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B.SRINIVASAN B.E AMIE.,
Chartered Engineer
CMDA & Greater Chennai Corporation
Registered Structural Engineer

Mobile : 9445210268
Email : srinideepan@rediffmail.com

STRUCTURAL STABILITY CERTIFICATE

STRUCTURAL STABILITY REPORT FOR THE PROPOSED CONSTRUCTION OF STILT +5 FLOORS - (5th FLOOR GYM) RESIDENTIAL BUILDING (HEIGHT-18.30m) WITH 98 DWELLING UNITS (AFFORDABLE HOUSING)AT ADHANUR ROAD, VARADHARAJAPURAM, CHENNAI COMPRISED IN S.No.44/2B1, 46/2A1, 46/2A2, 46/2A3, OF VARADHARAJAPURAM VILLAGE, KUNDRATHUR TALUK, WITHIN THE LIMIT OF KUNRATHUR PANCHAYAT UNION.

The Proposed Building referred to above is a framed structure with Stilt and Five Upper Floors .The Structural Design and Drawing for the building are being prepared by me conforming to the relevant Bureau of Indian Standard viz. IS 456:2000 for Plain and Reinforced Concrete, IS 875(Part II)—1987 for Imposed Loads and IS 1893:2002(part 1) for Seismic Force. We certify that the building when constructed according to our Structural Designs and Drawings will be structurally safe and sound and fit for occupation.

1. The minimum grade of concrete is M30.
2. Column Width at Stilt Floor is 300mm

B.SRINIVASAN, B.E.,A.M.I.E, C.Engg.,
Structural Engineer Grade - II
CMDA Reg No.S.E/GR-II/19/08/152
176/311, ARCOT ROAD,
KODAMBAKKAM, CHENNAI-600 024

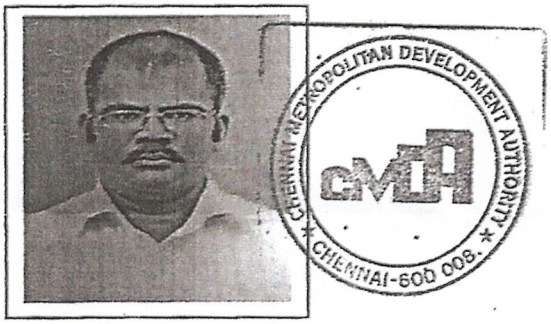
CHENNAI METROPOLITAN DEVELOPMENT AUTHORITY
'Thalamuthu Natarajan Building', No.1, Gandhi Irwin Road,
Egmore, Chennai-600 008.

PROFESSIONAL REGISTRATION CERTIFICATE

This is to certify that the **Thiru. B. SRINIVASAN** has enrolled as **Registered Structural Engineer Grade-II (SE)** with Chennai Metropolitan Development Authority (CMDA) who has the qualification of **B.E., (Civil Engg.)** and experience in the relevant field for **18 years**.

He has been given the Registration No.**SE/GR-II/2019/08/152 Renewed** on **21.08.2024.** He shall be required to comply with the duties and responsibilities prescribed by the Government of Tamil Nadu in Part-V, "Registration of Professionals", Tamil Nadu Combined Development and Building Rules, 2019 approved vide G.O.(Ms) No.18 MAWS (MA1) Dept. dated 04.02.2019.

This Registration is valid upto **20.08.2029**.



21/8/24

(A. MEGANATHAN)
Superintendent

B

B.SRINIVASAN, B.E.,A.M.I.E, C.Engg.,
Structural Engineer Grade - II
CMDA Reg No.S.E/GR-II/19/08/152
176/311, ARCOT ROAD,
KODAMBAKKAM, CHENNAI-600 024

DESIGN CALCULATION REPORT FOR THE PROPOSED CONSTRUCTION OF STILT +5 FLOORS - (5th FLOOR GYM) RESIDENTIAL BUILDING (HEIGHT-18.30m) WITH 98 DWELLING UNITS (AFFORDABLE HOUSING)AT ADHANUR ROAD, VARADHARAJAPURAM, CHENNAI COMPRISED IN S.No.44/2B1, 46/2A1, 46/2A2, 46/2A3, OF VARADHARAJAPURAM VILLAGE, KUNDRATHUR TALUK, WITHIN THE LIMIT OF KUNRATHUR PANCHAYAT UNION.

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B.SRINIVASAN, B.E.,A.M.I.E, C.Engg.,
Structural Engineer Grade - II
CMDA Reg No.S.E/GR-II/19/08/152
176/311, ARCOT ROAD,
KODAMBAKKAM, CHENNAI-600 024

1.0 INTRODUCTION

1.1 General Project Information

Project Title
RESIDENTIALBUILDING CONSISIT OF Stilt and Five Upper FLOORS

Location of Project
ADHANUR ROAD, VARADHARAJAPURAM, CHENNAI COMPRISED IN S.No.44/2B1, 46/2A1, 46/2A2, 46/2A3, OF VARADHARAJAPURAM VILLAGE,

Description of Project

RCC Framed Building consisting OF Stilt and Five Upper FLOORS

1.2 Purpose of Basis of Design Document

This document details the input data, principles, methods and performance criteria to be used in the structural engineering design of the Project.

The document serves as a plan for the basis of justification and calculations associated with the design and are a repository for all relevant structural information, including references and computer programs pertaining to the project.

The contents of this brief is based on the drawings available at time of design and actual structural working drawings may change to suit latest architectural design at time of construction.

1.3. Structural Design

The main considerations followed for the design of structure are:

(a) Structural safety and stability.
(b) Demands of aesthetics conceived by the architect.
(c) Availability of material, equipment and expertise.
(d) Constructability and ease of maintenance.
(e) Durability.
(f) Economy.
(g) Recyclability.

B.SRINIVASAN, B.E.,A.M.I.E, C.Engg.,
Structural Engineer Grade - II
CMDA Reg No.S.E/GR-II/19/08/152
176/311, ARCOT ROAD,
KODAMBAKKAM, CHENNAI-600 024

2.0 STRUCTURAL SYSTEM

This section provides an overview of the selected structural system and the structural concept employed for the Project. The stability of each building against imposed lateral loads, namely seismic loads /wind load is provided by RCC columns.

RCC RESIDNETIAL BUILDING – REINFORCED CONCRETE STRUCTURE

2.1.1 Foundations

The design options for Foundation shall be worked out based on the Soil test report shared by client. The foundations are to comprise of Individual Footing.

2.1.2 Superstructure – Gravity System

The load resisting system is to be framed utilising RCC slabs and beams with columns. Frames are classified as Ordinary Moment–Resisting Frames (OMRF).

2.1.3 Expansion joint

As the total length of the building is found to be not more than normal condition it is found that expansion joint is not necessary.

2.1.4

Seismic loads and earthquake resistant design shall be as per IS 1893(Part-1). Earthquake forces shall not be considered to act at the same time as wind forces. Direction of earthquake loading and combination thereof shall be as per clause 6.3.2 of IS 1893(Part-1).

Zone	: III (For Chennai)
Zone factor	: 0.16
Importance factor (I)	: 1.5
Response reduction factor (R)	: 5.0
Avg. response acceleration coefficients (Sa/g)	: As per soil condition

The building is designed by static analysis

B.SRINIVASAN, B.E.,A.M.I.E, C.Engg.,
Structural Engineer Grade - II
CMDA Reg No.S.E/GR-II/19/08/152
176/311, ARCOT ROAD,
KODAMBAKKAM, CHENNAI-600 024

3.0 DESIGN CODES, STANDARDS AND REFERENCE DOCUMENT

3.1 Codes, Standards and Commentaries

a) IS 456 – 2000 Plain and Reinforced Concrete structures
b) IS 875 – 1987 Design Loads
c) IS 3370 Part I, Part II and Part IV Concrete Structures for storage of liquids
d) SP 16 Design aids for Reinforced Concrete structures
e) SP 34 Concrete Reinforced & Detailing
f) IS 1786 Specification for high strength deformed bars
g) National Building Code of India 1983
h) IS 13920 -2016 for Seismic detailing

3.2 Design References and Guides

a) Reinforced Concrete Design –SP 16 BIS handbook
b) Reinforced Concrete Designers Handbook

3.3 Specification used

All the buildings have been designed as framed structures in accordance with the relevant Indian Codes of Practice for civil works i.e. IS: 456-2000. Seismic detailing is followed for the entire building wherever found to be necessary.

4.0 LOADSCRITERIA

The structure is analyzed for all possible combinations of loads i.e. gravity loads(dead and live loads). It should be noted that no extra provision has been made in the design of foundation and vertical structural elements for additional floors.

4.1 MATERIAL DEAD LOADS

Item	Density (kN/m^3)
Dense Concrete	25
Steelwork	78.5
Soil	18.0
Water	10.0
225 thk AAC Block with 8 mm plaster internal walls	7.0

B.SRINIVASAN, B.E.,A.M.I.E, C.Engg.,
Structural Engineer Grade - II
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176/311, ARCOT ROAD,
KODAMBAKKAM, CHENNAI-600 024

4.2 MINIMUM IMPOSED LOADS

RESIDENTIAL BUILDINGS (KN)

a) All rooms and Kitchen	2.0
b) Toilets and bathrooms	2.0
c) Corridors, passages, lobbies and staircases including fire escapes - as per the floor serviced but not less than	3.0

IMPOSED LOADS ON ROOFS

Roofs of buildings used for promenade or incidental to assembly purposes shall be designed for the appropriate imposed floor loads given in Table for the occupancy.

4.3 WIND LOADING

The building structure is of normal high so wind load does not dominate the result of the analysis.

4.4 FIRE RESISTANCE:

Cover to main rebars will be provided as per Table 16 in BIS 456 for fire rating of 1.0 hours.

4.5 EXPOSURE:

The Building will be exposed to Moderate environment as per Table 5 in BIS456.

B.SRINIVASAN, B.E.,A.M.I.E, C.Engg.,
Structural Engineer Grade - II
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5.0 REINFORCED CONCRETE STRENGTHS.

5.1 Concrete design grades are specified cube strengths to BIS

Elements	Concrete Grade Fck (N/sqmm)
Columns/Shear Walls	25
Foundations	30
Beams / Slabs	25/25
Lean Concrete	10

5.2 REINFORCEMENT

Reinforcement Yield Strengths used in the design of concrete elements:

Deformed Bars	500 MPa (D)

6.0 GEOTECHNICAL

Geotechnical Model and recommendations are based on report shared by the Client

The recommendations for the proposed structure (Residential building .comprising of an Stilt and Five upper floors)are given below:

a) Type of Foundations : Individual footing

b) Depth of foundations : 4mt from the existing ground level

c) Allowable bearing pressure : 30t/m²

d) Settlement considered for calculations: <50mm.

B.SRINIVASAN, B.E.,A.M.I.E, C.Engg.,
Structural Engineer Grade - II
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Design of TYP FOOTING

From Analysis the Load to the Footing are 900 KN from a square column 300x600 mm (with 25mm bar). M25 Grade of Concrete and Fe 500 steel is used and safe bearing capacity of soil is taken as 300KN/sqm as per soil report.

Maximum Load on Column = 900 KN.
Add 10% self weight of Footing = 90KN.
Total = 990 KN.

Area of Footing required $A = \frac{990KN}{300\ KN/m^2} = 3.3\ m^2.$

Providing footing size = 2.0x 2.0 m.

Ultimate Soil reaction = P/A $= \frac{1.5 \times 990}{2.m \times 2.m}$

$= 170\ KN/m^2$

= 0.17N/sqmm.

Depth of footing for shear.

d = 0.17 x 3500 x(1650-d)

=867375 – 693d.

Assume Pt = 0.12 ζc = 0.29N/sqmm.

shear resistance

V_{c1} = 0.29 x 3500xd
=783d

Vu1 ≤ Vc1
=867375-693d ≤ 783d

d ≥ 400mm Providing d=460 D=500.

B.SRINIVASAN, B.E.,A.M.I.E, C.Engg.,
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Flextural moment

Mu = $wl^2/2$

= 303x4x 1.65x1.65/2 = 528KNm = 528148000Nmm.

Mu/bd^2 = 528148000/3500x640x640 = 0.61Mpa.

Pt=1.9% Ast = Ptxbxd/100 = 1.9x1000x460/100 = 861 sqmm/m.

Using 10 mm rod for Footing. Spacing of bar = 1000x78.5 /861 = 120mm.

Use 10mm rod @ 100mmc/c both ways for Footing.

And Design of other Footings calculated in similar way

Design of TYP Column C1

From Analysis the Column Axial load is found to be 980 KN.
The size of the column is taken as
230mmx450mm. Grade of Concrete M25 and
Grade of steel Fe500 Cover = 40mm. Ht of
Column = 3mt. Fy = 500N/sqmm & Fck = 25
Effective Length ratio 0.65 as per IS 456:2000 (both end fixed)
Leff1 = 0.65 x 3 = 1.95, Leff2 = 0.65 x 3 = 1.95
Check for Slenderness
Leff1/D = 6.5 Leff1/b = 6.5 Leff2/D = 6.5 Leff2/b = 4.3
All Columns are short about both axis Size of Column
and check e_{min}
e_{min} = Leff/500+D/30 = 1950/500+300/30 = 13.9
Find Mmin = 0.031x980 = 30.38KNm.
Design Axial Load Pu = 890KN.
Design Moment Mx = Mmin = 30.38KNm.
Designing the column as an axially loaded column
with uni-axial moment
Calculation of Area of Steel.
Design Axial Load Pu =980KN.

B.SRINIVASAN, B.E.,A.M.I.E, C.Engg.,
Structural Engineer Grade - II
CMDA Reg No.S.E/GR-II/19/08/152
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Design Moment Mx = Pux e_{min} 30.38KNm.

d' = 40+20/2 = 50mm

d'/D = 50/300 = 0.217

$Mu/FckbD^2$ =30.38x1.5x10^6 /25x230x450x450 =

0.03 Pu/Fckbd = 980x1.5x10^3/25x230x450 = 0.43

From SP 16 Chart 44, p/Fck = 0.089

Ast = 0.089x25x230x450/100 = 1408sqmm.

Required 8 Nos of 16 tor rods.

For Distributing even arrangement of rod on all 4 sides of column

Also Lateral ties 8 tor rods @ 150c/c are to be Provided. And

Design of other Column calculated in similar way.

Design of TYP Beam

Beam size is taken as 230mm x 450mm.

Simply supported beam Effective span is 2.06mt

From analysis the Beam moment are as follows

Moment Top near support (left) is -4 KNm.

Moment Top near support (right) is -18 KNm.

Moment Bottom @ Mid span is +60 KNm.

Area of steel @ Top near support (left)

Mu = 0.87Ast fy d[1-(Ast fy/b d fck)]

-4000000 = 0.87 x Ast x 500 x 410[1-(Ast x 500 / 230 x 410 x 25)]

-4000000 = 178350Ast - 37.82 Ast^2

Ast = 197 sqmm.

Providing 3-12# @ Top near Left Support

B.SRINIVASAN, B.E.,A.M.I.E, C.Engg.,
Structural Engineer Grade - II
CMDA Reg No.S.E/GR-II/19/08/152
176/311, ARCOT ROAD,
KODAMBAKKAM, CHENNAI-600 024

Area of steel @ Top near support (right)

Mu = 0.87Ast fy d[1-(Ast fy/b d fck)]

-180000 = 0.87 x Ast x 500 x 410 [1-(Ast x 500 / 230 x 410 x 25)]

-1800000 = 178350Ast – 37.82 Ast^2

Ast = 278 sqmm.

Providing 3-12# @ Top near Left Support

Area of steel @ Bottom near mid span

Mu = 0.87Ast fy d[1-(Ast fy/b d fck)]

600000 = 0.87 x Ast x 500 x 410 [1-(Ast x 500 / 230 x 410 x 25)]

600000 = 178350Ast –37.82 Ast^2

Ast = 212 sqmm.

Providing 3-12# & 3-12# @ Bottom of Mid span

Also Stirrups 8 tor rods @ 150c/c are to be Provided.

And Design of other Beam calculated in similar way.

Design of TYP Slab

Effective span of Slab is 3.46mt x 7.96mt with beam support of 230mm

Taking M25 Grade Concrete and Fe500 Grade steel.

Thickness of slab = 3460/30 = 115mm.

Slab thickness is taken as 150mm

Effective depth = d = 150 – 20 – 6 = 124mm.

B.SRINIVASAN, B.E.,A.M.I.E, C.Engg.,
Structural Engineer Grade - II
CMDA Reg No.S.E/GR-II/19/98/152
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Self wt of slab = 0.15 x 25 = 3.75KN/sqm Finish = 1.5KN/sqm.

Total Dead Load = 5.25KN/sqm.

Live load for Office building Lobby Corridor etc = 4KN/sqm.

Partition Load on slab is taken as 4KN/sqm.

Total Load = 4+4+5.25 = 13.25KN/sqm.

Factored Load W= 1.5 x 13.25 = 19.875KN/sqm.

Coefficient in Shorter direction = 0.1149.

Shorter Span Positive moment = 0.1149 x 19.875 x 3.46 x 3.46 = 46.24

KNm. Mu limit = 0.138 fck bdd = 0.138 x 25 x 1000 x 124 x 124 = 53

KNm Since Mu is less than Mu limit the section is under reinforced. Mu

= 0.87Ast fy d[1-(Ast fy/b d fck)]

46240000 = 0.87 x Ast x 500 x 124 [1-(Ast x 500/1000 x 124 x 25)]

43240000 = 53940 Ast – 8.7 Ast^2

Ast = 645 sqmm.

Provide 10 Tor @ 150mm c/c.

Coefficient in Longer direction = 0.034.

Longer Span Positive moment = 0.034 x 19.875 x 3.46 x 3.46 = 13.68

KN.m Mu limit = 0.138 fck bdd = 0.138 x 25 x 1000 x 124 x 124 = 53

KNm Since Mu is less than Mulimit the section is under reinforced.

Mu = 0.87Ast fy d[1-(Ast fy/b d fck)]

13680000 = 0.87 x Ast x 500 x 124 [1-(Ast x 500/1000 x 124 x 25)]

13680000 = 53940 Ast – 8.7 Ast^2

Ast = 264 sqmm.

Provide 8 Tor @ 150mm c/c.

B.SRINIVASAN, B.E.,A.M.I.E, C.Engg.,
Structural Engineer Grade - II
CMDA Reg No.S.E/GR-II/19/08/152
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Check for Shear.

Span load = 19.875 x 4.5 = 89 KN V = 89/2 = 44.7KN.

Actual Shear stress V = 44700/1000 x 124 = 0.36N/sqmm < Tc(min).

From IS 456 Table 19 (Using Pt = 0.65%) Design shear strength = 0.574N/sqmm.

Max Allowable shear stress = 3.95 N/sqmm.

Check for Deflection.

Actual Span to depth ratio = 4500/124 = 36.2

Calculation of Allowable Span to depth ratio.

fs = 0.58 fy (Area of c.s of steel required/ Area of c.s of steel provided)

= 0.58 x 500(945/1120) = 244 N/sqmm. K

= 1/[0.225+0.003fs-0.625log(1/pt)].

= 1/[0.225+0.003x265-0.625log(1/0.65)].

= 1.3

Allowable Span to depth ratio = 30 x K = 30 x 1.3 = 39 < Actual ratio.

And Design of other Beam calculated in similar way.

B.SRINIVASAN, B.E.,A.M.I.E, C.Engg.,
Structural Engineer Grade - II
CMDA Reg No.S.E/GR-II/19/08/152
176/311, ARCOT ROAD,
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3/350/2 Mettukuppam,
OMR Thoraipakkam,
Chennai, India

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