No.	=	S1		
Grade of concrete	=	25	N/mm2	
Grade of steel	=	415	N/mm2	
Cover	=	20	mm	
Ly (Long span)	=	5.38	m	
Lx (Short span)	=	3.10	m	
Ly/Lx	=	1.74	<	2

Slab

Slab thickness D	=	0.15	m	
d	=	126	mm	
Sunkan depth	=	0	m	

LOAD:

Dead load	=	3.25	kN/m2
F.Finish	=	1.00	kN/m2
Wall load	=	0.75	kN/m2
Sunkan load	=	0	kN/m2
Live load	=	2.00	kN/m2
(DL+LL)	=	**7.00**	**kN/m2**

DESIGN:

Edge conditions	=	**9**
Short span mid span co.eff. Msx =		**0.100**
Long span mid span co.eff. Msx =		**0.056**

Moment

				say	
Mx	(+ve)	=	10.068	11.068	kNm
My	(+ve)	=	5.638	6.638	kNm

Depth check

Short span Effective depth d = 40.43 < 126 mm

Hence Safe

Deflection

Basic	L/d	=	20			M.F	=	2.00
Allowable	L/d	=	40.000	>	Actual	L/d	=	24.576

Hence Safe

REINFORCEMENT

		Ast req (mm2/m)	Min Ast (mm2/m)	st provided (mm2/m)		dia of ba mm	Spacing mm	inch
Mx	(+ve)	304.13	180	402		8	125	5
My	(+ve)	182.40	180	296		8	170	7

Main Rod
8Y-125mm

Distributor
8Y-170mm

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Kabilar Street, Senthil Nagar,
Thirumullaivoyal, Chennai - 600 062.
Ph:9940622035, E-mail: dhanastructural@gmail.com



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3/350/2 Mettukuppam,
OMR Thoraipakkam,
Chennai, India

hello@verified.realestate
+91 9996 12 9996
www.verified.realestate