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FORM-4B

STRUCTURAL STABILITY CERTIFICATE

BY REGISTERED STRUCTURAL ENGINEER (To be furnished on completion of building)

I/We **H N RENUKA PRASAD** have undertaken assignment as Structural Engineer for the detailed design and construction of the building/block/Tower T S No.6542/1BlockNo.140 T Nagar Village, Mambalam Guindy Taluk, Chenani District, Tamilnadu of the building comprising of Basement Floor + Ground floor + 3 Upper Floors + Head room / Lift floors situated in the land bearing Survey Number/s : 6542/ plot **No.8, SIR THEYAGARAYA ROAD, T NAGAR Village, CHENNAI 600 017**. It is certified that the building 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 applicable relevant standards and Codes of Bureau of Indian Standards. Further after the detailed inspection of the building, it is certified that the constructed building is structurally safe and sound for the purpose for which it is constructed.

Yours faithfully,

H N RENUKA PRASAD - Structural Engineer
CMDA Registration. No.: SE/GR-I/2019/ 03 /061

Signature, Name and seal of the Registered Structural Engineer

**PRASAD CONSULTANTS (Prc India)**
SAFE, ECONOMICAL,EXCELLENT&EFFICIENT
G11& G-12 N0.37 RAMANASHREE CHAMBERS
CUBBON ROAD, BANGLORE-560001
Ph:080-222115666
Email: info@prcindia.in

# STABILITY CERTIFICATE

(To be furnished while filing application for registration of building)

It is certified that the proposed construction RETAIL DEVELOPMENT AT T NAGAR is designed to resist earthquake. Check has been made and found safe and I hereby certify that:

1. The minimum grade of concrete is RCC M30

2. The design and analysis using the code of practice for plain and reinforced concrete as per IS 456, Design Loads as per - IS: 875 (Part-I), (Part -2) &Part (3) 1987 and Design of Earthquake resistant Structure as per IS: 1893 (Part-I) 2002 with co-efficient applicable for Seismic Zone - III. are carried out.

The building will be safe and sound when used for the purpose for which it is designated.

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Stamp and Signature

Encl.: Structural Design Calculation

Proposed "Retail Development " at T Nagar, Chennai.

Date .17.06.2016.

# STRUCTURAL STABILITY CERTIFICATE

This is to certify that the proposed construction of Commercial building (Basement + Ground floor+ 3 upper floors + terrace) at Site No.8, Theyagaraya Road, Opposite to Globus, Corner of Chevaliers Sivaji Ganesan Road, T Nagar, Chennai Corporation, is structurally designed by me based on the architectural drawings furnished by client.

I have studied soil investigation report in detail and the soil conditions are adequate for the proposed construction.

The structure is a Reinforced-Concrete structure with Flat slab and Beam-slab system and is complying with the Bureau of Indian Standard norms for seismic forces-IS: 1893 with co-efficient applicable for Zone-III and design is suitable for the purpose of usage.

The design development of the structure is started during the Second-half of 2016. Hence the forces considered as per Zone-III based on IS: 1893 Part-1 - 2002 and IS: 875 Part-3 – 1987 are applicable.

I also certify that:

1. The Least dimension of the column is 200 mm.
2. The minimum Grade of concrete is M30.
3. The design analysis using the code of practice for loading standards as per IS: 875 Part-1 - 1987 to 3, IS: 432, IS: 456 and SP: 16 and seismic force as per the code IS 1893 Part-1 - 2002.

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DESIGN CONSIDERING THE SESMIC CONDITION AS PER IS 1893 Part-1 / 2002 AND AS PER IS 873/Part-II.

| | | |
|---|---|---|
| Live load on roof | = | 1.50 KN/$m^2$ |
| Live load on floors | = | 4.00 KN/$m^2$ |
| Weathering course on roof | = | 3.5 KN/$m^2$ |
| Floor finish | = | 2.0 KN/$m^2$ |
| Weight of concrete | = | 25.00 KN/$m^2$ |

Weight of Solid concrete block with plastering = 22.00 KN/$m^2$

Least dimension of the column = 200x600 mm

Other columns Max size adopted = 200x600, 300x600, 400x800, 600x1000 mm, 600x800 & 800x800 mm

DESIGN DETAILS :

| | |
|---|---|
| Design Method | : Limit state design for all structures. |
| Codes and special | : IS-456, SP 16, IS 875 Part -1 to 3 & IS |
| Publication used. | 1893-Part-1 2002 for Earthquake condition. |
| Concrete Grade | : M30 for all elements (Pile , Pile cap, Retaining wall, columns, beam & slabs) . |
| Steel Grade | : Fe 500. |
| Is Code dimension of column | : 1893 – Part-1 2002 & IS 875 Part-1 (Adopted to seismic condition.) |
| Least dimension of column Adopted in this building | : 200mm x600mm |

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SEISMIC LOADS

Seismic design and detailing shall be in accordance with IS: **1893: 2002**, **IS: 13920-1993** as applicable. **Chennai** falls under **Zone III** and the considered building is 16.**30m** high from the NGL as categorized by **IS: 1893-2002** and **IS: 13920-1993,** the building shall be designed and detailed for the following parameters.

| | |
|---|---|
| Zone factor, Z | = 0.16 (Refer Table 2) |
| Importance factor, I | = 1.0 (Refer Table 6) |
| Response reduction factor, R | = 5.0 (Refer Table 7) |

(Special RC moment resisting frame (SMRF))

Dynamic analysis shall be performed to obtain the design seismic forces and its distribution to different levels along the height of the building and to the various load resisting elements. A design seismic force in both the directions is carried out by **Response Spectrum Method**. Response Spectrum values are calculated based on the Time history (T) & Average response acceleration coefficient for rock or soil sites as given by **Fig-2 & Table 3 in IS1893 Part-1-2002** based on appropriate natural periods and damping of the structure. Base shears of the analysis are raised to a factor of [Vb/Vb] as per clause No. 7.8.2

WIND LOADS:

Wind design shall be in accordance with IS: **875 (Part-3): 1987,** the building shall be designed and detailed for the following parameters.

| | |
|---|---|
| Building Location | = T. Nagar, Chennai |
| Basic Wind Speed, Vb | = 50 m/s |
| Height of Building (from EFL to Top of OHT) | = 21.45m (from E.F.L) |
| Probability Factor (Rick Co-efficient) from table-1, k1 | = 1.0 |
| Terrain, based on Structure height & base size from table-2, k2 | = 1.0 |
| Topography factor, k3 | = 1.0 |
| Design Wind Speed, Vz | = (k1 * k2 * k3 * Vb) |
| Design Wind Pressure, Pz | = (0.6 * Vz^2)/1000 |

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## STRUCTURAL DESIGN LOAD CALCULATION SHEET:

| | |
|---|---|
| Name of project : | Proposed construction of Commercial building at Site No.8, Theyagaraya Road, Opposite to Globus, Corner of Chevaliers Sivaji Ganesan Road, T Nagar, Chennai. |
| Construction and type of foundation : | RCC framed type structure with pile foundation. |
| Floor height : | 3.125 m. |
| Size of columns : | 200x600, 300x600, 400x800, 600x100, 600x800 & 800x800 mm |

## PILE DESIGN CALCULATION

Pile capacity as per Geotechnical Investigation Report

| Diameter | Safe Vertical Load Capacity of bored cast-in-situ concrete piles for different pile diameters. |
|---|---|
| 600 mm | 129 tonnes |
| 750 mm | 200 tonnes |
| 900 mm | 310 tonnes |

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## GEO-TECHNICAL INVESTIGATION & RECOMMENDATIONS:

The recommendation as per the soil report is

Report No. 074/GI/14-15

### DESIGN INFORMATION

For the proposed building with a basement floor a: Circulation (DMC) Bored Cast In-Situ" piles were recom: piles of minimum 19.5-, and 16.5-M total and effective lengt floor, and pile caps was considered. The piles actual pile l vary from the considered 19-M in case of lower N values so allowable pile capacities of various pile diameters are summa:

| Pile Dia., M | Compressive Cap: 0.60 | 0.75 | |
|---|---|---|---|
| $Q_{ult}$ | 323.42 | 522.16 | 7 |
| $Q_{all}$ | 129 | 209 | |

It is recommended to provide at least a two-pile grou: single pile – single column by selecting appropriate pile bending forces from the column loads. Foundation capacity c

### GROUND WATER

Groundwater was seen in the Boring 1 at 3.5-M below the drilling of the boring and bailing out the bentonite solu: diameter open well and unknown depth was present in the Boring 2. Groundwater sample was collected from the open v results indicate that groundwater from the bore well was not IS: 456 – 2000 due to high alkalinity as inferred by the meth: be used for construction purposes after suitable treatment quality per IS: 456 – 2000 guidelines. Summary of ground wa

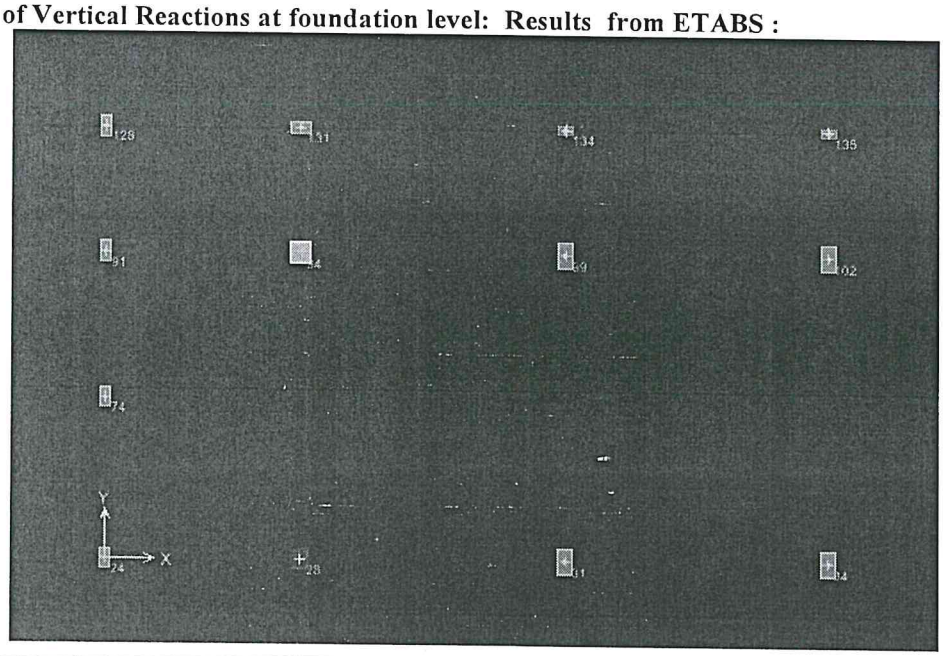
### CONSTRUCTION CONSIDERATIONS

**We do not expect construction problems at this si conditions in non-rainy seasons.** In rainy season or soo: reach higher level that may be higher than the required h was at about 0.45- to 0.6-M above ERL of road in front flooding from rainwater it is recommended to raise FGL of



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**Sum of Vertical Reactions at foundation level: Results from ETABS :**

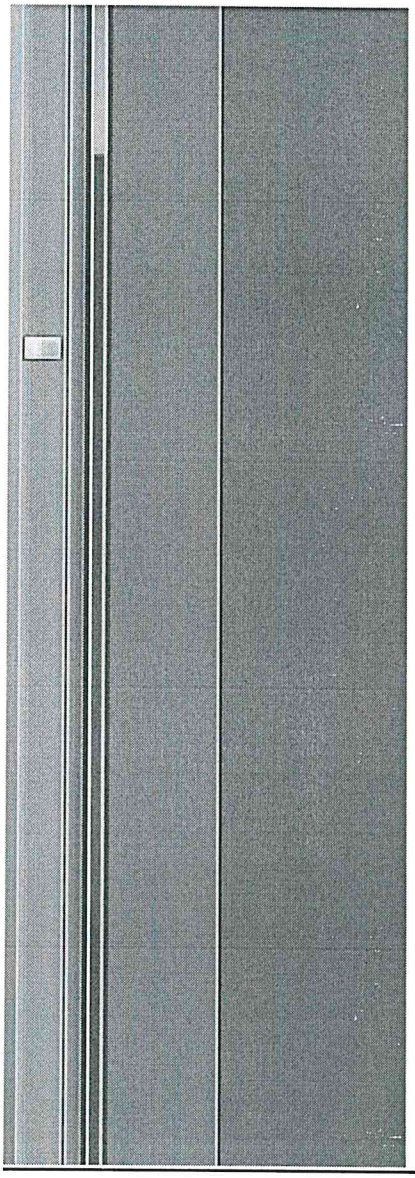



| Story | Point | Load | FX | FY | FZ | MX | MY | MZ |
|---|---|---|---|---|---|---|---|---|
| BASEMENT | 1 | FOOTING | 3.89 | 53.84 | 864.41 | 6254.077 | -5068.39 | 183.574 |
| BASEMENT | 2 | FOOTING | -77.14 | 13.24 | 874.53 | -11355.9 | -17196 | -7.749 |
| BASEMENT | 3 | FOOTING | -70.41 | 74.66 | 613.58 | -8335.26 | -8824.23 | 186.913 |
| BASEMENT | 4 | FOOTING | 45.01 | 18.48 | 1021.2 | -19950.3 | 33535.27 | 315.609 |
| BASEMENT | 7 | FOOTING | -5.27 | 14.62 | 1089.41 | -11400.8 | -4425.95 | 190.529 |
| BASEMENT | 8 | FOOTING | -23.71 | -73.36 | 436.93 | -26983 | -21120.9 | 396.087 |
| BASEMENT | 18 | FOOTING | 88.9 | 27.08 | 1448.53 | 28033.03 | 65719.22 | 144.692 |
| BASEMENT | 20 | FOOTING | -10.24 | -8.18 | 1391.94 | 6280.627 | -8666.93 | 68.245 |
| BASEMENT | 21 | FOOTING | -36.87 | 482.32 | 1327.56 | 125721 | -33619.1 | 275.018 |
| BASEMENT | 24 | FOOTING | 227.45 | 276.15 | 3298.09 | -107968 | 163463 | 126.749 |
| BASEMENT | 28 | FOOTING | 17.95 | 763.5 | 9030.4 | -435664 | -15658 | -4906.25 |
| BASEMENT | 74 | FOOTING | 409.78 | 32.08 | 4839.23 | 75796 | 305060.2 | -120.07 |
| BASEMENT | 91 | FOOTING | 172.38 | -263.37 | 3253.83 | 182804.7 | 122610.4 | -40.864 |
| BASEMENT | 94 | FOOTING | -33.08 | -352.12 | 7720.51 | 219646.8 | -77244.7 | -4256.39 |
| BASEMENT | 128 | FOOTING | 59.94 | -110.48 | 1525.45 | 5760.992 | -15938.1 | -812.548 |
| BASEMENT | 131 | FOOTING | 0.45 | -15.86 | 1506.59 | 8260.92 | 9578.787 | -679.786 |
| BASE | 31 | FOOTING | 8.2 | 12.53 | 9918.94 | -113103 | -3516.37 | 1650.017 |
| BASE | 34 | FOOTING | -40.77 | 331.05 | 10928.14 | -591372 | -62376.1 | -717.367 |
| BASE | 37 | FOOTING | -53.38 | -41.25 | 5964.35 | 6492.959 | -99425.7 | -4109.09 |
| BASE | 99 | FOOTING | 130.32 | -205.82 | 9970.16 | 306318.4 | 140260.8 | 134.944 |
| BASE | 102 | FOOTING | -4.79 | -354.9 | 12669.15 | 523568.8 | -8682.71 | -552.482 |
| BASE | 105 | FOOTING | -104.74 | -111.93 | 6990.55 | 162785.7 | -130679 | 2553.213 |
| BASE | 134 | FOOTING | 8.5 | -13.83 | 531.41 | 17352.7 | 11455.51 | -52.632 |
| BASE | 135 | FOOTING | -9.52 | -4.84 | 703.59 | 8039.969 | -13761.8 | -0.872 |
| BASE | 136 | FOOTING | -20.67 | -13.25 | 403.84 | 16352.29 | -34465 | 92.828 |



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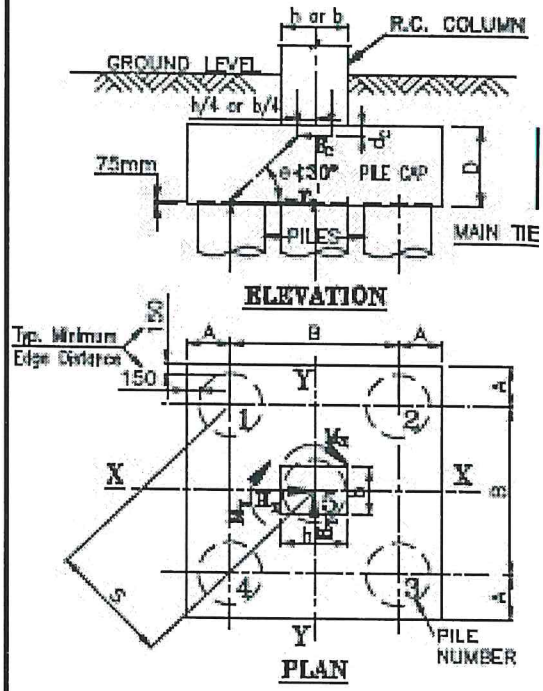
PILE FOUNDATION DESIGN CALCULATION



| | |
|---|---|
| | Bangalore |
| Client: | TSM Sadunissa |
| Project: | JCT Commercial Bu |

**SPREADSHEET OF R.C. PILE CAI**

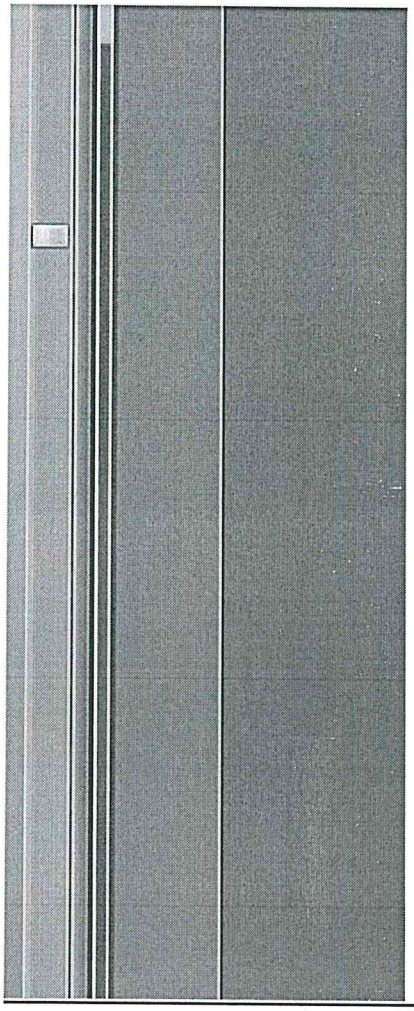
Checks the adequacy of Pile Cap section for




**Pile Cap Size:**

| Pile Cap Mk. | Pile Cap Size (mm) | | | Col. Size(mm) | |
|---|---|---|---|---|---|
| | A | B | D | h | b |
| PC12 | 1000 | 4530 | 2000 | 1000 | 600 |

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| | |
|---|---|
| | Bangalore |
| Client: | TSM Sadunissa |
| Project: | JCT Commercial E |

## Reaction on Piles (Service Load cc

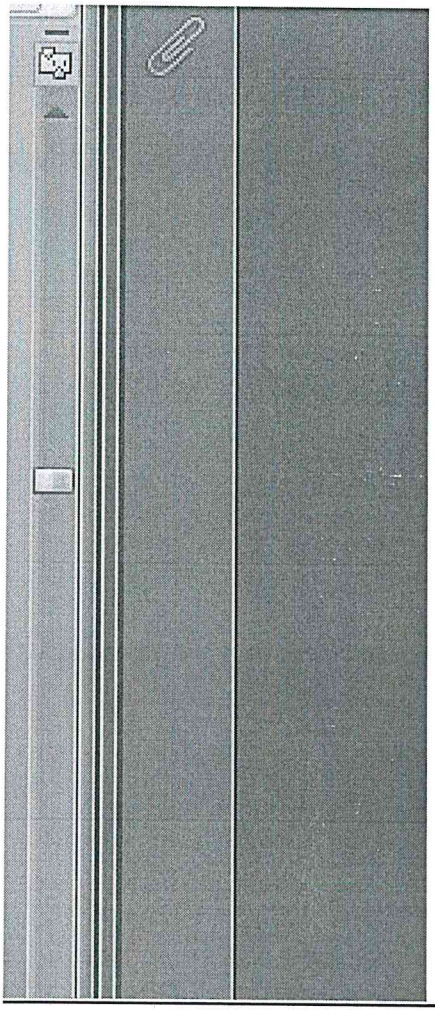
| Pile Cap Mk. | Pile spacing, S (mm) | Soil over Pile Cap Pressure (kN/m2) | Wt.(k |
|---|---|---|---|
| PC12 | 3200 | 0.0 | 0.0 |
| 0 | | | - |
| 0 | | | - |
| 0 | | | - |
| 0 | | | - |
| 0 | | | - |
| 0 | | | - |
| 0 | | | - |
| 0 | | | - |
| 0 | | | - |

## Main Steel at bottom by Limit State

| Pile Cap Mk. | Max. Pile Reaction, Pu (kN | Conc. Gr. M | Steel $f_y$ N/mm$^2$ | Eff. (mm |
|---|---|---|---|---|
| PC12 | 4215.60 | 30 | 500 | #### |



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| Client: | TSM Sadunissa |
|---|---|
| Project: | JCT Commercial |

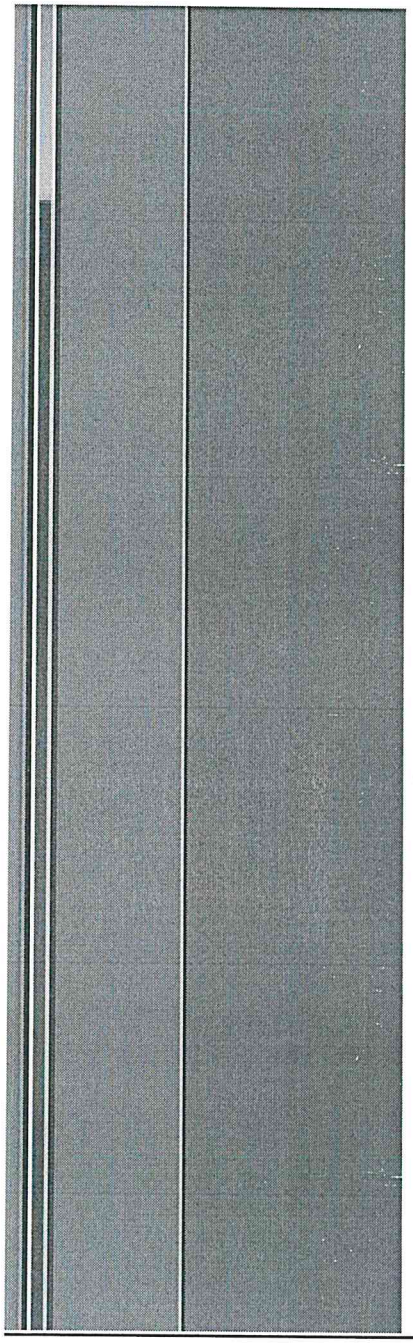
## Pile Cap Top Main Steel - Limit St

| Pile Cap Mk. | Min. Pile Reaction, Pu (kN) | -ve BM at face of Col, Mu(kNm) | Eff p |
|---|---|---|---|
| PC12 | 8431.20 | 0.00 | |
| 0 | - | - | |
| 0 | - | - | |
| 0 | - | - | |
| 0 | - | - | |
| 0 | - | - | |
| 0 | - | - | |
| 0 | - | - | |
| 0 | - | - | |
| 0 | - | - | |

## Check for Shear

| Pile Cap Mk. | Shear Force (kN) | Shear Stress $\tau_v$ (N/mm$^2$) | 100 bd |
|---|---|---|---|
| PC12 | 7774.77 | 0.867 | 0.4 |
| 0 | | | |

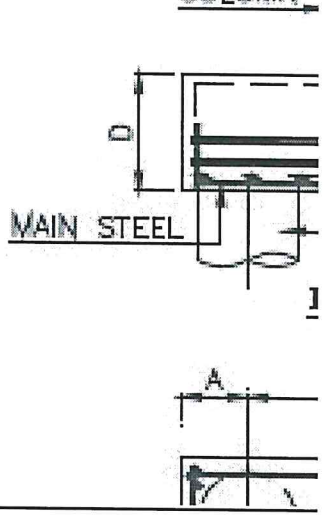
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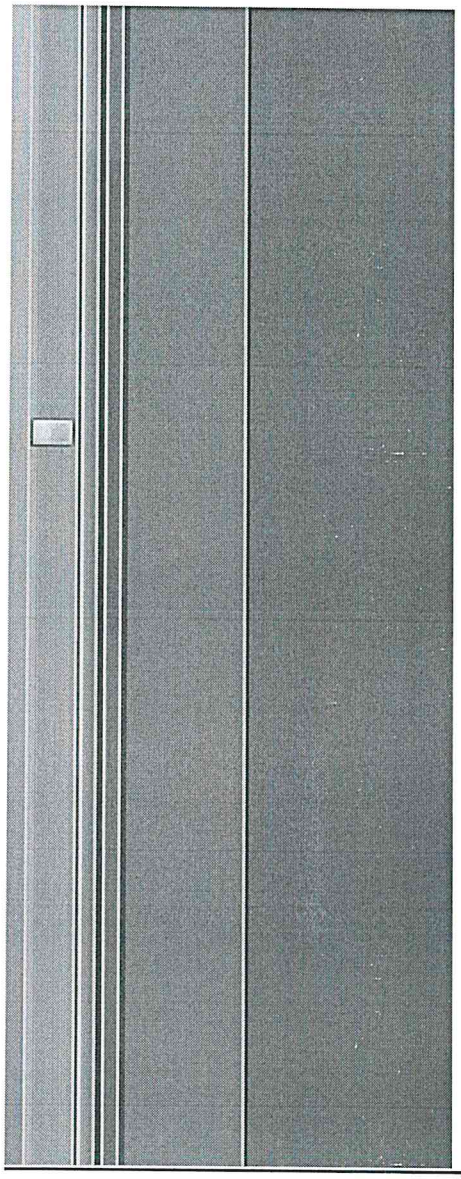
| | |
|---|---|
| Client: | TSM Sa |
| Project: | JCT Con |

**Horizontal Links**

| Pile Cap Mk. | Φ(mm) | L |
|---|---|---|
| PC12 | 16 | |
| 0 | | |
| 0 | | |
| 0 | | |
| 0 | | |
| 0 | | |
| 0 | | |
| 0 | | |
| 0 | | |
| 0 | | |

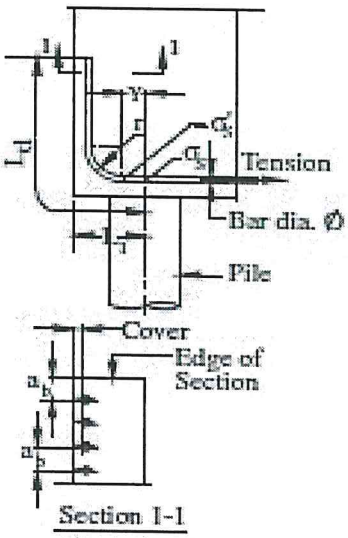



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| | |
|---|---|
| | Bangalore |
| Client: | TSM Sadumissa |
| Project: | JCT Commercial |

## Anchorage of Main Tension Rein




$$L_d = \frac{\emptyset\, \sigma_s}{4\, \tau_{bd}}$$

$$\sigma_s' = \frac{L_d - Y}{L_d}$$

Bearing St
(Ref:
Bearing Str
Bearing Str
By Limit-S

**Bearing Stress in Concrete at inner bend of L-shaped bar**

## Calculations for Radius 'r' at ben

**(Minimum Rad. r = 2xΦ for MS bars**

| Pile Cap Mk. | $L_1$ (mm) | Φ bar (mm) | Cover (mm) | Rad. r (mm) | a (m |
|---|---|---|---|---|---|
| PC12 | 1000 | 32 | 50 | 128 | 1( |

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## COLUMN DESIGN CALCULATION:

**Definitions Of Terms:**

**All forces in units kN and m**

**All reinforcement details like area, spacing in mm**

| | | | |
|---|---|---|---|
| 1 | Ag | = | Gross area of the column cross section |
| 2 | Ak | = | Area of confined concrete core |
| 3 | Ash | = | Area of link cross section |
| 4 | B | = | Width / Smaller Dimension of Column in mm |
| 5 | D | = | Depth / Larger Dimension of Column OR Diameter of Circular Column in mm |
| 6 | b | = | Effective Width of Column in mm |
| 7 | d | = | Effective Depth of Column in mm |
| 8 | Dk | = | Diameter Of core measured to the outside of circular link |
| 9 | Fck | = | Characteristic compressive strength of concrete cube in N/SqMM |
| 10 | Fy | = | Yield Stress Of Steel in N/SqMM |
| 11 | h | = | Longer dimension of rectangular link measuered to its outer face |
| 12 | k | = | Reduction factor for slenderness moments |
| 13 | Mux | = | Factored moment Along D |
| 14 | Muy | = | Factored moment Along B |
| 15 | Max | = | Additional moment due to slenderness about major axis (Along D) |
| 16 | May | = | Additional moment due to slenderness about minor axis (Along B) |
| 17 | Mux1 | = | Maximum uniaxial moment capacity for Pu Along D |
| 18 | Muy1 | = | Maximum uniaxial moment capacity for Pu Along B |
| 19 | Mminx | = | Moment due to minimum eccentricity along D |
| 20 | Mminy | = | Moment due to minimum eccentricity along B |
| 21 | Pb | = | Axial capacity of column as defined in 39.7.1.1 |
| 22 | Pu | = | Factored axial force |
| 23 | S | = | Link Spacing |
| 24 | Shear Strength Enhancement Factor | = | Multiplying factor for shear strength of concrete as per 40.2.2 |
| 25 | Vux | = | Factored shear force Along D |
| 26 | Vuy | = | Factored shear force Along B |
| 27 | Vur | = | Factored resultant shear force acting on the column |

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**Codal References:**

**IS 456 -2000**

| | ELEMENT | | CLAUSE / table |
|---|---|---|---|
| 1 | Max area of reinforcement | : | 26.5.3.1-a & b |
| 2 | Min area of reinforcement | : | 26.5.3.1-a & b |
| 3 | Min number of bars | : | 26.5.3.1-c |
| 4 | Minimum Eccentricity Calc | : | 25.4 & 39.2 |
| 5 | Effective Length | : | 25.2 |
| 6 | Slenderness Moments | : | 25.3 & 39.7 |
| 7 | Design for axial loads | : | 39.3 |
| 8 | Design for axial loads And uniaxial bending | : | 39.5 |
| 9 | Design for axial loads And Biaxial bending | : | 39.6 |
| 10 | Design of horizontal links | : | 26.5.3.2 |
| 11 | Design shear strength | : | 40.2 |

**IS 13920 - 2002**

| | ELEMENT | | CLAUSE / table |
|---|---|---|---|
| 1 | Spacing of special confining reinforcement | : | 7.4.6 |
| 2 | C/s area of special confining reinforcement | : | 7.4.7 |

**General Data**

| | | | |
|---|---|---|---|
| Column No. | : | C3 | |
| Level | : | BASEMENT To GF | |
| Design Code | = | IS 456 - 2000 + IS 13920 - 1993 | |
| Grade Of Concrete | = | M45 | N/SqMM |
| Grade Of Steel | = | Fe500 | N/SqMM |
| Column B | = | 600 | MM |
| Column D | = | 1000 | MM |
| Clear Cover | = | 50 | MM |
| Clear Floor Height @ B | = | 1650 | MM |
| Clear Floor Height @ D | = | 1800 | MM |
| No Of Floors | = | 1 | |
| No Of Columns In Group | = | 1 | |
| Column Type | : | UnBraced | |
| Minimum eccentricity check | : | One Axis at a Time | |



**Load Data**

| | | | |
|---|---|---|---|
| Analysis Reference No. | = | C18 | |
| Load Combination | = | 1.5 (DEAD) +1.5 (SDL) +1.5 (LIVE) | |
| Critical Location | = | Top Joint | |
| Pu | = | 14160.87 | KN |
| Mux | = | -932.91 | KNM |
| Muy | = | -188.61 | KNM |
| Vux | = | 329.8 | KN |
| Vuy | = | 567.63 | KN |

**Minimum Eccentricity Check**

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

| | | | |
|---|---|---|---|
| Mimimum Eccentricity | = | Unsupported Length / 500 + B / 30 | |
| | = | 23.3 | MM |
| Mimimum Eccentricity | > | 20 | MM |
| Mminy | = | Pu x Mimimum Eccentricity | |
| | = | 329.95 | KNM |

**Slenderness Check**

| | | | |
|---|---|---|---|
| Max Slenderness Ratio(L/B) | = | 2.75 | |
| | < | 60 | (Hence Ok) |

Column Is Unbraced Along D

Slenderness Check Along D:

| | | | |
|---|---|---|---|
| Effective Length Factor | = | 1 | |
| Slenderness Ratio | = | Effective Length / D | |
| | = | 1.8, Column not Slender Along D | |

Column Is Unbraced Along B

Slenderness Check Along B:

| | | | |
|---|---|---|---|
| Effective Length Factor | = | 1 | |
| Slenderness Ratio | = | Effective Length / B | |
| | = | 2.75, Column not Slender Along B | |

**Calculation of Design Moment**

| Direction | Manalysis | Mmin | Mdesign | Mslndx | Mdesign-final |
|---|---|---|---|---|---|
| | A | B | C | E | F |
| Major Axis - Mux | 932.91 | --- | 932.91 | 0 | 932.91 |
| Minor Axis - Muy | 188.61 | 329.95 | 329.95 | 0 | 329.95 |

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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**

Critical Case - Axial Load & BiAxial Bending

| | | | |
|---|---|---|---|
| Pu | = | 14160.87 | KN |
| Mux | = | 932.91 | KNM |
| Muy | = | 329.95 | KNM |

**Biaxial Bending Check**

| | | | |
|---|---|---|---|
| Pt Calculated | = | 2.38 | |
| Steel Provided | = | 8-T32 + 16-T25 | |
| Mux1 | = | 1261.24 | KNM |
| Muy1 | = | 747.49 | KNM |
| Puz | = | 0.45 x Fck x Ac + 0.75 x Fy x Asc | |
| | = | 17218.66 | KN |
| Pu/Puz | = | 0.82 | |
| Alpha | = | 2 | |
| Interaction Ratio | = | (Mux / Mux1)^Alpha + (Muy / Muy1)^Alpha) | |
| | = | 0.74 < 1 | |

**Design Of Shear**

| | | | |
|---|---|---|---|
| Design for shear along D | | | |
| Design shear force, Vuy | = | 567.6331 | kN |
| Design shear stress, Tvy | = | Vuy / (B x D) | kN |
| | = | 0.9461 | N/SqMM |
| Design shear strength, Tc | = | 0.9529 | N/SqMM |
| Shear Strength Enhancement Factor | = | 1 + 3 x Pu / ( B x D x Fck) | |
| | = | 2.5734 | |
| Shear Strength Enhancement Factor (max) | = | 1.5 | |
| Shear Strength Enhancement Factor | = | 1.5 | |
| Design shear strength | = | 1.4294 | |
| Design shear check | = | Tvy < Tc x Enhancement factor | |
| Link for Shear Design along D are not required | | | |



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| | | | |
|---|---|---|---|
| Design for shear along B | | | |
| Design shear force, Vux | = | 329.8015 | kN |
| Design shear stress, Tvx | = | Vux / (B x D) | kN |
| | = | 0.5497 | N/SqMM |
| Design shear strength, Tc | = | 0.9529 | N/SqMM |
| Shear Strength Enhancement Factor | = | 1 + 3 x Pu / ( B x D x Fck) | |
| | = | 2.5734 | |
| Shear Strength Enhancement Factor (max) | = | 1.5 | |
| Shear Strength Enhancement Factor | = | 1.5 | |
| Design shear strength | = | 1.4294 | |
| Design shear check | = | Tvx < Tc x 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 | |
| | = 8 | mm |
| Criterion for spacing of normal links | | |
| Min. Longitudinal Bar dia X 16 | = 400 | mm |
| Min. dimension of column | = 600 | mm |
| Max. 300 mm | = 300 | mm |
| Provided spacing | = 300 | mm |

**Special confining reinforcement as per IS 13920**

| | | |
|---|---|---|
| Min. Lateral dimension of column, B | = 600 | mm |
| B/4 | = 150 | mm |
| Hence Link spacing, S | = 100 | mm |
| Hoop dimension, h | = 169 | mm |
| Gross area of column, Ag | = B x D | |
| | = 600000 | sqmm |
| Core area of column, Ak | = (B- 2 x cover to Link) x (D- 2 x cover to Link) | |
| | = 478400 | sqmm |



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| | | |
|---|---|---|
| Area of special confining link, Ash | = 0.18 x S x h x (Fck/Fy) x (Ag/Ak-1) | |
| | = 77.83 | sqmm |
| Diameter of special confining link | = 10 | mm |
| | = > Max. longitudinal bar dia / 4 | |
| | = 8 | mm |
| Zone for special confining links - criterion | | |
| Max. Size of column, D | = 1000 | mm |
| Clear height/6 | = 300 | mm |
| Minimum value | = 450 | mm |
| Since length of Confining | > Clear height/2 | |
| Length of confining zone | = Clear height/2 | |
| | = 900 | mm |

Table For Links

| | Required | | | Provided | |
|---|---|---|---|---|---|
| | Normal Design | Shear Design | Ductile Design | Normal Zone | Ductile Zone |
| Link Dia. | 8 | --- | 10 | 8 | 10 |
| Spacing | 300 | --- | 100 | 300 | 100 |

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## BEAM DESIGN

| Sr.No. | Symbol | | Definitions |
|---|---|---|---|
| 1. | b | = | Width of the Beam in mm |
| 2. | D | = | Depth of Beam in mm |
| 3. | d | = | Effective depth of Beam in mm |
| 4. | Mu | = | Factored Bending Moment in Limit State at a section in KNM |
| 5. | Tu | = | Factored Torsional Moment in Limit State at a section in KNM |
| 6. | $M_{Tu}$ | = | Converted Bending Moment due to Torsion at a section in KNM |
| 7. | MuLim | = | Limiting Moment of Resistence of Singly Reinforced Section |
| 8. | Mud | = | Total Design Moment = Mu + $M_{Tu}$ in KNM |
| 9. | R | = | Moment Ratio Mud/$Bd^2$ |
| 10. | Ptmin | = | Minimum percentage steel as per code |
| 11. | Ptclc | = | Calculated percentage tension steel |
| 12. | Pcclc | = | Calculated percentage compression steel |
| 13. | PtPrv | = | provided percentage steel |
| 14. | AstCalc | = | Area of Tension reinforcement required in Sqmm |
| 15. | Reinf | = | Rebar arrangement provided |
| 16. | AstPrv | = | Area of reinforcement provided at given section in Sqmm |
| 17. | Vu | = | Factored Shear Force in Limit State at a section in KN |
| 18. | $V_{Tu}$ | = | Converted Shear Force due to Torsion at a section in KN |
| 19. | Vut | = | Total Shear Force = Vu + $V_{Tu}$ in KN |
| 20. | Tv | = | Shear stress due to Vud in N/Sqmm |
| 21. | Tc | = | Permissible Shear stress in concrete at a given section in N/Sqmm. Calculated as per Tensile reinforcement |
| 22. | Vc | = | Shear capacity of concrete section due to Tc in KN |
| 23. | Vus | = | Vud - Vc Design Shear Force for reinforcement, in KN |
| 24. | Asv | = | Area of shear reinforcement required per meter length in Sqmm |
| 25. | Legs | = | Number of legs of the shear reinforcement |
| 26. | Stirrup Dia | = | Diamter of shear stirrups in mm |
| 27. | SvCalc | = | Stirrup spacing calculated as per Asv in mm |
| 28. | SvPrv | = | Stirrup spacing provided in mm |
| 29. | Spc1 to Spc6 | = | Max Stirrup Criteria in mm |
| 30. | $V^{D+L}$ | = | Shear force 1.2x(Dead Load + Live Load) in KN |
| 31. | Mh | = | Hogging Moment of Resistance in KNM |
| 32. | Ms | = | Sagging Moment of Resistance in KNM |
| 33. | Vu-A1 | = | $V^{D+L}$Left - 1.4 x (MsLeft + MhRight)/L in KN |
| 34. | Vu-B1 | = | $V^{D+L}$Right + 1.4 x (MsLeft + MhRight)/L in KN |
| 35. | Vu-A2 | = | $V^{D+L}$Left + 1.4 x (MhLeft + MsRight)/L in KN |
| 36. | Vu-B2 | = | $V^{D+L}$Right - 1.4 x (MhLeft + MsRight)/L in KN |
| 37. | Vu-sway | = | Max of (Vu-A1 and Vu-A2) & (Vu-B1 and Vu-B2) in KN |



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| | | | |
|---|---|---|---|
| 38. | Vud | = | Design Shear Force (Max of Vus and Vu-sway) in KN |
| 39. | D' | = | Distance (c/c) between top-most and bottom-most layer |
| 40. | Vue | = | Earthquake inducted shear in KN |
| 41. | Tce | = | Earthquake inducted shear stress in N/mm² |
| 42. | Tcep | = | Permissible value of shear stress for checking of coupling action in N/mm² |
| 43. | α | = | Angle formed with horizontal by diagonal reinforcement |

All Forces are In KN / KNM, Stress in N / Sqmm & Dimension are in mm.

**Codal References**

**IS 456 - 2000**

| Sr.No. | Item | Clause / Table |
|---|---|---|
| 1. | Ptmax | : 26.5.1.1 |
| 2. | Ptmin | : 26.5.1.1 |
| 3. | $M_{Tu}$ | : 41.4.2 |
| 4. | $V_{Tu}$ | : 41.3.1 |
| 5. | Ptclc | : 38 |
| 6. | Tc | : 40.2.1 |
| 7. | Tcmax | : 40.2.3 |
| 8. | Asv | : 40.4 |
| 9. | Min Shear Reinf | : 26.5.1.6 |
| 10. | Max Stirrup Spacing | : 26.5.1.5 |
| 11. | Shear Reinf - Torsion | : 26.5.1.7 |
| 12. | Side Face Reinforcement | : 26.5.1.3 |

**IS 13920 - 1993**

| Sr.No. | Item | Clause / Table |
|---|---|---|
| 1. | Ptmax | : 6.2.2 |
| 2. | Ptmin | : 6.2.1 |
| 3. | Astmin | : 6.2.3 & 6.2.4 |
| 4. | Svclc | : 6.3.5 |

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| | |
|---|---|
| Group | : **1** |
| Beam No | : **B4A SPAN-1** |
| Analysis Reference (Member) | GF : B33 |
| Beam Length | : 9800 mm |
| Breadth (B) | : 600 mm |
| Depth (D) | : 750 mm |
| Effective Depth (d) | : 695 mm |
| Design Code | : IS 456 + IS 13920 |
| Beam Type | : Ductile Beam |
| Grade Of Concrete | : M30 |
| Grade Of Steel | : Fe500 |
| Clear Cover | : 25 mm |

**Flexure Design**

| | Beam Bottom | | | Beam Top | | |
|---|---|---|---|---|---|---|
| | Left | Mid | Right | Left | Mid | Right |
| Mu (KNm) | 12.47 | 603.94 | 0 | 625.99 | 12.08 | 636.46 |
| Tu (KNm) | 0.16 | 0 | 0.22 | 1.79 | 0 | 0.28 |
| $M_{Tu}$ (KNm) | 0.22 | 0 | 0.29 | 2.37 | 0 | 0.37 |
| Mud (KNm) | 12.69 | 603.94 | 0.29 | 628.36 | 12.08 | 636.83 |
| MuLim (KNm) | 1157 | 1157 | 1157 | 1157 | 1157 | 1157 |
| R | 0.044 | 2.084 | 0.001 | 2.168 | 0.042 | 2.197 |
| Ptmin (%) | 0.263 | 0.263 | 0.263 | 0.263 | 0.263 | 0.263 |
| Ptclc (%) | 0.274 | 0.525 | 0.263 | 0.549 | 0.263 | 0.557 |
| Pcclc (%) | 0 | 0 | 0 | 0 | 0 | 0 |
| PtPrv (%) | 0.289 | 0.527 | 0.289 | 0.579 | 0.289 | 0.615 |
| AstCalc ($mm^2$) | 1144.44 | 2190.37 | 1096.32 | 2288.88 | 1096.32 | 2323.26 |
| AstPrv ($mm^2$) | 1206.36 | 2199.12 | 1206.36 | 2412.72 | 1206.36 | 2563.56 |
| Reinforcement | 6-T16 | 7-T16<br>7-T12 | 6-T16 | 6-T16<br>6-T16 | 6-T16 | 6-T20<br>6-T12 |

**Shear Design**

| | Left | Mid | Right |
|---|---|---|---|
| Vu (KN) | 511.56 | 421.74 | 461.42 |
| Tu (KN) | 0 | 0 | 0.28 |
| $V_{Tu}$ (KN) | 0 | 0 | 0.76 |
| Vut (KN) | 511.56 | 421.74 | 462.18 |
| $V^{D+L}$ (KN) | 27.6 | | 242.4 |
| Mh (KNm) | 658.73 | | 695.22 |
| Ms (KNm) | 347.04 | | 347.04 |
| Vu-A1&B1 (KN) | 121.29 | | 391.29 |
| Vu-A2&B2 (KN) | 171.28 | | 98.72 |
| Vu-Sway (KN) | 171.28 | | 391.29 |

| | | | |
|---|---|---|---|
| Vud (KN) | 511.56 | 421.74 | 462.18 |
| Tv (N/Sqmm) | 1.23 | 1.01 | 1.11 |
| Tc (N/Sqmm) | 0.53 | 0.51 | 0.54 |
| Vc (KN) | 220.02 | 211.77 | 225.54 |
| Vus=Vud-Vc (KN) | 291.54 | 209.97 | 236.64 |
| Asv (Sqmm) | 1162 | 1027 | 943 |
| Legs | 4 | 4 | 4 |
| Stirrup Dia (mm) | 8 | 8 | 8 |
| SvCalc (mm) | 125 | 195 | 100 |
| SvPrv (mm) | 125 | 195 | 100 |

**Maximum Spacing Criteria**

Basic

Spc1 =0.75d = 521 mm
Spc2 = 300 mm

For Torsion

(X1 = 560, Y1 = 710)
Spc3 = X1 = 560 mm
Spc4=(X1+Y1)/4 = 317.5 mm

For Ductility

Left Section
Spc5 = d / 4 = 174 mm
Spc6 = 8 x Small Longitudinal Dia >= 100 = 128 mm

Mid Section
Spc5 = d / 2 = 348 mm

Right Section
Spc5 = d / 4 = 174 mm
Spc6 = 8 x Small Longitudinal Dia >= 100 = 128 mm

**SFR Design**

Beam Width = 600 mm
Beam Depth = 750 mm
Flange Thickness = 0 mm
Web Depth = 750 mm
Torsion = 0.28 KNM> 0



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| | | |
|---|---|---|
| ASFR Required | = 450 | Sqmm |
| SFR Provided | = 2-T12 On Each Face | |
| ASFR Provided | = 452.4 | Sqmm |
| Provided Spacing | = 197.11 | mm |

Spacing Criteria

| | | |
|---|---|---|
| 1.<= beam Width | = 600 | mm |
| 2. Not Greater Than | = 300 | mm |

| | |
|---|---|
| Group | : 1 |
| Beam No | : **B4A SPAN-2** |
| | GF : B34 |
| Beam Length | : 9800 mm |
| Breadth (B) | : 600 mm |
| Depth (D) | : 750 mm |

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| | |
|---|---|
| Effective Depth (d) | : 695 mm |
| Design Code | : IS 456 + IS 13920 |
| Beam Type | : Ductile Beam |
| Grade Of Concrete | : M30 |
| Grade Of Steel | : Fe500 |
| Clear Cover | : 25 mm |

**Flexure Design**

| | Beam Bottom | | | Beam Top | | |
|---|---|---|---|---|---|---|
| | Left | Mid | Right | Left | Mid | Right |
| Mu (KNm) | 0 | 731.43 | 170.52 | 682.51 | 4.88 | 906 |
| Tu (KNm) | 1.75 | 0 | 0 | 0 | 0 | 0 |
| $M_{Tu}$ (KNm) | 2.31 | 0 | 0 | 0 | 0 | 0 |
| Mud (KNm) | 2.31 | 731.43 | 170.52 | 682.51 | 4.88 | 906 |
| MuLim (KNm) | 1157 | 1157 | 1157 | 1157 | 1157 | 1157 |
| R | 0.008 | 2.524 | 0.588 | 2.355 | 0.017 | 3.126 |
| Ptmin (%) | 0.263 | 0.263 | 0.263 | 0.263 | 0.263 | 0.263 |
| Ptclc (%) | 0.263 | 0.651 | 0.418 | 0.602 | 0.263 | 0.836 |
| Pcclc (%) | 0.002 | 0 | 0 | 0 | 0 | 0 |
| PtPrv (%) | 0.289 | 0.675 | 0.419 | 0.615 | 0.289 | 0.904 |
| AstCalc ($mm^2$) | 1096.32 | 2715.57 | 1742.23 | 2510.74 | 1096.32 | 3484.46 |
| AstPrv ($mm^2$) | 1206.36 | 2814.84 | 1746.72 | 2563.56 | 1206.36 | 3769.92 |
| Reinforcement | 6-T16 | 7-T16<br>7-T16 | 7-T16<br>3-T12 | 6-T20<br>6-T12 | 6-T16 | 6-T20<br>6-T20 |

**Shear Design**

| | Left | Mid | Right |
|---|---|---|---|
| Vu (KN) | 476.2 | 470.59 | 590.59 |
| Tu (KN) | 0 | 0.27 | 0 |
| $V_{Tu}$ (KN) | 0 | 0.71 | 0 |
| Vut (KN) | 476.2 | 471.3 | 590.59 |
| $V^{D+L}$ (KN) | 213.6 | | 304.8 |
| Mh (KNm) | 695.22 | | 967.15 |
| Ms (KNm) | 347.04 | | 491.03 |
| Vu-A1&B1 (KN) | 25.86 | | 492.54 |
| Vu-A2&B2 (KN) | 383.06 | | 135.34 |
| Vu-Sway (KN) | 383.06 | | 492.54 |
| Vud (KN) | 476.2 | 471.3 | 590.59 |
| Tv (N/Sqmm) | 1.14 | 1.13 | 1.42 |
| Tc (N/Sqmm) | 0.54 | 0.56 | 0.63 |



| | | | |
|---|---|---|---|
| Vc (KN) | 225.54 | 234.26 | 263.02 |
| Vus=Vud-Vc (KN) | 250.66 | 237.04 | 327.57 |
| Asv (Sqmm) | 999 | 945 | 1305 |
| Legs | 4 | 4 | 4 |
| Stirrup Dia (mm) | 8 | 8 | 8 |
| SvCalc (mm) | 100 | 210 | 100 |
| SvPrv (mm) | 100 | 210 | 100 |

**Maximum Spacing Criteria**

Basic

Spc1 =0.75d = 521 mm
Spc2 = 300 mm

For Torsion

(X1 = 560, Y1 = 710)
Spc3 = X1 = 560 mm
Spc4=(X1+Y1)/4 = 317.5 mm

For Ductility

Left Section
Spc5 = d / 4 = 174 mm
Spc6 = 8 x Small Longitudinal Dia >= 100 = 100 mm

Mid Section
Spc5 = d / 2 = 348 mm

Right Section
Spc5 = d / 4 = 174 mm
Spc6 = 8 x Small Longitudinal Dia >= 100 = 100 mm

**SFR Design**

| | | |
|---|---|---|
| Beam Width | = 600 | mm |
| Beam Depth | = 750 | mm |
| Flange Thickness | = 0 | mm |
| Web Depth | = 750 | mm |
| Torsion | = 0.27 KNM> 0 | |
| ASFR Required | = 450 | Sqmm |

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| | | |
|---|---|---|
| SFR Provided | = 2-T12 On Each Face | |
| ASFR Provided | = 452.4 | Sqmm |
| Provided Spacing | = 197.11 | mm |

Spacing Criteria

| | | |
|---|---|---|
| 1.<= beam Width | = 600 | mm |
| 2. Not Greater Than | = 300 | mm |

DESIGN OF FLOOR SLAB:

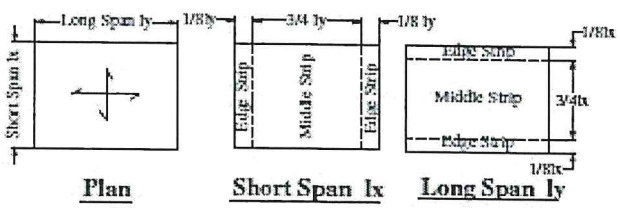
PRASAD CONSULTANTS BANGLORE 560001

| | |
|---|---|
| Client: | Very Important Industries Ltd, Well Kn |
| Project: | XYZ Building |

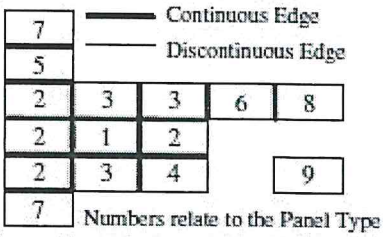
***SPREADSHEET OF*** DESIGN OF TWO-WAY RE
SUBJECTED TO UNIFORMLY DISTRIBUTED LOA
AS PER IS:456-20

Calculates Bending Moments and Reinforcement for different
Concrete grade and type of Steel. Deflection check is made.

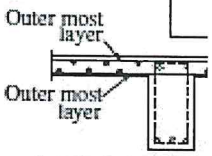
| | | |
|---|---|---|
| Concrete Grade = | M 30 | |
| Yield Strength of steel, fy = | 500 | $N/mm^2$ |
| Clear cover to Reinforcement = | 20 | mm |




Plan Short Span lx Long Span ly




Typical Layout of Two-way Slabs




Arrangement of R

Design of Two-way Restrained Slabs Types 1 to 9

| Slab Mk. | Panel Type | Description | L |
|---|---|---|---|

PRASAD CONSULTANTS BANGLORE 560001

| Project: | X YZ Building | | | | |
|---|---|---|---|---|---|
| Slab Mk. | Working Finish Load ($kN/m^2$) | Total Ult. Load* (kN/m2) | Ratio of Spans ly / lx | Bending M Short Span +ve | |
| S1 | 2 | 13.125 | 1.132 | 0.0535 | 0. |
| 0 | | - | - | - | |
| 0 | | - | - | - | |
| 0 | | - | - | - | |
| 0 | | - | - | - | |
| 0 | | - | - | - | |
| 0 | | - | - | - | |
| 0 | | - | - | - | |
| 0 | | - | - | - | |
| 0 | | - | - | - | |

*Note: Total ultimate load is based on partial safety factor $\gamma_f$ :

## Bending Moments & Effective Depth

| Slab Mk. | Ultimate Bending Moments (kNm) | | | | Ma d |
|---|---|---|---|---|---|
| | Short Span | | Long Span | | |
| | +ve | -ve | +ve | -ve | reqc |
| S1 | 10.145 | 0.000 | 8.1496 | 10.803 | 5 |
| 0 | - | - | - | - | |
| 0 | - | - | - | - | |
| 0 | - | - | - | - | |
| 0 | - | - | - | - | |
| 0 | - | - | - | - | |
| 0 | - | - | - | - | |
| 0 | - | - | - | - | |
| 0 | - | - | - | - | |

PRASAD CONSULTANTS BANGLORE 560001

| Client: | Very Important Industries Ltd, Well Kn |
|---|---|
| Project: | XYZ Building |

**Reinforcement Calculation - Short Span**

| Slab Mk. | Steel at bottom | | | | |
|---|---|---|---|---|---|
| | Eff. 'd' | Reqd.$A_{st}$($mm^2$) | ($mm^2$) | Provide $A_{st}$ | Ef |
| S1 | 126 | 189.85 | 330 | 8 dia at 150 crs | 1 |
| 0 | - | - | | - | |
| 0 | - | - | | - | |
| 0 | - | - | | - | |
| 0 | - | - | | - | |
| 0 | - | - | | - | |
| 0 | - | - | | - | |
| 0 | - | - | | - | |
| 0 | - | - | | - | |
| 0 | - | - | | - | |

**Reinforcement Calculation - Long Span**

| Slab Mk. | Steel at bottom | | | |
|---|---|---|---|---|
| | Eff. 'd' | Reqd.$A_{st}$($mm^2$) | Provide $A_{st}$ | Ef |
| S1 | 118 | 180.00 | 8 dia. at 275 crs | 1 |
| 0 | - | - | - | |
| 0 | - | - | - | |
| 0 | - | - | - | |
| 0 | - | - | - | |
| 0 | - | - | - | |
| 0 | - | - | - | |
| 0 | - | - | - | |
| 0 | - | - | - | |
| 0 | - | - | - | |

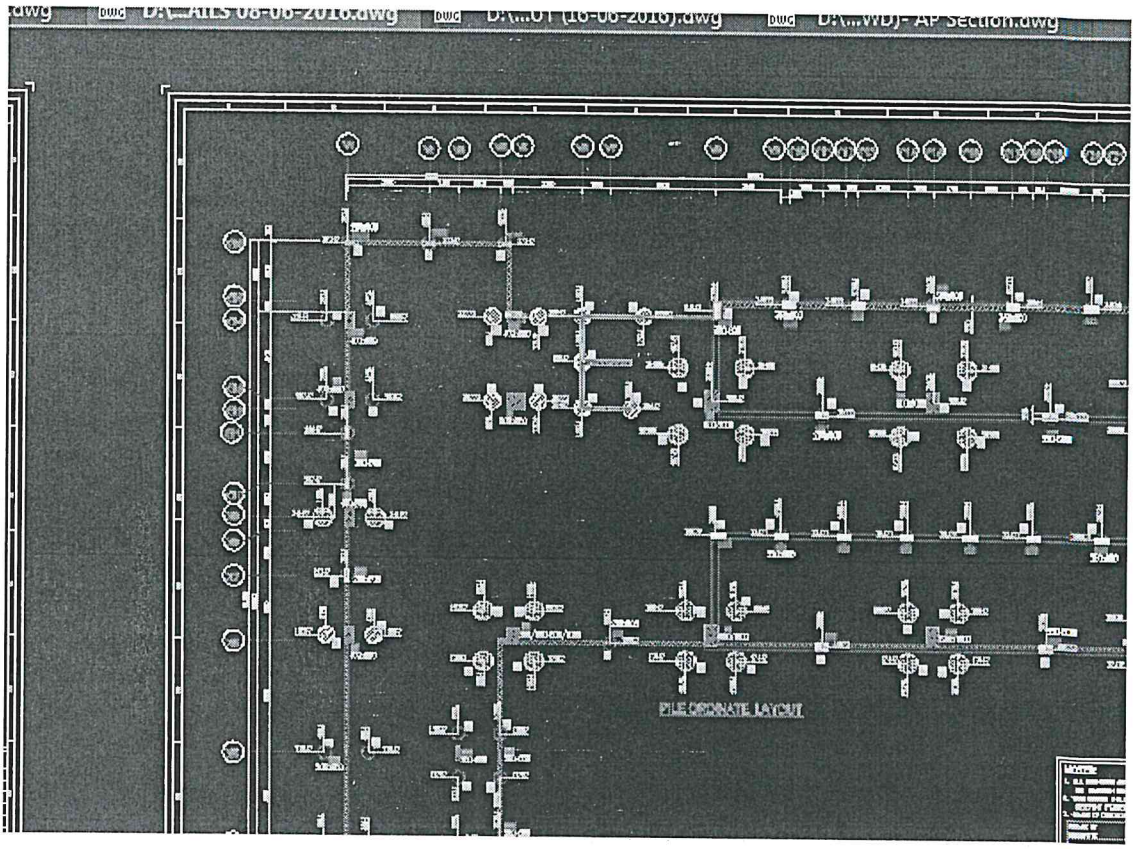
**Check on Deflection** (Ref.: Clauses 23.2.1 and 24.1 of IS:

| Slab Mk. | Reqd. Span / Eff. d or D | Short Span Btm $A_{st}$($mm^2$) | | Percentage of Tension Reinf't | Mo Fa (I |
|---|---|---|---|---|---|
| | | Reqd. | Provided | | |

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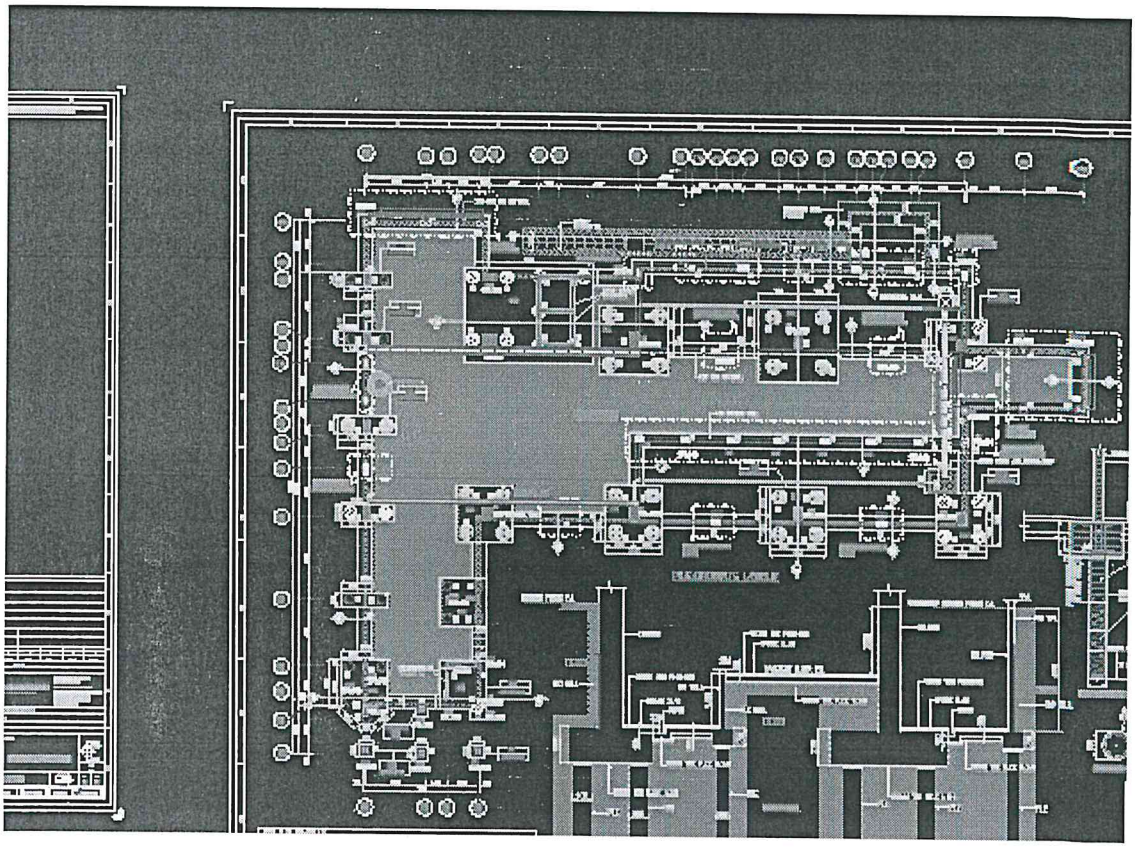
# DRAWINGS:

## PILE LAYOUT AND DETAILS:



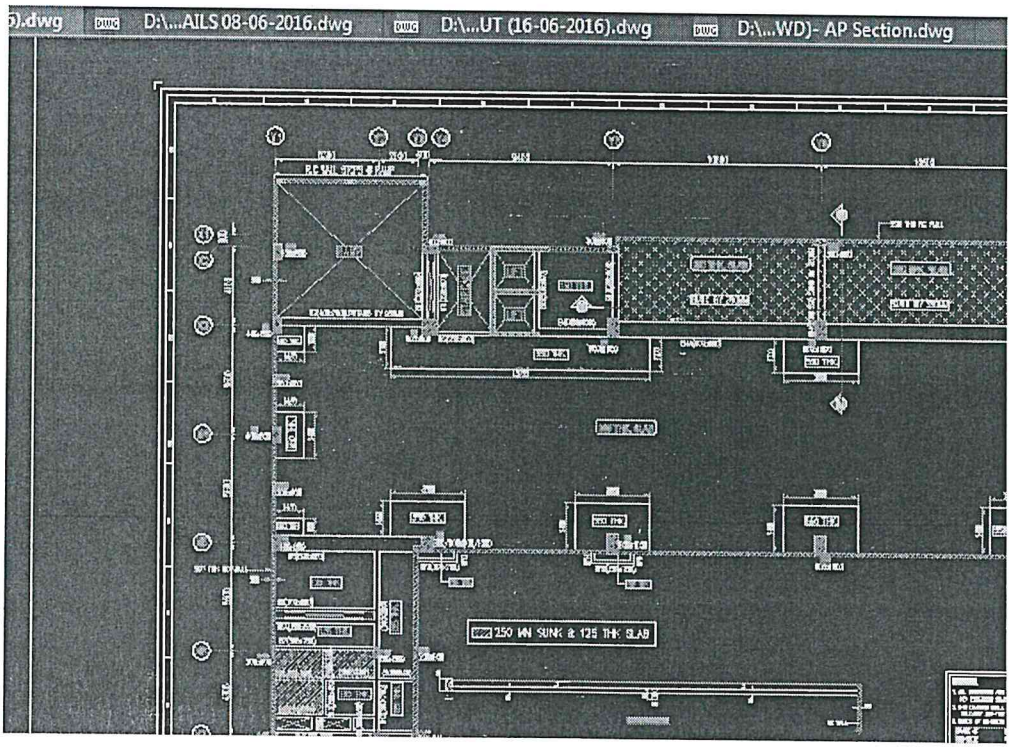

PRASAD CONSULTANTS BANGLORE 560001

## PILE CAP LAYOUT AND DETAILS:

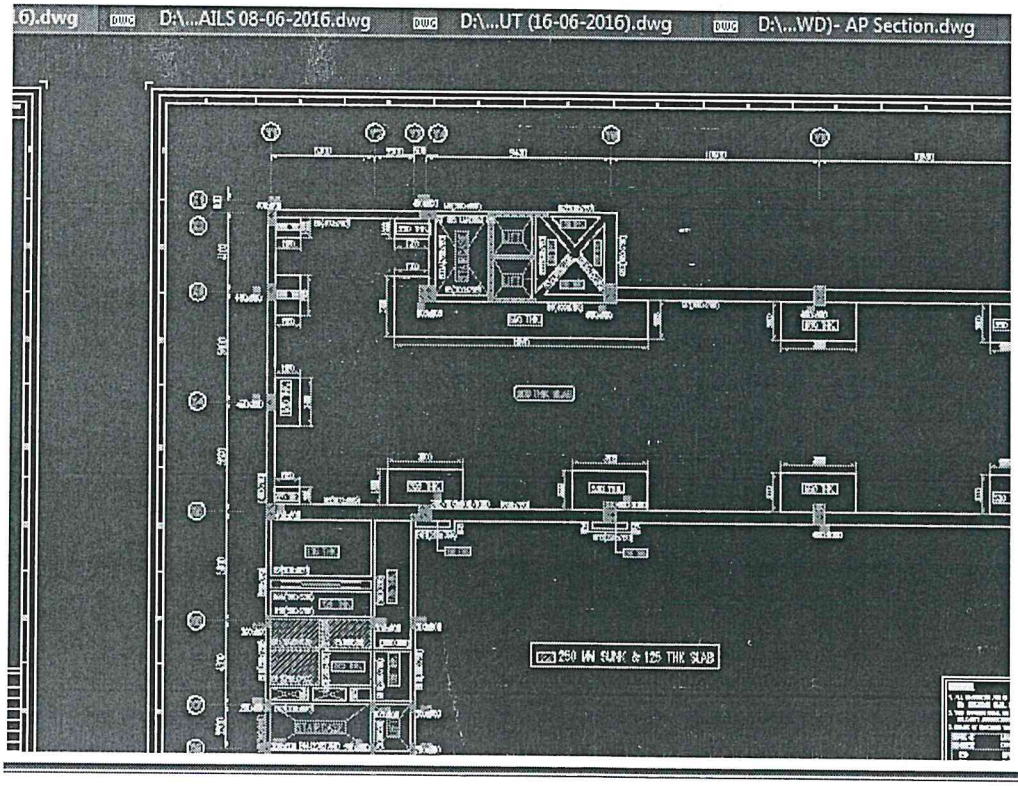


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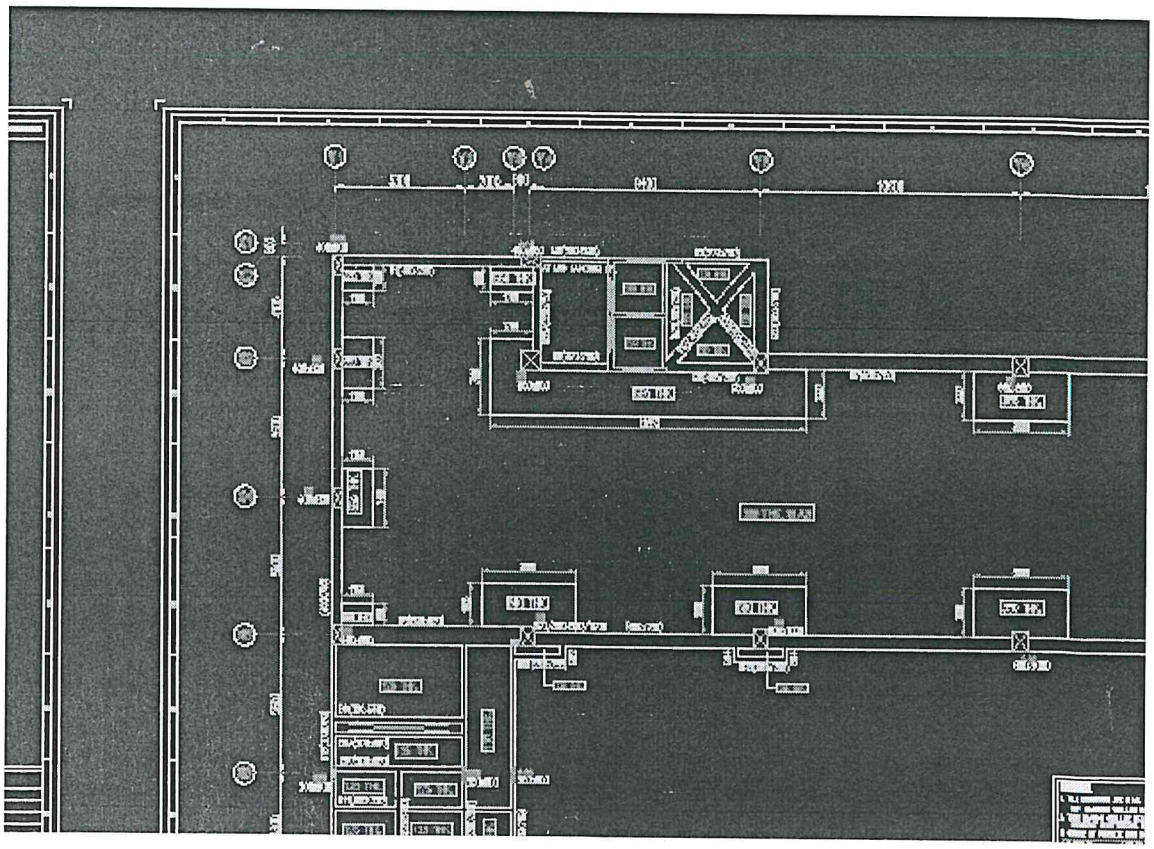
## GROUND FROOR FRAMING LAYOUT:




## FIRST FROOR FRAMING LAYOUT :



## TERRACE FROOR FRAMING LAYOUT:



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# Our services go beyond

## Buying & Selling Services

Property Buying Assistance, Property Selling Support, Market Price Analysis, Owner Outreach and Negotiation.

## Legal & Documentation Services

Certified EC, Patta, legal opinions, property verification, due diligence, litigation solutions, and legal heir certificates.

## Property Development & Approvals

Building plan approvals, construction, layout and sub-division approvals, zone conversion, and occupancy certification.

## NRI & Investment Services

Escrow Services, Rentals, Litigation Solutions, Property Valuation and Property Management

## Compliance & Special Services

Demolition, Vaasthu checks, regularization of unauthorized buildings, and office space solutions.

# Smarter Tools, Stronger Decisions

## Property Valuation & Cost Estimation

Guideline Value, Apartment Composite Value, Stamp Duty & Registration Fees Calculator, Building Value Calculator, Capital Gains Calculator, Area Unit Converter, Length Unit Converter

## Ownership, Compliance & Legal Verification

Encumbrance Certificate (EC) Search, Find Your SRO, Temple Property Check, WAQF Property Check, View Patta/Chitta, View FMB, Patta Analyzer, EC Analyzer

## Zoning & Land Use Analysis

Land Use Zone Finder, CRZ Zone Check, Aquifer Zone Check, CBA Check, EWS Check, Road Width Check, Proposed Road Widening Check, FSI Calculator

## Property Documentation & Workflow Tools

Forms & Templates, Document Generator, Document Translation, Dictionary

## Vastu & Property Management Tools

Home Vastu Shastra, Plot Vastu Shastra, Property Management

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