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Date: 16/09/2024
Place: Chennai

STRUCTURAL STABILITY CERTIFICATE

This is to certify that the proposed construction of 08 Individual Villa Buildings in Plot Nos. 99A, 99B, 100, 103A, 103B, 103C, 109A, & 109B in the House site Layout approved in CMDA PPD L.O.No.14/2022 and in Vengaivasal Panchayat President Proc.No.245/2021-22 dt. 24.2.22 comprised in S.No. 209/1C, 209/3B, 209/3D, 209/4A, 209/4C, 209/4D, 209/ 5, 209/6, in Vengaivasal village, St. Thomas Mount Panchayat Union, Tambaram Taluk Chengalpattu District Tamil Nadu state is designed to resist all possible Gravity, Seismic loads and other Combination of loads as per the relevant IS Codes and other Codes in vogue which the structure is intended to with stand.

Check has been made & found the structure is safe and sound, hereby certify that the

1. Foundation & its vertical elements (RC Column & RC wall) are designed for a Ground Floor, First Floor & Terrace Floor with Head Room and OHT as per Architectural plans considering all relevant Residential Building loadings.

2. The grade of concrete used in the structural design of Building is M25.

3. The Analysis and design carried out for the intended Residential Building loading as per the code of Practice IS 875 Part 1 to 2 and seismic forces as per the seismic code of practice IS 1893-2016.

4. Design of Structural elements carried out as per the stipulations made in latest code of practice IS 456-2000 and ductile detailing is adopted as per the stipulations given in IS-13920-2016.

5. Foundation is designed considering the sub soil condition reported & the recommendation laid down in the Soil Investigation Report No. 204/GI/18-19 dated 12th December, 2018, investigation carried out by Mis. Prasad Armstrong Yen GEC(P) Ltd, Chennai.

Signature of the Structural Engineer,

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(A PERAMAIYAN)

STRUCTURAL DESIGN CALCULATION REPORT OF THE PROPOSED CONSTRUCTION OF VILLAS AT SURVEY NO: 209/1C, 209/3B, 209/3D, 209/4A, 209/4C, 209/4D, 209/5, 209/6 VENGAIVASAL VILLAGE, ST. THOMAS MOUNT PANCHAYAT UNION, TAMBARAM TALUK CHENGALPATTU DISTRICT, TAMIL NADU FOR M/S EMERALD HAVEN REALTY LIMITED

R0	16-09-2024	STRUCTURAL DESIGN BASIS REPORT	OK	N.K.GOWTHAM	KALEEM	PERAM
REV NO.	**DATE**	**DESCRIPTION**	**STATUS**	**PREPARED BY**	**REVIEWED BY**	**APPRVD. BY**

STRUCTURAL CONSULTANT

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CLIENT

M/S. EMERALD HAVEN REALTY LIMITED, CHENNAI

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PART 1. REPORT

The Project undertaken for the structural design of Proposed Individual Villas 08 villa Buildings in Plot Nos. 99A, 99B, 100, 103A, 103B, 103C, 109A & 109B in the House site Layout approved in CMDA PPD L.O.No. 14/2022 and in Vengaivasal Panchayat President Proc. No.245/2021-22 dt. 24.2.22 comprised in S.No. 209/1C, 209/3B, 209/3D, 209/4A, 209/4C, 209/4D, 209/5 & 209/6, in Vengaivasal village, St. Thomas Mount Panchayat Union, Tambaram Taluk Chengalpattu District Tamil Nadu state. Proposed villas consist of G+1 structure with staircase and head room. All the Buildings are designed for Ground Floor and First Floor.

PART 2. STRUCTURAL SYSTEM

The chosen structural system for the villas is RCC building. All structural members are designed as a RCC members such as Footing, Column, Beam and Slab. Roof is considered as flat roof system with access. The primary load scenarios to be considered are the self-weight (gravity load) and the imposed live loads (vertical loads). The self-weight of the structure includes the dead load from the structural elements such as slabs, beams, columns, shear walls etc. and the live loads are usually imposed on the slab. Along with these, superimposed dead loads like floor finishes, services do contribute to gravity load. The live load application is done based on IS 875-2 (1987): Code of Practice for Design Loads (Other Than Earthquake) For Buildings and Structures. These imposed loads are first transferred to the slabs/beams, which gets transfers to the columns. The load further gets transferred to the foundations from the columns. Finally, the foundations transfer the load to the earth below. Here the columns with l/d.=4 are considered as shear wall which takes vertical as well as seismic forces and columns as with l/d<=4 are considered as gravity columns which takes only the vertical loads.
Seismic forces under Zone-III for earthquake consideration as provided in IS 1893 (Part 1) -2016 Criteria for Earthquake Resistant Design of Structures.

PART 3. GENERAL

Structural drawings shall be read and used in conjunction with relevant architectural drawings. Any discrepancy between the same should be brought to the notice of the consultant, who will rectify the same. All structural materials used shall conform with relevant Indian Standard Code specifications. Dimensions mentioned in structural drawings will be in millimetre unless otherwise mentioned.

PART 4. ANALYSIS

The above Buildings are analysed with a full 3D Model. All supports of the modelled structure are considered as fixed joints for analysis. Effective length of columns is considered as per the standard codes of practice. This structure is designed and detailed as per Indian codes of practice only. SI units are followed for entire analysis and design. The modelled structure is analysed for dead loads (DL), live loads (LL) and seismic loads (EQ) with their combinations as per **IS 456 – 2000 and IS 1893 (Part 1) - 2016.**

PART 5. LOADS

Part 5.1. Dead loads

Dead load in the building shall comprise the weight of all walls, partitions, floors and roofs and shall include the weights of all permanent constructions in the buildings. The unit weight per mass of the materials and parts or components of the building that are applicable to the determination of dead load calculations are obtained by considering complying with **IS 875 (Part 1) - 1987** and according to densities of the possible dead loads. **(Ref. Appendix A)**

Part 5.2. Live loads

The minimum live load on floors depending on different purpose of usage is considered using **IS-875 (Part 2)-1987**. Live load on floors comprises all loads other than dead loads produced by intended use or occupancy of a building including the weight of movable partitions, distributed and concentrated loads, loads due to impact and vibrations and dust load but excluding wind, seismic loads, etc. **(Ref. Appendix A)**

Live load distribution varies from floor to floor. In general, all the floors of a building may not be fully loaded with the help of reduction factor. Therefore, code permits reduction in live loads in designing columns, walls and foundations.

Part 5.3. Earthquake loads

Earthquakes cause random motion of ground, which can be resolved in any three mutually perpendicular directions. This motion causes the structure to vibrate. The response of the structure to the ground vibration is a function of the nature of foundation soil, materials, form, size and mode of construction of the structure, duration and the intensity of ground motion. **IS 1893 (PART1)-2016** has been used for the earthquake analysis of the proposed structure. **(Ref. Appendix B)**

PART 6. LOAD COMBINATIONS

Detailed as per **Appendix C.**

PART 7. GRADE OF MATERIALS

All reinforcement used shall be high yield strength deformed TMT bars of Grade Fe- 500D confirming to IS 1786 indicated with a prefix Fe of with the appropriate bar diameter.

PART 8. GRADE OF CONCRETE

Minimum Grade of concrete will be as per code provision conforming to IS 456: 2000, for **"Moderate"** environmental exposure condition (As per IS-456-2000 Table-3). Different Grades of concrete have been used to design the structural elements as per the design requirement. The minimum cement content for different grades of concrete and **"Moderate"** environmental exposure condition will be as per IS 456:2000.

Suggested preliminary values are based on exposure conditions and other criteria such as reinforcement demand, punching shear requirement (if applicable) etc.

- Footings and Raft - M25
- Columns and Pedestals - M25
- Beams and Slabs - M25
- Retaining walls - M25
- Shear walls - M25 for 200 mm thick wall.

PART 9. NOMINAL COVER TO MEET DURABILITY REQUIREMENTS

Nominal Concrete cover not less than 30 mm for **"Moderate"** Exposure Condition as per relevant codes. The covers are suggested using both moderate exposure and fire resistance of two hours and other code provisions.

- Footings : 50 mm
- Columns & Pedestals : 40 mm
- Beams : 40 mm (SS) or 30 mm (continuous)
- Slabs : 25 mm
- Walls : 30 mm

PART 10. MATERIAL SAFETY FACTORS

Partial safety factor for concrete and steel are 1.5 and 1.15 respectively.

PART 11. STRUCTURAL ANALYSIS

The structures were analysed by modelling in 3D FEM Package (ETABS). The analysis results were checked manually to ensure the right structural behaviour. The adopted member sections were checked for serviceability criteria to ensure the following deflection limits as specified in the code.

For Vertical Deflections	
Live Load deflections	
Total load deflection	Span /250
Live Load deflection	Span/350 or 20mm (whichever is less)
For Lateral Deflections	
Earth quake deflections	Height /250

PART 12. SUPER-STRUCTURE (RCC)

All the structural elements are designed as per **IS: 456-2000** using the fundamentals of Limit State Method. All corresponding parameters are input through ETABS. Reinforcement of Beams, Columns and Structural Walls are taken from structural software. Slabs are designed and checked for deflection with the appropriate L/d ratios and Modification factors using in home excel sheet.

PART 13. SUB-STRUCTURE (RCC)

The type of foundation recommended by the soil consultant is Isolated footing for Safe Bearing Capacity of 250 kN/m2 at 2m below ground level. Foundations are designed by using RCDC from the input taken from ETABS.

A combined footing or a mat foundation may be needed based on the proximity of the columns and their loads post-analysis. The combined footing is designed to withstand the critical load case obtained from ETABS by importing it into another software package SAFE (ver. 16.0).

PART 14. SHEAR WALL

Based on the architectural feasibility and keeping the services requirement in consideration, shear walls will be provided to transfer part of the lateral forces, based on the relative stiffness.

PART 15. DETAILING

The building is designed for Seismic Zone III. All the structural elements are detailed as per **SP-34 and IS 13920:2016**, respectively. Proper curtailments details were detailed to get the economy and ease in construction at site. As per **IS 13920**, lap splices shall not be used for bars of diameter larger than 32 mm for which mechanical splicing shall be adopted. Proper curtailment details are followed to get the economy and ease in construction at site.

PART 16. LIST OF CODES AND REFERENCES

- IS 456 2000: Code of practice for Plain and Reinforced Concrete.
- IS 875 1987: Code of practice for design loads (other than earthquake) for Buildings & structures.
- IS 875 Part 1: Code of Practice for Design Loads (Other than earthquake) for buildings and structures (Dead Loads).
- IS 875 Part 2: Code of Practice for Design Loads (Other than earthquake) for buildings and structures (Imposed Loads).
- IS 875 Part 5: Code of Practice for Design Loads (Other than earthquake) for buildings and structures (Special Loads & Load Combinations).
- IS 1893 (Part 1) 2016: Criteria for earthquake resistant design of Structures.
- IS:1893 (Part 4) 2015: Criteria for earthquake resistant design of Structures.
- IS 13920 2016: Ductile Design and Detailing of Reinforced Concrete Structures Subjected to Seismic Forces
- SP 16: Design aids for reinforced concrete to IS: 456- 1978.
- SP 34: Hand book on concrete reinforcement detailing.
- IS 1786:2008 High Strength Deformed Steel Bars and Wires for Concrete Reinforcement

APPENDIX A: LOAD DETAILS

Table for Density of Materials

No	Description	Unit	Value	Remarks
1	RCC	kN/m^3	25	-
2	PCC	kN/m^3	24	
3	Steel	kN/m^3	78.5	
4	Saturated Soil	kN/m^3	20	
5	Brick work	kN/m^3	20	

Table for Dead Loads

No	Description	Unit	Value	Remarks
1	Super Imposed Load	kN/m^2	1.5	-
2	Terrace Floor finish	kN/m^2	2.5+5.5	600mm soil fill for terrace garden area.

Table for Live Loads

Floor No	Description	Unit	Value	Remarks
1	Typical Floors	kN/m^2	2	-
2	Terrace Floor	kN/m^2	1.5	-
3	Stair case	kN/m^2	2.5	-
4	Toilets	kN/m^2	2	-

Table for Wall Load

No	Description	Unit	Value	Remarks
1	Wall Load	kN/m	11.4	On Beams below wall.
2	Wall Load	kN/m	5.7	On Beams below wall.
3	Wall Load	kN/m	3.375	Parapet wall load on beams

APPENDIX B: EARTHQUAKE LOAD CALCULATION

	JOB NO		DATE :	19-04-2022
	:CLIENT:	TVS EMERALD	DESIGN BY :	
	BUILDING :	villas	CHECKED BY :	NBNATR0
	SESIMIC BASE SHEAR CALCULATION		REV NO :	

Design Seismic Base Shear (V_b) as per IS 1893 (Part 1) : 2016

Description		Symbol	Value	Units
Seismic Zone			III	
Damping Ratio (%)			5	
Multiplying Factor (Annex A 1893 P4			1	
2015)Seismic Intensity		z	0.16	
Importance factor		I	1	
Response Reduction factor		R	5	
Lateral Dimension of Building		dx	7.8	
		dy	11.6	m
Height of the of Building		h	6.6	m
Fundamental Natural Period		Ta	0.308829811	s
	Time Period RC	Ta	0.350007119	s
	MRF Time Period STEEL MRF			
Type of Soil			Medium Soil	
Design Methodology			Equivalent Static Method	
Spectral Acceleration Coefficient	x-dir	Sa/g	2.5	
	y-dir	Sa/g	2.5	
Design Horizontal Seismic Coefficient	x-dir	Ah	0.04	
	y-dir	Ah	0.04	

c) All other buildings:

$$T_a = \frac{0.09h}{\sqrt{d}}$$

where

h = height of building, as defined in **7.6.2**(a), in m; and

d = base dimension of the building at the plinth level along the considered direction of earthquake shaking, in m.

APPENDIX C: LOAD COMBINATIONS

Load cases/definition:

DL – Dead Load LL – Live Load

EQX, EQY – Seismic load in X & Y directions

Load combinations for limit state of collapse (RCC)

1.5 (DL + LL)

1.5 (DL ± EQX)

1.5 (DL ± EQY)

1.2 (DL + LL ± EQX)

1.2 (DL + LL ± EQZ)

0.9 DL ± 1.5 EQX

0.9 DL ± 1.5 EQY

Load combinations for limit state of serviceability (RCC) DL + LL

DL ± EQX

DL ± EQY

DL+LL ± EQX

DL+LL ± EQY

DL+0.8LL ± 0.8EQX

DL+0.8LL ± 0.8EQY

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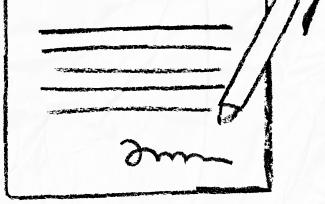

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