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Official Property Record



STRUCTURAL STABILITY CERTIFICATE

Date : 03/07/2024

Site Location at Plot no 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18 & 19, Survey No. 509/1C1G1C & 509/1C1G1A of Kundrathur 'B' Village, Kundrathur Taluk, Kancheepuram District, Kundrathur Municipality Limit.

It is Certificate that the proposed Residential Building "**MP Petals**" Stilt + 3 Floors - **19 blocks** Owned by **M/s. MP Developers** is designed as per the Indian code of practice for Concrete Construction IS 456:2000, where the grade of concrete used for all Structural elements is M20. Loading standards followed for design are IS875 part-I (DEAD LOAD), IS-875 part-II (LIVE LOAD).

Thus, analysis check has been made and we found it is structurally stable and safe for construction.


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CERTIFICATE

This is Certified that the construction of a Residential Buildings "MP Petals" Stilt + 3 Floors - **19 blocks** at Plot no 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18 & 19, Survey No. 509/1C1G1C & 509/1C1G1A of Kundrathur 'B' Village, Kundrathur Taluk, Kancheepuram District, Kundrathur Municipality Limit is designed to resist Dead load and Live load, check has been made and found safe and

I hereby certify that,

1. The least dimension of the column is 230mm
2. The min grade of concrete is M20
3. The design analysis using the code of practice for
loading Standards as per IS-875 part I & II and IS 456.


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1. DESIGN ASSUMPTION

a) STRUCTURAL SYSTEM

The structural system for the "PROPOSED RESIDENTIAL BUILDING AT Plot No. 1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18&19", Survey No. 509/1C1G1C & 509/1C1G1A of kundrathur 'B' Village, kundrathur Taluk, Kancheepuram District, Kundrathur Municipality Limit, consists of Stilt + 3 upper floors and OHT. The total height of the building is about 12 m from Stilt floor level. The structure is supported on shallow foundation below basement level as per the soil test report recommendation.

2. DESIGN LOADS

a) Dead Load:

Dead Load considered on slab: Self Weight + 1.5 kN/m² for Floor Finish.

Wall load	= 6 kN/m (230mm thick AAC Block)
Wall load	= 3kN/m (115mm thick AAC Block)
Wall load (Parapet)	= 4kN/m (115mm & 230mm thick Red Brick)
Staircase load	= 15 kN/m (RCC staircase)
Sunken load	= 4kN/m ²
Water Tank	= 15kN/m ² (1500 mm height)
Floor finish	= 2kN/m ² (Terrace)

b) Roof Live Load:

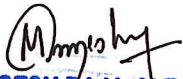
The super imposed load or otherwise live load is assessed based on the occupancy classifications as per IS = 0.75 kN/m² on Solar panel roof.

Live Load considered on slab	= 2 kN/m ²
Live Load considered on slab	= 3 kN/m ² (Lobby & Staircase)
Live Load considered on slab	= 1.5 kN/m ² (Terrace)

3. MATERIALS

The self-weight of the various elements is computed based on the built weight of materials as given below: -

Materials	Unit weight in kN/m ³
Steel	78.5
Plain concrete	24
Reinforced concrete	25
Soil	18
Red brick	20
AAC Block	8


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4. **CONCRETE**

All the concrete items for the construction have the following characteristics

Grade of Concrete = M20

Aggregate = 20mm and down size, mechanically crushed Aggregate.

5. **STEEL**

Steel reinforcement shall be of Grade Fe500 & Fe550 conforming to IS: 1786-2008.

6. **COVER TO REINFORCEMENT**

The clear cover to main reinforcement shall be as follows.

Foundation	= Bottom: 50mm, Sides: 50mm
Slab	= 20mm
Columns	= 40mm
Beams	= 25mm

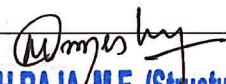
7. **FOUNDATION SYSTEM**

Foundation systems are based on recommendations given as per soil investigation report by GEO MINES ENGINEERS PVT. LTD.

8. **CODES & STANDARDS**

All the design are conforming to the relevant Indian Standards. Some of the relevant Indian Standard Codes, which have been followed for the structural design are given below.

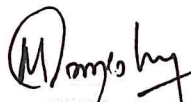
	Description
IS:875 (Part-1)-1987	Code of Practice for Design Loads (Other than Earthquake) for Building and Structures-Unit Weights of Buildings Materials and Stored Material.
IS:875 (Part-2)-1987	Code of Practice for Design Loads (Other than Earthquake) for Building and Structures-Imposed loads
IS:456 (Part-1)-2000	Code of Practice for Plain and Reinforced Concrete
IS:432 (Part-2)-1982	Specification of Mild Steel and Medium Tensile Steel bars and Hard drawn Steel Wire for concrete reinforcement – Hard drawn Steel Wire.
IS:1786-2008	Specification for High Strength Deformed Steel Bars and Wires for Concrete Reinforcement
IS:1904	Indian Standard Code of practice for Design & Construction foundations in Soil: General Requirements.
IS:1642-1989	Indian Standard Code of practice for Fire Safety Of Buildings (General): Details Of Construction.


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IS: 1786-2008 Specification for High Strength Deformed Steel Bars and Wires for Concrete Reinforcement. IS: 1904 Indian Standard Code of practice for Design & Construction foundations in Soil: General Requirements IS: 1642-1989 Indian Standard Code of practice for Fire Safety of buildings (General): Details of Construction.

13. STRUCTURAL ANALYSIS

The Building structures are analyzed using STAAD for various load combination as per Indian Codes.


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COLUMN DESIGN

General Data

Column No.	:	C4 (GRID -A/1)	
Level	:	7.5 m To 9 m(FIRST TO SECOND)	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 + IS 13920 - 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel	=	Fe500	N/sqmm
Column B	=	230	mm
Column D	=	450	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2475	mm
Clear Floor Height @ D	=	2620	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	Simultaneously (Both Axis)	
Code defined D/B ratio	:	4	
D/B Ratio	:	1.96 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	51	
Critical Analysis Load Combination	:	4	
Load Combination	=	[2] : 1.5 (LOAD 1: DL) +1.5 (LOAD 2: LL)	
Critical Location	=	Bottom Joint	
Pu	=	442.69	kN
Mux	=	-12.12	kNm
Muy	=	-68.24	kNm
Vux	=	43.75	kN
Vuy	=	-7.84	kN

Minimum Eccentricity Check

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

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	20.24	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	8.96	kNm


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Minimum Eccentricity Along B :

$$\begin{aligned}\text{Minimum Eccentricity} &= \text{Unsupported Length} / 500 + B / 30 \\ &= 12.62 \text{ mm} \\ M_{\min y} &= P_u \times \text{Minimum Eccentricity} \\ &= 8.85 \text{ kNm}\end{aligned}$$

Slenderness Check

$$\begin{aligned}\text{Max Slenderness Ratio}(L/B) &= 10.76 \\ &< 60 \quad (\text{Hence Ok})\end{aligned}$$

Column Is Unbraced Along D

Slenderness Check Along D:

$$\begin{aligned}\text{Effective Length Factor} &= 1 \\ \text{Slenderness Ratio} &= \text{Effective Length} / D \\ &= 5.82, \text{ Column not Slender Along D}\end{aligned}$$

Column Is Unbraced Along B

Slenderness Check Along B:

$$\begin{aligned}\text{Effective Length Factor} &= 1 \\ \text{Slenderness Ratio} &= \text{Effective Length} / B \\ &= 10.76, \text{ Column not Slender Along B}\end{aligned}$$

Calculation of Design Moment

Direction	M _{analysis}	M _{min} (Abs)	M _{design}	M _{sldnx} (Abs)	M _{design-final}
	A	B	C	E	F
Major Axis - M _{ux}	-12.12	8.96	-12.12	0	-12.12
Minor Axis - M _{uy}	-68.24	8.85	-68.24	0	-68.24

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

$$\begin{aligned}P_u &= 442.69 \text{ kN} \\ M_{ux} &= -12.12 \text{ kNm} \\ M_{uy} &= -68.24 \text{ kNm}\end{aligned}$$


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Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	2.43	
Reinforcement Provided	=	8-T20	
Load Angle	=	$\tan^{-1}(M_{uy}/M_{ux})$	
	=	79.93	deg
MRes	=	69.31	kNm
MCap	=	73.14	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.95 <= 1	

Shear Design (Analysis Forces)

Design for shear along D

Critical Analysis Load Combination :	4	
Critical Load Combination	=	[2] : 1.5 (LOAD 1: DL) +1.5 (LOAD 2: LL)
Design shear force, Vuy	=	-7.8391 kN
Pu	=	431.71 kN
Deff	=	400 mm
Design shear stress, Tvy	=	$V_{uy} / (B \times Deff)$ N/sqmm
	=	0.0852 N/sqmm
Pt	=	1.214 %
Design shear strength, Tc	=	0.6667 N/sqmm
Shear Strength Enhancement Factor	=	$1 + 3 \times P_u / (B \times D \times F_{ck})$
	=	1.6257
Shear Strength Enhancement Factor (max)	=	1.5
Shear Strength Enhancement Factor	=	1.5
Enhanced shear strength, Tc-e	=	1 N/sqmm
Design shear check	=	$T_{vy} < T_c \times \text{Enhancement factor}$

Link for Shear Design along D are not required

Design for shear along B

Critical Analysis Load Combination :	4	
Critical Load Combination	=	[2] : 1.5 (LOAD 1: DL) +1.5 (LOAD 2: LL)
Design shear force, Vux	=	43.7461 kN
Pu	=	431.71 kN
Beff	=	180 mm
Design shear stress, Tvx	=	$V_{ux} / (D \times Beff)$ kN
	=	0.5401 N/sqmm
Pt	=	1.214 %
Design shear strength, Tc	=	0.6667 N/sqmm


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Shear Strength Enhancement Factor = $1 + 3 \times P_u / (B \times D \times F_{ck})$
 = 1.6257
 Shear Strength Enhancement Factor (max) = 1.5
 Shear Strength Enhancement Factor = 1.5
 Enhanced shear strength, T_{c-e} = 1 N/sqmm
 Design shear check = $T_v < T_c \times \text{Enhancement factor}$
Link for Shear Design along B are 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
 = 5 mm

Criterion for spacing of normal links

Min. Longitudinal Bar dia X 16 = 320 mm
 Min. dimension of column = 230 mm
 Max. 300 mm = 300 mm
 Provided spacing = 225 mm

Table For Links

	Required			Provided	
	Normal Design	Shear Design	Ductile Design	Normal Zone	Ductile Zone
Link Dia.	8	---	---	8	---
Spacing	225	---	---	225	---


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BEAM DESIGN

Group : GRID(1/A-D)
 Beam No : RB2
 Analysis Reference (Member) : 6 : 120,142,145
 Beam Length : 7200 mm
 Breadth (B) : 230 mm
 Depth (D) : 525 mm
 Effective Depth (d) : 470 mm
 Design Code : IS 456
 Beam Type : Regular Beam
 Grade Of Concrete (Fck) : M20 N/sqmm
 Grade Of Steel : Fe500 N/sqmm
 Clear Cover (Cmin) : 25 mm
 Es : 2×10^5 N/sqmm

Flexure Design						
	Beam Bottom			Beam Top		
	Left	Mid	Right	Left	Mid	Right
Critical L/C - Analysis	4	4	4	4	4	4
Critical L/C - RCDC	2	2	2	2	2	2
Mu (kNm)	30.96	158.6	58.05	106.6	-	112.41
Tu (kNm)	0.69	0.69	2.59	0.69	2.59	2.59
M _{Tu} (kNm)	1.32	1.32	5.01	1.32	5.01	5.01
Mud (kNm)	32.29	159.92	63.06	107.92	5.01	117.42
MuLim (kNm)	135	135	135	135	135	135
R	0.635	3.148	1.241	2.124	0.099	2.311
Ptmin (%)	0.2	0.2	0.2	0.2	0.2	0.2
Ptcl (c) (%)	0.2	0.882	0.309	0.57	0.2	0.631
Pccl (c) (%)	0	0.139	0	0	0.023	0
PtPrv (%)	0.372	0.93	0.372	0.581	0.372	0.908
AstCalc (sqmm)	216.2	952.96	334.45	616.09	216.2	682.6
AstPrv (sqmm)	402.12	1030	402.12	1030	402.12	1030
Reinforcement Provided	2-T16	2-T16 2-T20	2-T16	2-T16 2-T20	2-T16	2-T16 2-T20

Shear Design			
	Left	Mid	Right
Critical L/C - Analysis	4	4	4
Critical L/C - RCDC	2	2	2
PtPrv (%)	0.581	0.93	0.908
Vu (kN)	114.87	84.87	136.42
Tu (kNm)	0.69	2.6	2.6
V _{Tu} (kN)	4.77	18.05	18.05
Vut (kN)	119.65	102.92	154.47
Tv (N/sqmm)	1.11	0.95	1.43
Tc (N/sqmm)	0.51	0.61	0.6


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Vc (kN)	54.89	65.55	64.99
Vus=Vut-Vc (kN)	64.76	37.37	89.48
Legs	2	2	2
Stirrup Rebar	8	8	8
Asv Torsion (sqmm)	305.805	300.318	438.895
Asv Torsion Prv (sqmm)	609.33	609.33	609.33
Asv Reqd (sqmm/m)	381.6	254.81	527.32
SvCalc (mm)	165	165	165
SvPrv (mm)	165	165	165
Asv Total Prv (sqmm)	609.33	609.33	609.33

Maximum Spacing Criteria

Basic

Spc1 = 0.75d = 352 mm
Spc2 = 300 mm

For Torsion

(X1 = 190, Y1 = 485)
Spc3 = X1 = 190 mm
Spc4 = (X1 + Y1) / 4 = 165 mm


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FOOTING DESIGN_ GRID (A/1)

DATA

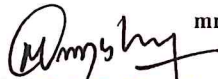
Longer dimension of column L	450	mm
Shorter dimension of column B	230	mm
Unfactored axial load P	438	kN
Unfactored moment in longer direction M1	1	kN-m
Unfactored moment in shorter direction M2	3.2	kN-m
Net soil bearing capacity	140	kN/m ²
Gross safe bearing capacity	176	kN/m ²
Height of footing below NGL	2	m
Unit weight of soil	18	kN/m ³
Total load on footing	577	kN
Gross pressures and check for tension		

P1	156	ok	} No tension
P2	158	ok	
P3	164	ok	
P4	162	ok	

Required area	3.3	m ²
Provided area	3.61	m ²
Longer dimension of footing L1	1.90	m
Shorter dimension of footing B1	1.90	m
Overall depth of footing D	450	mm
Effective depth of footing d	400	mm
Edge depth of footing ed	300	mm
Cover to the main reinforcement	50	mm
Grade of concrete fck	20	N/mm ²
Grade of steel fy	500	N/mm ²
Diameter of bars	10	mm

LONGER MOMENTS

Maximum pressure Pmax	125	kN/m ²
Minimum pressure Pmin	123	kN/m ²
Cantilever length	0.73	m
Average pressure	125	kN/m ²
Moment M11	62	kNm
Effective width for moment	0.44	m
Mu/bd ²	1.33	
Required percentage of steel	0.33	%
Minimum steel area	875.7	mm ²
Provided steel area Ast	586	mm ²
Spacing of reinforcement	170	mm


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SHORTER MOMENTS

Maximum pressure Pmax	125	kN/m ²
Minimum pressure Pmin	119	kN/m ²
Cantilever length	0.84	m
Average pressure	124	kN/m ²
Moment M22	82	kN-m
Effective width for moment	0.63	m
Required percentage of steel	0.32	%
Minimum steel area	895.5	mm ²
Provided steel area Ast	788	mm ²
Spacing of reinforcement	160	mm

CHECK FOR ONE-WAY SHEAR

Longitudinal Direction

Effective width at the section	1030	mm
Effective depth at the section	317	mm
Shear Area at the section	573509	mm ²
Pressure at distance d from the face	124.7	kN/m ²
Shear force at the section	77	kN
Shear stress at the section Tv	0.202	N/mm ²
pt for shear stress	0.153	%
Allowable shear stress Tc	0.290	ok
Revised pt from shear requirement	0.120	%
Revised area of steel Ast	688	mm ²
Spacing of reinforcement	210.000	mm

Transverse Direction

Effective width at the section	1230	mm
Effective depth at the section	316	mm
Shear Area at the section	575484	mm ²
Pressure at distance d from the face	124	kN/m ²
Shear force at the section	100	kN
Shear stress at the section Tv	0.262	N/mm ²
pt for shear stress	0.156	%
Allowable shear stress Tc	0.292	ok
Revised pt from shear requirement	0.120	%
Revised area of steel Ast	691	mm ²
Spacing of reinforcement	210.000	mm

CHECK FOR PUNCHING SHEAR

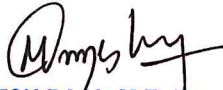
Average pressure	121	kN/m ²
Punching shear force	373	kN
Perimeter at distance d/2	2940	mm
Effective depth at distance d/2	356	mm
Shear area	1046338	mm ²


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Shear stress at the section T_v	0.36	N/mm ²
Allowable shear stress T_c	1.118033989	ok

TRANSFER OF LOAD AT BASE

Supporting area for bearing (A1)	3751500	mm ²
Loaded area at column base (A2)	103500	mm ²
$\sqrt{A1/A2}$	2	
Actual bearing stress	6.35	N/mm ²
Allowable bearing stress	18	ok


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PLOT18		FF SLAB								
Along Grid : (A-B) TO (2-4)		slab Reff.		S3						
INPUT DATA										
Slab			Loads							
Shorter Span	Lx =	3.700 m	Dead Load	DL =	3.75 kN/m ²					
Longer Span	Ly =	4.960 m	Live load	LL =	2.00 kN/m ²					
Thickness of Slab	D =	150 mm	Floor Finishes	FF =	1.50 kN/m ²					
Clear Cover	d' =	20 mm	False Ceiling Load	=	0.25 kN/m ²					
Ly/Lx ratio	k =	1.34 Two-Way Slab	Total Load	w =	7.50 kN/m ²					
Panel Type			Materials							
Basic L/d ratio = 26			Grade of Concrete = 20 N/mm ²							
Edge Condition: = 9			Grade of Reinf. Steel = 500 N/mm ²							
Four Edges Discontinuous			Young's Modulus E = 2.24E+04 N/mm ²							
DESIGN										
Direction	BM Coefficients (IS:456-2000)	Flexural Design			dia & Required Spacing				Provided Reinforcement	
		Mu kNm	Ast _{req} mm ²	Ast _{pro} mm ²	8 mm	10 mm	12 mm	16 mm		
Shorter Span	$\alpha_x (-)$ =	0.0000	0.000	151	352	300	300	300	300	8 @ 150 Safe
	$\alpha_x (+)$ =	0.0814	12.542	240	352	209	300	300	300	8 @ 150 Safe
Longer Span	$\alpha_y (-)$ =	0.0000	0.000	151	302	300	300	300	300	8 @ 200 Safe
	$\alpha_y (+)$ =	0.0560	8.625	163	302	300	300	300	300	8 @ 200 Safe
CHECK FOR DEFLECTION										
Area of Steel required = 240 mm ² Area of Steel Provided = 352 mm ² Steel stress of service load = 198.11 N/mm ² Provided reinforcement (%) = 0.28% Modification ratio MF = 1.935 Effective depth required for deflection point of view $d_{req} = 73.53082$ mm Eff. depth provided d = 126 mm Safe										
SLAB SUMMARY										
Shorter Span: Provide T 8 @ 150 mm c/c + 1 T 8 Extra between the two cranked bars			Longer Span: Provide T 8 @ 200 mm c/c + 1 T 8 Extra between the two cranked bars							
CHECK FOR SHEAR										
Max Shear Force = 21 KN Actual Shear stress $\tau_v = 0.165$ N/mm ² P_t of Ast = 0.28% Design Shear Stress $\tau_c = 0.37$ N/mm ² Shear is less than Design Shear Stress, Hence Safe against shear										
NOTES										
1. Crank alternate bars at 0.3 times the respective span. 2. Provide 12mm dia chairs at 1000mm c/c in both directions. 3. Provide 5 mm thick cover blocks at 600mm c/c in both directions.										
Reinforcement Summary: Along Shorter Span Provided T8@ 150mm c/c Along Longer Span Provided T8@ 200mm c/c										

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