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**BOURNA**
CONSULTANTS - ENGINEERS

S.P.S. Inbarajan, M.E. (Structural)
Structural Consultant

Date: 29-01-2025

# STRUCTURAL DESIGN STABILITY CERTIFICATE.

It is certified that the Proposed Commercial Cum Residential Building comprising **Stilt Floor + Five floors with 10 Dwelling Units** to be set up **Door Nos:111/1, 111/3,113/4, 113/1, 113/2 & 113/3 OLD DOOR NOS: 58/1, 58/3, 58/4, 58/2/1, 58/2/2 & 58/2/3, Plot No:6, 6A, Chamiers Road, R.A.Puram, Chennai-600 028, Comprised In Survey Nos:3925/23, 3925/32, Block No:86, Mylapore Village, Mylapore- Triplicane Taluk, Within The Limits Of Greater Chennai Corporation.Zone – 09,Division - 122.**have been designed as a RCC structure to withstand the Dead Load, Imposed Load and Wind Load / Earthquake loads ensuring Structural Safety and service ability 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: 4236-1993 Code of Practice for Earthquake resistant design & Construction of Buildings.
5. IS: 13920-1993 Code of Practice for Ductile detailing of concrete structures subjected to seismic forces and
6. National Building code of India – 2005.

It is further certified that the above structures will 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.

For **BOURNA CONSULTANTS ENGINEERS,**

**(S.P.S. INBARAJAN.)**
Chief Consultant.

S. P. S. INBARAJAN, M.E., (Struct)
Registered Structural Engineer
Grade-I (SE) in CMDA
Reg. No. SE/GR-1/2024/02/009 dt. 27.02.2024
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Door No.50, Kirupasankari Street,
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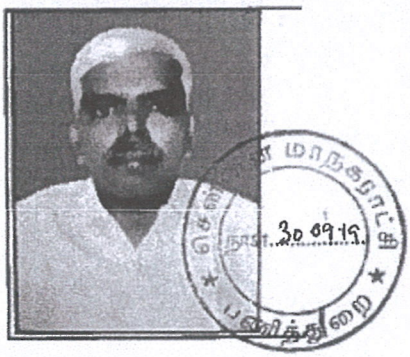
**GREATER CHENNAI CORPORATION**
**WORKS DEPARTMENT**

# PROFESSIONAL REGISTRATION CERTIFICATE

This is to certify that **Thiru. Inbarajan S P S** has been enrolled as **Registered Structural Engineer Grade- I (RSE)** in Greater Chennai Corporation (GCC) who has the qualification of **M.E.,(Structural Engg.)** with minimum of **5 Years** experience in the relevant field.

The Registration No. is **RSE100302019** dated **30.09.2019.** It is informed herewith to comply with the scope of work, duties and responsibilities as 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 **29.09.2024.**



30/9/19

Superintending Engineer (Works)
Greater Chennai Corporation.

| |
|---|
| **RGN No: RSE100302019** |
| **Dated: 30.09.2019** |

30/09/19

30.9.19

S. P. S. INBARAJAN
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BOURNA
CONSULTANTS - ENGINEERS

S.P.S. Inbarajan, M.E. (Structural)
Structural Consultant

# STRUCTURAL DESIGN STABILITY CERTIFICATE.

I hereby certify that the Proposed Construction of Commercial Cum Residential Building with 10 Dwelling Units Availing Premium FSI at Door Nos:111/1, 111/3,113/4, 113/1, 113/2 & 113/3 Old Door Nos: 58/1, 58/3, 58/4, 58/2/1, 58/2/2 & 58/2/3, Plot No:6, 6a, Chamiers Road, R.A.Puram, Chennai-600 028, Comprised In Survey Nos:3925/23, 3925/32, Block No:86, Mylapore Village, Mylapore- Triplicane Taluk.Zone – 09,Division - 122.Greater Chennai Corporation. To certify that the building will withstand against the Earthquake, (Seismic Zone III as per IS 1893 (Part I) 2002) loading stress parameters are within limits of National Building Code and Bureau of Indian standards code of practice for concrete and loading. The building consists of Stilt + 5 floors upper floors. The R.C.C. building frame of the structure is designed as per the Indian Standard code of practice for concrete and loadings. The structure will be constructed as per our structural design and detailing of reinforcements given in our drawing from foundation to roof slab and beam. For external and internal partition walls 230/115 thick brick work walls are used.

For **BOURNA CONSULTANTS ENGINEERS,**

**(S.P.S. INBARAJAN.)**
Chief Consultant.

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Reg. No. RSE 100302019 Dt. 30.09.2019
Door No.50, Kirupasankari Street,
West Mambalam, Chennai-600 033.

# DESIGN BASIS REPORT

FOR

# M/S. INDIA BUILDERS

THE PROPOSED CONSTRUCTION OF COMMERCIAL CUM RESIDENTIAL BUILDING WITH 10 DWELLING UNITS AVAILING PREMIUM FSI AT DOOR NOS:111/1, 111/3,113/4, 113/1, 113/2 & 113/3 OLD DOOR NOS: 58/1, 58/3, 58/4, 58/2/1, 58/2/2 & 58/2/3, PLOT NO:6, 6A, CHAMIERS ROAD, R.A.PURAM, CHENNAI-600 028, COMPRISED IN SURVEY NOS:3925/23, 3925/32, BLOCK NO:86, MYLAPORE VILLAGE, MYLAPORE- TRIPLICANE TALUK, WITHIN THE LIMITS OF GREATER CHENNAI CORPORATION.ZONE – 09,DIVISION - 122.

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## 1.0 OBJECTIVE

The Design basis covers the basic requirement that will be followed for the design of THE PROPOSED CONSTRUCTION OF COMMERCIAL CUM RESIDENTIAL BUILDING FOR M/S.INDIA BUILDERS WITH 10 DWELLING UNITS AVAILING PREMIUM FSI AT DOOR NOS:111/1, 111/3,113/4, 113/1, 113/2 & 113/3 OLD DOOR NOS: 58/1, 58/3, 58/4, 58/2/1, 58/2/2 & 58/2/3, PLOT NO:6, 6A, CHAMIERS ROAD, R.A.PURAM, CHENNAI-600 028, COMPRISED IN SURVEY NOS:3925/23, 3925/32, BLOCK NO:86, MYLAPORE VILLAGE, MYLAPORE- TRIPLICANE TALUK, WITHIN THE LIMITS OF GREATER CHENNAI CORPORATION.ZONE – 09,DIVISION - 122.

The building is designed for Stilt + 5 Floors. The structure is supported on column in turn resting on Pile Foundation. The Structural system comprises columns, beams, slabs and wall structure.

3-D Analysis of all the building structures will be carried out using STAAD PRO software package and analysis results shall be used for designing the various elements.

## 2.0 DESIGN LOADS

### 2.1 Dead Loads

The Dead loads that are envisaged to act permanently are considered as per IS**: 875 (Part 1) – 1987 – Dead loads.** Indian Standard **"Code of Practice for Design Loads (other than earthquake) for Buildings and Structures"**.

1. Slab is assumed to be 150mm thick – 3.75 KN/m²
2. Slab is assumed to be 125mm thick – 3.125 KN/m²
3. Floor finish – 1.5KN/m²
4. Brick work masonry walls 230thick are proposed to be used (location of walls per Architectural drawings) Unit weight is taken as 20 $KN/m^3$
5. Weathering course in Terrace finish – 3 $KN/m^2$

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**2.2 Imposed Loads**

The imposed loads that are envisaged to act permanently are considered as per **IS : 875 ( Part 2 ) – 1987** . Indian Standard **"Code of Practice for Design Loads (other than earthquake) for Buildings and Structures"**.

1. Living = 2 KN/$m^2$
2. Staircase = 4 KN/$m^2$
3. Toilets = 2 KN/$m^2$
4. Terrace floors = 1.5 KN/$m^2$

**2.3 Earthquake Load**

The loading due to earthquake is assessed based on the provisions of **IS: 1893-2016**. Structure with ductile detailing is considered as per **IS: 13920-2016.**

**CHENNAI falls under Seismic Zone III**

| | | |
|---|---|---|
| **Zone factor** | = | **0.16** |
| **Response reduction factor** | = | **5** |
| **Importance factor** | = | **1.0** |

Structure with ductile detailing is considered as per IS: 13920-2016

**2.4 Load Combinations**

The various loads shall be combined in accordance with the stipulations in IS: 875 (Part 5) – 1987. Whichever combinations produced the most unfavorable effect in the building, foundations or structural member concerned shall be adopted. The various load combinations considered in the analysis are as follows:

1. 1(DL+LL)
2. 1 DL+0.8 LL+ 0.8 SQX +1
3. 1 DL+0.8 LL+ 0.8 SQX -1
4. 1 DL+0.8 LL+ 0.8 SQZ +1
5. 1 DL+0.8 LL+ 0.8 SQZ -1

6. 1.0 (DL+SQX +)
7. 1.0 (DL+SQX -1)
8. 1.0 (DL+SQZ +1)
9. 1.0 (DL+SQZ -1)
10. 1.5(DL+LL)
11. 1.5(DL+SQX +1)
12. 1.5(DL+SQX -1)
13. 1.5(DL+SQZ +1)
14. 1.5(DL+SQZ -1)
15. 1.2(DL+LL+SQX +1)
16. 1.2(DL+LL+SQX -1)
17. 1.2(DL+LL+SQZ +1)
18. 1.2(DL+LL+SQZ -1)
19. 0.9DL+1.5SQX+1
20. 0.9DL+1.5SQX -1
21. 0.9DL+1.5SQZ +1
22. 0.9DL+1.5SQZ -1

The above load combinations will be considered and effect of worst combinations Will be taken for design of various building elements.

**3.0 ANALYSIS METHODS**

The analysis of the structures is carried out using the STAAD PRO. The entire super-structure is modeled using frame elements as appropriate. Beams and columns are modeled as frame elements. Appropriate loads and its combinations, as per relevant IS code clauses, for most unfavorable effects are chosen for design. Various load cases considered in the analysis are briefed above.

## 4.0DESIGNASSUMPTION

4.1.1 The Base of the Foundation is assumed to be FIXED.

4.1.2 All Concrete elements shall be designed in accordance with IS456:2000 Limit State Design.

4.1.3 Appropriate loads and its combinations, as per relevant clauses, for the most unfavorable effects are chosen for design.(Refer Load Combination below).

## 5.0FOUNDATIONDESIGN

Type of Foundation : Pile foundation.

Depth of Foundation : 30 m

## 6.0MATERIALS

The self-weight of the various elements are computed based on the unit weight of materials a sgiven below:

| S.no | Materials | Unit weight KN/$m^3$ |
|---|---|---|
| 1 | Reinforced Cement Concrete | 25 |
| 2 | Solid Block/Brick | 20 |
| 3 | Steel | 78.50 |

Structural concrete shall be of grade M25 for Pile

Structural concrete shall be of grade M20 for Pilecap & Column

Structural concrete shall be of grade M20 for Beam & Slab

Steel reinforcement shall be of Grade Fe500 confirming to IS:1786-2008.

## 7.0NOMINALCOVERTOREINFORCEMENT

From Durability requirement, exposure conditionis assumed as mild for structural elements above ground level and moderate for structural elements below ground level.

The Clear cover to reinforcement to meet durability requirement shall be as follows:

Column –40mm

Pile cap – 100mm

Beam – 25mm

Slab – 20mm

**DESIGN OF BEAM: 1**

Beam size: 230mm x 450mm

Bending moment at support = 140kNm

Bending moment at mid span = 133kNm

Shear force, Vu = 149kN

Bending moment at support, Mu = 140kNm

$R = (140 \times 10^6)/230x409^2$

$= 3.64$

Pt/100 =Ast/bd = fck/2fy [1-Sq.rt (1-4.598xR/fck)\

fck = 20 N/mm$^2$

fy = 500 N/mm$^2$

Pt = 1.07%

Ast required = 1013 mm$^2$

Provide 6nos of 16Y

Ast provided = 1206 mm$^2$

Hence safe.

Bending moment at mid span, Mu = 133kNm

$R = (133 \times 10^6)/230 \times 409^2$

$= 3.46$

Pt = 1.0%

Ast required = 944 mm$^2$

Provide 6nos of 16Y

Ast provided = 1206 mm$^2$

Hence it is safe

Shear force, Vu, = 149kN

$\tau v$ = Vu/bd

= $(149 \times 10^3)/ 230 \times 409$

= $1.58\ N/mm^2$

Hence ok.

Shear capacity of concrete:

Pt = 1.0 %

$\tau c$ = 0.62

= $\tau c$ bd

= 0.62X 230 X 409

= 58323 N (or) 58 kN

Shear to be carried by stirrups

Vu = Vs – $\tau c$ bd

= 149 – 58 kN

= 91kN

Therefore, provide 2 legged 10Y @ 150 mm C/C at the supports.

Provide 2 legged 10Y @ 200mm C/C at the midspan.

**DESIGN OF BEAM: 2**

Beam size: 230mm x 525mm

Bending moment at support = 132kNm

Bending moment at mid span = 111kNm

Shear force, Vu = 96kN

Bending moment at support, Mu = 132kNm

R = $(132 \times 10^6)/230x484^2$

= 2.44

Pt/100 =Ast/bd = fck/2fy [1-Sq.rt (1-4.598xR/fck)\

fck = 20 N/mm$^2$

fy = 500 N/mm$^2$

Pt = 0.65%

Ast required = 725 mm$^2$

Provide 4nos of 16Y

Ast provided = 804 mm$^2$

Hence safe.

Bending moment at mid span, Mu = 111kNm

R = (111 x 10$^6$)/230 x 484$^2$

= 2.06

Pt = 0.53%

Ast required = 593 mm$^2$

Provide 4 nos of 16Y

Ast provided = 804 mm$^2$

Hence it is safe

Shear force, Vu, = 96kN

$\tau$v = Vu/bd

= 96 x 10$^3$ / 230 x 484

= 0.86 N/mm$^2$

Hence ok.

<u>Shear capacity of concrete:</u>

Pt = 0.65 %

$\tau$c = 0.53

= $\tau$c bd

= 0.53 X 230 X 484

| | | |
|---|---|---|
| | = | 58999 N (or) 59kN |

Shear to be carried by stirrups

| | | |
|---|---|---|
| Vu | = | Vs – $\tau$c bd |
| | = | 96 – 59 kN |
| | = | 37kN |

Therefore, provide 2 legged 8Y @ 100 mm C/C at the supports.

Provide 2 legged 8Y @ 200 mm C/C at the midspan.

**Design of Pile Cap :**

| | | |
|---|---|---|
| Safe load for 600mm Dia pile | = | 1130 KN |
| Concrete grade for pile cap | = | M20 |
| Un factored Column load | = | 1442KN |
| No of piles required | = | 1442/1130 = 1.28 |
| Provide 2 nos of Pile (600Ø) | | |
| Spacing of Piles | = | 1800mm |
| | = | 1.8m |
| Factored load | = | 1442 x 1.5 |
| | = | 2163 |
| Bending moment WL/4 | = | 2163 x 1.8 / 4 |
| | = | 973KNM |
| R = MU/bd$^2$ | = | 973 x 10$^6$ / 975 x 875$^2$ |
| | = | 1.3 |
| fck | = | 20N/mm$^2$ |
| fy | = | 500N/mm$^2$ |
| Pt/100 = Ast/bd | = | fck/2fy [1-sqrt (1 - 4.598xR/20)] |

Ast required = 2739 $mm^2$

Provide 7 nos of 25 Dia bar

Ast provided = 3437$mm^2$

Ast required > Ast provided

Hence it is safe.

# DESIGN OF COLUMN C1

| | | | | |
|---|---|---|---|---|
| Length of column | D | 450 | mm | |
| Breadth of column | b | 230 | mm | |
| Unsupported length (longer direction) | $L_x$ | 2700 | mm | |
| Unsupported length (shorter direction) | $L_y$ | 2700 | mm | |
| Eff. Length (longer direction) | $L_{ex}$ | 2160 | mm | |
| Eff. Length (shorter direction) | $L_{ey}$ | 2160 | mm | |
| | | | | |
| Factored Load | $P_u$ | 1051 | kN | |
| Factored moment (longer direction) | Mux | 65 | kNm | |
| Factored moment (shorter direction) | Muz | 21 | kNm | |
| Charac. comp strength of concrete | $f_{ck}$ | 20 | $N/mm^2$ | |
| Yield stress of steel | $f_y$ | 500 | $N/mm^2$ | |
| Dia of bar used | Φ | 20 | mm | |
| Clear cover | | 40 | mm | |
| Effective cover | d' | 50 | mm | |
| Effective depth | d | 400 | mm | |
| | | | | |
| **Check for slenderness** | | | | |
| | | | | |
| **Longer Direction** | | | | |
| Slenderness ratio | $L_{ex}/D$ | 4.80 | **short** | |
| Additional moment due to slenderness | $M_{ax}$ | 0 | kN-m | |
| **Shorter Direction** | | | | |
| Slenderness ratio | $L_{ey}/b$ | 9.39 | **short** | |
| Additional moment due to slenderness | $M_{ay}$ | 0 | kN-m | |
| **Calculation of $P_{uz}$** | | | | |
| No of bars used | | 8 | | |
| Area of reinforcement | Ast | 2512 | | |
| Provided steel | | 8 nos Y20 | | |
| Percentage of reinforcement | $p_t$ | 2.427 | % | |
| Area of concrete | Ag | 103500 | $mm^2$ | |
| Ultimate axial load (without moments) | $P_{uz}$ | 1851 | kN | |
| | | | | |
| **Calculation of $P_b$:** | | | | |
| **Longer Direction** | | | | |
| | d'/D | 0.111 | | |
| Coefficient $k_1$(from TABLE 60 of SP:1980) | $k_{1x}$ | 0.204 | From Sp16 | |
| Coefficient $k_2$(from TABLE 60 of SP:1980) | $k_{2x}$ | 0.398 | | |
| Axial load corresponding to balanced failure | $P_{bx}$ | 523 | kN | |
| Reduction factor for additional moments | $k_x$ | 1.000 | | |
| Moment due to slenderness | $M_{ax}$ | **0.00** | kN-m | |
| **Shorter Direction** | | | | |
| | d'/b | 0.217 | | |
| Coefficient $k_1$(from TABLE 60 of SP:1980) | $k_{1y}$ | 0.179 | | |
| Coefficient $k_2$(from TABLE 60 of SP:1980) | $k_{2y}$ | 0.143 | | |
| Axial load corresponding to balanced failure | $P_{by}$ | 406 | kN | |
| Reduction factor for additional moments | $k_y$ | 0.554 | | |
| Moment due to slenderness | $M_{ax}$ | **0.00** | kN-m | |
| | | | | |
| **Check for moments due to min. eccentricity** | | | | |
| | | | | |
| **Longer Direction** | | | | |
| Minimum eccentricity | $e_x$ | 20.40 | mm | |

| | | | | | |
|---|---|---|---|---|---|
| Moment due to min. eccentricity | | | $M_x$ | 21.44 | kN-m |
| Moment in longer direction | | | $M_{ux}$ | 65.00 | kNm |
| **Shorter direction** | | | | | |
| Minimum eccentricity | | | $e_y$ | 13.07 | mm |
| Moment due to min. eccentricity | | | $M_y$ | 13.73 | kN-m |
| Moment in shorter direction | | | $M_{uy}$ | 21 | kNm |
| | | | | | |
| **Final design moments** | | | | | |
| | | | | | |
| Moment in longer direction | | | $M_{ux}$ | **65.00** | kNm |
| Moment in shorter direction | | | $M_{uy}$ | **21.00** | kNm |
| | | | | | |
| **Check for interaction** | | | | | |
| | | | d'/D | 0.111 | |
| | | | d'/b | 0.217 | |
| $p/f_{ck}$ | | | $p/f_{ck}$ | 0.121 | |
| $P_u/f_{ck}bD$ value | | | $P_u/f_{ck}bD$ | 0.508 | |
| $M_{ux1}/f_{ck}bD^2$ value (from SP 16:1980 charts) | | | $M_{ux1}/f_{ck}bD^2$ | 0.130 | |
| Uniaxial moment capacity (longer direction) | | | $M_{ux1}$ | **121.095** | kNm |
| $M_{uy1}/f_{ck}bD^2$ value (from SP 16:1980 charts) | | | $M_{uy1}/f_{ck}bD^2$ | 0.110 | |
| Uniaxial moment capacity (shorter direction) | | | $M_{uy1}$ | **52.371** | kNm |
| $P_u/P_{uz}$ ratio | | | $P_u/P_{uz}$ | **0.568** | |
| Value of exponent | | | | 1.614 | |
| Interaction ratio | | | | **0.595** | |
| Percentage reinforcement satisfactory or not | | | | **safe** | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| $b/D$ ratio | | | b/D | 0.51111111 | |
| Status of dimensions | | | | **OK** | |
| Gross area | | | $A_g$ | 103500 | $mm^2$ |
| Area of core | | | $A_k$ | 60800 | $mm^2$ |
| Spacing of lateral ties | | | S | 57.5 | mm |
| Larger dimension of the hoop | | | H | 230 | mm |
| Cross sectional area of hoop | | | $A_{sh}$ | 66.87 | $mm^2$ |

# DESIGN OF COLUMN C2

| | | | | | |
|---|---|---|---|---|---|
| Length of column | | D | 375 | mm |
| Breadth of column | | b | 300 | mm |
| Unsupported length (longer direction) | | $L_x$ | 2700 | mm |
| Unsupported length (shorter direction) | | $L_y$ | 2700 | mm |
| Eff. Length (longer direction) | | $L_{ex}$ | 2160 | mm |
| Eff. Length (shorter direction) | | $L_{ey}$ | 2160 | mm |
| | | | | |
| Factored Load | | $P_u$ | 895 | kN |
| Factored moment (longer direction) | | Mux | 41 | kNm |
| Factored moment (shorter direction) | | Muz | 11 | kNm |
| Charac. comp strength of concrete | | $f_{ck}$ | 20 | $N/mm^2$ |
| Yield stress of steel | | $f_y$ | 500 | $N/mm^2$ |
| Dia of bar used | | Φ | 16 | mm |
| Clear cover | | | 40 | mm |
| Effective cover | | d' | 48 | mm |
| Effective depth | | d | 327 | mm |
| | | | | |
| **Check for slenderness** | | | | |
| | | | | |
| **Longer Direction** | | | | |
| Slenderness ratio | | $L_{ex}/D$ | 5.76 | **short** |
| Additional moment due to slenderness | | $M_{ax}$ | 0 | kN-m |
| **Shorter Direction** | | | | |
| Slenderness ratio | | $L_{ey}/b$ | 7.20 | **short** |
| Additional moment due to slenderness | | $M_{ay}$ | 0 | kN-m |
| **Calculation of $P_{uz}$** | | | | |
| No of bars used | | | 8 | |
| Area of reinforcement | | Ast | 1607.68 | |
| Provided steel | | | 8 nos Y16 | |
| Percentage of reinforcement | | $p_t$ | 1.429 | % |
| Area of concrete | | Ag | 112500 | $mm^2$ |
| Ultimate axial load (without moments) | | $P_{uz}$ | 1601 | kN |
| | | | | |
| **Calculation of $P_b$:** | | | | |
| **Longer Direction** | | | | |
| | | d'/D | 0.128 | |
| Coefficient $k_1$(from TABLE 60 of SP:1980) | | $k_{1x}$ | 0.200 | From Sp16 |
| Coefficient $k_2$(from TABLE 60 of SP:1980) | | $k_{2x}$ | 0.358 | |
| Axial load corresponding to balanced failure | | $P_{bx}$ | 508 | kN |
| Reduction factor for additional moments | | $k_x$ | 1.000 | |
| Moment due to slenderness | | $M_{ax}$ | **0.00** | kN-m |
| **Shorter Direction** | | | | |
| | | d'/b | 0.160 | |
| Coefficient $k_1$(from TABLE 60 of SP:1980) | | $k_{1y}$ | 0.193 | |
| Coefficient $k_2$(from TABLE 60 of SP:1980) | | $k_{2y}$ | 0.281 | |
| Axial load corresponding to balanced failure | | $P_{by}$ | 479 | kN |
| Reduction factor for additional moments | | $k_y$ | 0.629 | |
| Moment due to slenderness | | $M_{ax}$ | **0.00** | kN-m |
| | | | | |
| **Check for moments due to min. eccentricity** | | | | |
| | | | | |
| **Longer Direction** | | | | |
| Minimum eccentricity | | $e_x$ | 17.90 | mm |

| | | | | | |
|---|---|---|---|---|---|
| Moment due to min. eccentricity | | | $M_x$ | 16.02 | kN-m |
| Moment in longer direction | | | $M_{ux}$ | 41.00 | kNm |
| **Shorter direction** | | | | | |
| Minimum eccentricity | | | $e_y$ | 15.40 | mm |
| Moment due to min. eccentricity | | | $M_y$ | 13.78 | kN-m |
| Moment in shorter direction | | | $M_{uy}$ | 13.783 | kNm |
| | | | | | |
| **Final design moments** | | | | | |
| | | | | | |
| Moment in longer direction | | | $M_{ux}$ | **41.00** | kNm |
| Moment in shorter direction | | | $M_{uy}$ | **13.78** | kNm |
| | | | | | |
| **Check for interaction** | | | | | |
| | | | d'/D | 0.128 | |
| | | | d'/b | 0.160 | |
| $p/f_{ck}$ | | | $p/f_{ck}$ | 0.071 | |
| $P_u/f_{ck}bD$ value | | | $P_u/f_{ck}bD$ | 0.398 | |
| $M_{ux1}/f_{ck}bD^2$ value (from SP 16:1980 charts) | | | $M_{ux1}/f_{ck}bD^2$ | 0.090 | |
| Uniaxial moment capacity (longer direction) | | | $M_{ux1}$ | **75.9375** | kNm |
| $M_{uy1}/f_{ck}bD^2$ value (from SP 16:1980 charts) | | | $M_{uy1}/f_{ck}bD^2$ | 0.090 | |
| Uniaxial moment capacity (shorter direction) | | | $M_{uy1}$ | **60.75** | kNm |
| $P_u/P_{uz}$ ratio | | | $P_u/P_{[illegible]}$ | **0.559** | |
| Value of exponent | | | | 1.599 | |
| Interaction ratio | | | | **0.466** | |
| Percentage reinforcement satisfactory or not | | | | **safe** | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| $b/D$ ratio | | | b/D | 0.8 | |
| Status of dimensions | | | | **OK** | |
| Gross area | | | $A_g$ | 112500 | $mm^2$ |
| Area of core | | | $A_k$ | 70150 | $mm^2$ |
| Spacing of lateral ties | | | S | 75 | mm |
| Larger dimension of the hoop | | | H | 230 | mm |
| Cross sectional area of hoop | | | $A_{sh}$ | 74.98 | $mm^2$ |

## DESIGN OF SLAB S1

**ROOF LEVEL SLAB**

**Design of two way Slab**

**Basic Data**

| | | | | |
|---|---|---|---|---|
| Grade of concrete (fck) | | = | M 20 | |
| Grade of steel (fy) | | = | Fe 500 | |
| Thickness of slab (D) | | = | 125 | mm |
| Clear cover (cc) | | = | 15 | mm |
| Effective thickness of slab (deff) | = 125 - 15 - 8 /2 | = | 106 | mm |
| Unit weight of concrete | | = | 25 | $KN/m^3$ |
| Effective Shorter Span (Lx) | | = | 3.18 | m |
| Effective Longer Span (Ly) | | = | 3.467 | m |
| Aspect ratio Ly/Lx | | = | 1.09 | **Two way slab** |

Edge Condition : **Two adjacent Edges Discontinous**

**Load Data**

| | | | | |
|---|---|---|---|---|
| Dead Load | = 0.13 x 25 | = | 3.125 | $KN/m^2$ |
| Floor finish | | = | 1.50 | $KN/m^2$ |
| Imposed Load | | = | 2.00 | $KN/m^2$ |
| Total load | | = | 6.63 | $KN/m^2$ |
| Design load ( Wu ) = 1.5 x 6.625 | | = | **9.94** | $KN/m^2$ |

**Moment and Shear Calculations**

**Short Span Direction**

| | | | | | |
|---|---|---|---|---|---|
| ax for positive moment | 1 | → | 0.035 | | |
| | 1.1 | → | 0.04 | | |
| | for 1.09 | αx | = | 0.040 | |
| Positive moment Mx | 0.040 x 9.94 x 3.18 ^2 | | = | **3.97** | KN-m |
| ax for negative moment | 1 | → | 0.047 | | |
| | 1.1 | → | 0.053 | | |
| | for 1.09 | αx | = | 0.052 | |
| Negative moment Mx : | 0.052 x 9.94 x 3.18 ^2 | | = | **5.27** | KN-m |

**Long Span Direction**

| | | | | |
|---|---|---|---|---|
| For positive moment | | αy | = | 0.035 | |
| Positive moment My : | 0.035 x 9.94 x 3.18 ^2 | | = | **3.52** | KN-m |
| For negative moment | | αy | = | 0.047 | |
| Negative moment My : | 0.047 x 9.94 x 3.18 ^2 | | = | **4.72** | KN-m |

Shear force $V_u$ = 9.94 x 3.2 x 0.5 = **15.80** KN

**Check Effective Depth for Bending**

Depth required = $(M_x / (0.133x\ fck \times b))^{1/2}$ = 44.50 mm

Depth provided = 125 - 15 - 8 /2 = 106 mm

**Hence O.K**

**Reinforcement calculations**

**Short Span Direction @ Support**

$Mu/bd^2 = \frac{5.27 \times 10 \wedge 6}{1000 \times 106 \times 106} = \mathbf{0.469}$

Pt = **0.11** %

Area of steel Ast = 0.00111 x 1000 x 106 = 117.55 $mm^2$

Minimum area of steel 0.0012 x 1000 x 125 = 150.00 $mm^2$

Spacing of Y **8** bars 50.27 x 1000 / 150.00 = 334.93 mm

Ast provided = 335.1 $mm^2$

**Check for Spacing**

Minimum of

1) 3d = 318 mm

2) = 300 mm

3) = 334.93 mm

Therefore provide Y **8** @ **150** mm C/C

**Short Span Direction @ Mid Span**

$Mu/bd^2 = \frac{3.97 \times 10 \wedge 6}{1000 \times 106 \times 106} = 0.353$

Pt = 0.083 %

Area of steel Ast = 0.00083 x 1000 x 106 = 87.982 $mm^2$

Minimum area of steel 0.0012 x 1000 x 125 = 150.00 $mm^2$

Spacing of Y **8** bars 50.27 x 1000 / 150.00 = 334.93 mm

Ast provided = 335.1 $mm^2$

**Check for Spacing**

Minimum of

1) 3d = 318 mm

2) = 300 mm

3) = 334.93 mm

Therefore provide Y **8** @ **150** mm C/C 100

Provided % of Tension Reinforcement (pt) = **0.316** %

**Long Span Direction @ Support**

$Mu/bd^2 = \frac{4.72 \times 10 \wedge 6}{1000 \times 106 \times 106} = 0.420$

Pt = 0.099 %

Area of steel Ast = 0.00099 x 1000 x 106 = 105.09 $mm^2$

Minimum area of steel 0.0012 x 1000 x 125 = 150.00 $mm^2$

Spacing of Y **8** bars 50.27 x 1000 / 150.00 = 334.93 mm

Ast provided = 335.1 $mm^2$

**Check for Spacing**

Minimum of

1) 3d = 318 mm

2) = 300 mm

3) = 334.93 mm

Therefore provide Y **8** @ **150** mm C/C

**Long Span Direction @ mid Span**

$Mu/bd^2 = \frac{3.52 \times 10 \wedge 6}{1000 \times 106 \times 106} = 0.313$

Pt = 0.073 %

Area of steel Ast = 0.00073 x 1000 x 106 = 77.742 $mm^2$

Minimum area of steel 0.0012 x 1000 x 125 = 150.00 $mm^2$

Spacing of Y **8** bars 50.27 x 1000 / 150.00 = 334.93 mm

Ast provided = 335.1 $mm^2$

**Check for Spacing**

Minimum of

1) 3d = 318 mm

2) = 300 mm

3) = 334.93 mm

Therefore provide Y **8** @ **150** mm C/C

**Check for Deflection:**

Basic Span/depth Ratio = 22

% of Tension Reinforcement provided ( pt ) = 0.316 %

Service stress of steel (fs) : 0.58fy(Ast_r/Ast_p) = 76.14 $N/mm^2$

Modification Factor for Tension Reinforcement (F1) = 2.00

Allowable Span/Eff Depth Ratio = 44

Actual Span/Eff Depth Ratio = 3.18 x 1000 / 106 = 30.00

**Hence O.K**

## DESIGN OF SLAB S2

**ROOF LEVEL SLAB**

**Design of two way Slab**

**Basic Data**

| | | | |
|---|---|---|---|
| Grade of concrete (fck) | = | M 20 | |
| Grade of steel (fy) | = | Fe 500 | |
| Thickness of slab (D) | = | 125 | mm |
| Clear cover (cc) | = | 15 | mm |
| Effective thickness of slab (deff) = 125 - 15 - 8 /2 | = | 106 | mm |
| Unit weight of concrete | = | 25 | $KN/m^3$ |
| Effective Shorter Span (Lx) | = | 3.35 | m |
| Effective Longer Span (Ly) | = | 3.467 | m |
| Aspect ratio Ly/Lx | = | 1.03 | **Two way slab** |

Edge Condition : **Two adjacent Edges Discontinous**

**Load Data**

| | | | |
|---|---|---|---|
| Dead Load = 0.13 x 25 | = | 3.125 | $KN/m^2$ |
| Floor finish | = | 1.50 | $KN/m^2$ |
| Imposed Load | = | 2.00 | $KN/m^2$ |
| Total load | = | 6.63 | $KN/m^2$ |
| Design load ( Wu ) = 1.5 x 6.625 | = | **9.94** | $KN/m^2$ |

**Moment and Shear Calculations**

**Short Span Direction**

| | | | |
|---|---|---|---|
| ax for positive moment 1 → | | 0.035 | |
| 1.1 → | | 0.04 | |
| for 1.03 αx | = | 0.037 | |
| Positive moment Mx 0.037 x 9.94 x 3.35 ^2 | = | **4.10** | KN-m |
| ax for negative moment 1 → | | 0.047 | |
| 1.1 → | | 0.053 | |
| for 1.03 αx | = | 0.049 | |
| Negative moment Mx : 0.049 x 9.94 x 3.35 ^2 | = | **5.48** | KN-m |

**Long Span Direction**

| | | | |
|---|---|---|---|
| For positive moment αy | = | 0.035 | |
| Positive moment My : 0.035 x 9.94 x 3.35 ^2 | = | **3.90** | KN-m |
| For negative moment αy | = | 0.047 | |
| Negative moment My : 0.047 x 9.94 x 3.35 ^2 | = | **5.24** | KN-m |

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West Mambalam, Chennai-600 033.

Shear force $V_u$ = 9.94 x 3.4 x 0.5 = **16.65** KN

**Check Effective Depth for Bending**

Depth required = $(M_x / (0.133x\ fck \times b))^{1/2}$ = 45.37 mm

Depth provided = 125 - 15 - 8 /2 = 106 mm

**Hence O.K**

**Reinforcement calculations**

**Short Span Direction @ Support**

$Mu/bd^2$ = $\frac{5.48 \times 10 \wedge 6}{1000 \times 106 \times 106}$ = **0.487**

Pt = **0.12** %

Area of steel Ast = 0.00115 x 1000 x 106 = 122.33 $mm^2$

Minimum area of steel 0.0012 x 1000 x 125 = 150.00 $mm^2$

Spacing of Y **8** bars 50.27 x 1000 / 150.00 = 334.93 mm

Ast provided = 402.12 $mm^2$

**Check for Spacing**

Minimum of

1) 3d = 318 mm

2) = 300 mm

3) = 334.93 mm

Therefore provide Y **8** @ **125** mm C/C

**Short Span Direction @ Mid Span**

$Mu/bd^2$ = $\frac{4.10 \times 10 \wedge 6}{1000 \times 106 \times 106}$ = 0.365

Pt = 0.086 %

Area of steel Ast = 0.00086 x 1000 x 106 = 90.868 $mm^2$

Minimum area of steel 0.0012 x 1000 x 125 = 150.00 $mm^2$

Spacing of Y **8** bars 50.27 x 1000 / 150.00 = 334.93 mm

Ast provided = 402.12 $mm^2$

**Check for Spacing**

Minimum of

1) 3d = 318 mm

2) = 300 mm

3) = 334.93 mm

Therefore provide Y **8** @ **125** mm C/C 100

Provided % of Tension Reinforcement (pt) = **0.379** %

**Long Span Direction @ Support**

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$Mu/bd^2 = \frac{5.24 \times 10 \wedge 6}{1000 \times 106 \times 106} = 0.467$

Pt = 0.110 %

Area of steel Ast = 0.00110 x 1000 x 106 = 116.96 $mm^2$

Minimum area of steel 0.0012 x 1000 x 125 = 150.00 $mm^2$

Spacing of Y **8** bars 50.27 x 1000 / 150.00 = 334.93 mm

Ast provided = 335.1 $mm^2$

**Check for Spacing**

Minimum of

1) 3d = 318 mm

2) = 300 mm

3) = 334.93 mm

Therefore provide Y **8** @ **150** mm C/C

**Long Span Direction @ mid Span**

$Mu/bd^2 = \frac{3.90 \times 10 \wedge 6}{1000 \times 106 \times 106} = 0.347$

Pt = 0.082 %

Area of steel Ast = 0.00082 x 1000 x 106 = 86.458 $mm^2$

Minimum area of steel 0.0012 x 1000 x 125 = 150.00 $mm^2$

Spacing of Y **8** bars 50.27 x 1000 / 150.00 = 334.93 mm

Ast provided = 335.1 $mm^2$

**Check for Spacing**

Minimum of

1) 3d = 318 mm

2) = 300 mm

3) = 334.93 mm

Therefore provide Y **8** @ **150** mm C/C

**Check for Deflection:**

Basic Span/depth Ratio = 22

% of Tension Reinforcement provided ( pt ) = 0.379 %

Service stress of steel (fs) : 0.58fy(Ast_r/Ast_p) = 65.53 $N/mm^2$

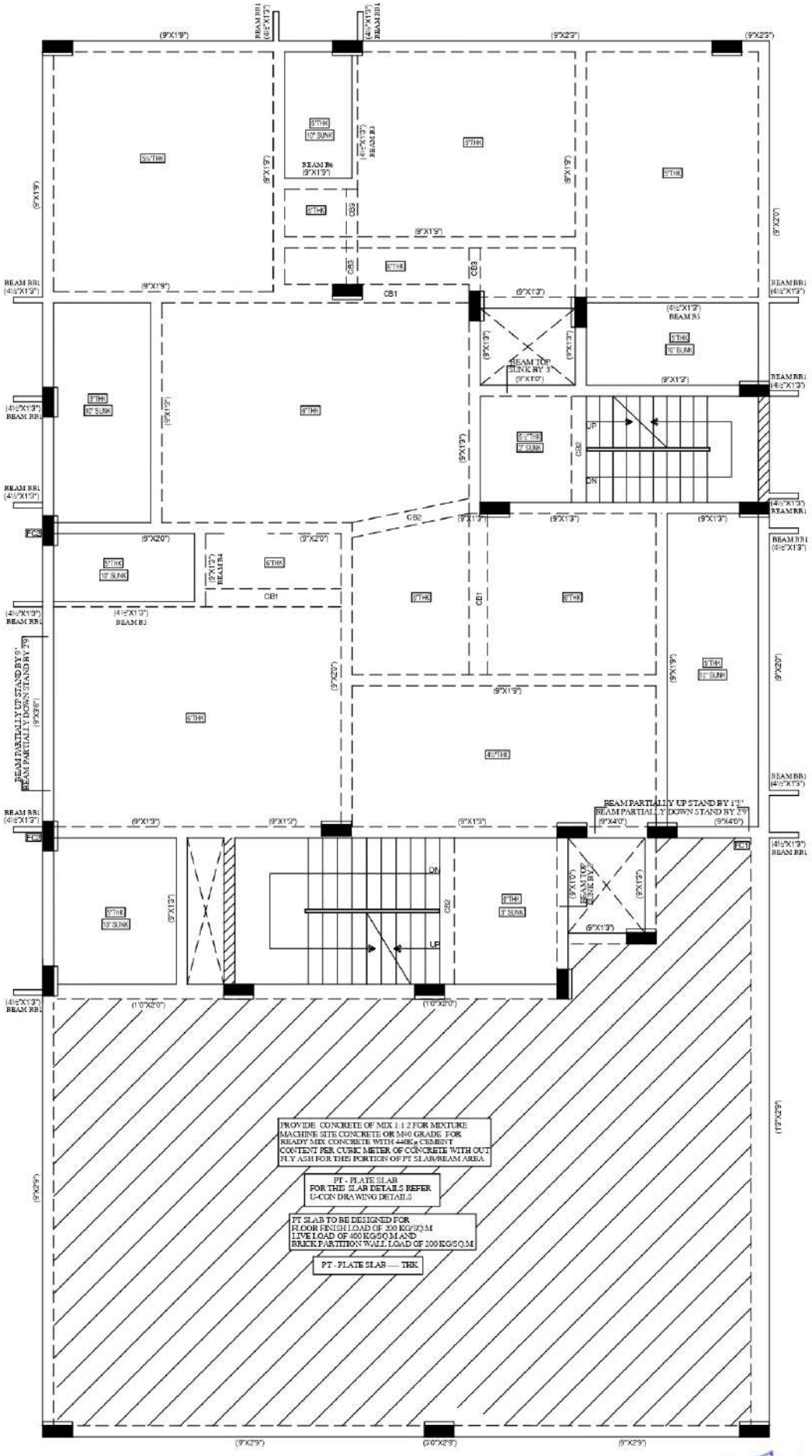
Modification Factor for Tension Reinforcement (F1) = 2.00

Allowable Span/Eff Depth Ratio = 44

Actual Span/Eff Depth Ratio = 3.35 x 1000 / 106 = 31.60

**Hence O.K**

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# TYPICAL FLOOR PLAN
## I, II, III, IV AND V

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THE LANDLENS SUITE

# Eight ways to know a piece of land before you pay for it.

This report covers one part of the picture. These cover the rest, drawn from the same government records, for any property in Tamil Nadu.

### LandLens One
Ask anything about a property and get an answer grounded in live government records, with the sources shown.
**/landlens/one**

### Verify My Land
Every record check run on one property and returned as a single report.
**/landlens/verify-my-land**

### Legal Opinion
An advocate's written opinion on the title, built on the records we pull for it.
**/landlens**

### One Map
Every layer on one map: the parcel, its boundary, zoning, water bodies and what sits around it.
**/landlens/one/map**

### PriceMap
What land actually changed hands for around this plot, taken from the registered deeds.
**/landlens/pricemap**

### Build Scope
What you are allowed to build here: floor space, height, coverage and setbacks.
**/landlens/build-scope**

### Property Tracker
Watch a property and hear about it when something new is registered against it.
**/landlens/property-tracker**

### Deal Room
Run the transaction in one place: documents, stamping, signatures and the parties.
**/landlens/deal-room**

FREE TOOLS · NO ACCOUNT NEEDED

# Twenty-four checks you can run yourself, at no cost.

## Records and verification

The registers themselves, read for you.

- Encumbrance Certificate
- Patta and Chitta
- Field Measurement Sketch
- EC Analyzer
- Bank charge check
- Court case search
- Seller background check
- Approval check by survey

## Value and duty

What it is worth and what it costs to register.

- Guideline value by street
- Guideline value by survey
- Stamp duty and registration fees
- Capital gains
- Floor space index
- Area unit converter

## Zoning and land use

What the plan says can happen on this land.

- Land use zone finder
- CMDA land use check
- Coastal regulation zone
- Master plan check
- Water bodies finder
- Airport height clearance

## Registers and directories

Who holds it, and which office keeps the record.

- Find your registering office
- Temple property check
- Waqf property check
- RERA register

**Every free tool**
/tools

**Services we run for you**
/services

**The LandLens suite**
/landlens/one

Verified RealEstate™

# Every claim in this document traces back to a government record.

- Legal opinions, due diligence and title verification
- Building plan, layout and sub-division approvals
- Completion and occupancy certificates, regularisation
- Escrow, negotiation and NRI property management
- Land survey, soil testing, architecture and construction

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Prepared from the registers named on the page each finding sits on. Where a register could not be read, this document says so in its place rather than leaving the gap to be read as a clean result.