# Design Report & Stability Certificate

**Site Address**

The Proposed Construction of Stilt Floor Parking + 5 Floors Residential Building (Height - 18.0m) With 25 Dwelling Units at Door No : 2(1), 4(2), Silambu Street, Padmanaba Nagar, Arumbakkam, Chennai 600094.Comprised in T.S.No : 79 / 17 & 79/18 ( Old T.S. No : 79 Part) , Block No : 1, Puliyur Village With in the limit Greater Chennai Corporation.

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Registered Structural Engineer Grade – 1
CMDA : (SE/GR-I/19/02/008)
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**KC-6300**

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# Stability Certificate

It is certified that The Proposed Construction of Stilt Floor Parking + 5 Floors Residential Building (Height - 18.0m) With 25 Dwelling Units at Door No : 2(1), 4(2), Silambu Street, Padmanaba Nagar, Arumbakkam, Chennai 600094.Comprised in T.S.No : 79 / 17 & 79/18 ( Old T.S. No : 79 Part) , Block No : 1, Puliyur Village With in the limit Greater Chennai Corporation is Designed to resist for earthquake, check has been made and found safe and sound

and I hereby certify that

- The Minimum grade of concrete is M25.
- The design analysis using the code of practice for loading standards as per IS-875 part and seismic force as per the IS 1893 & IS456-2000
- The above said building is designed for earthquake forces of Zone III. The relevant BIS codes were used for its design. Hence it is certified that the above said building is safe in its life circle against the forces like Service loads as well as seismic forces as per specifications given in Zone III of BIS 1893
- Minimum size of the column is 300 mm

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**COLUMN DESIGN**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Column load as per load calculation | | = | 200 | Mt | | | |
| Long Column design as per IS456-2000, Page 71 | | | | | | | |
| Factored Load | $P_u$ | = | $C_r(0.4\ f_{ck}.\ A_c + 0.67\ f_y.\ A_{sc})$ | | | | |
| Working load | P | = | $P_u/1.5$ | | | | |
| | $C_r$ | = | 1.25 - [($l_e$/D)/48] | | | | |
| **PROCEDURE:** | | | | | | | |
| | $F_{ck}$ | = | 25 | N/mm² | | | |
| | $F_y$ | = | 415 | N/mm² | | | |
| Length of column | L | = | 3.6 | m | | | |
| | $l_e$ | = | 3.06 | m | 0.85* L | | |
| | $C_r$ | = | 0.97 | | | | |
| Modulus of elasticity of concrete | $E_c$ | = | 25000.00 | N/mm² | | | |
| Ref IS 456-2000 Cl 6.2.3.1 | | | | | | | |
| Flexural strength of concrete | $f_{cr}$ | = | 3.50 | N/mm² | | | |
| Ref IS 456-2000 Cl 6.2.2 | | | | | | | |
| Maximum shear stress in concrete for limit state method of design | | | | | | | |
| Ref IS 456-2000 Table 20 Cl 40.2.3 | $t_{c\,max}$ | = | 3.1 | N/mm² | | | |
| Permissible bearing stress | | = | 0.45*Fck | | | | |
| | | = | 0.45 | x | 25 | | |
| Permissible bearing stress | | = | 11.25 | N/mm² | | | |
| Column size | | = | 230 | 750 | mm | | |
| Minimum Eccentricity,e | | = | L/500 + Lateral dimension/30 | | | | |
| One direction | | = | 14.87 | mm | | | |
| Another Direction | | = | 32.20 | mm | | | |
| Minimum eccentricity | | = | 20 | mm | | | |
| Consider Minimum Eccentricity | | = | 32.20 | mm | | | |
| 0.05*b | | = | 11.50 | | < | 32.20 | |
| Area of column | | = | 172500 | mm² | | | |
| Number of rod | | = | | | | | |
| | | = | 6 | 25 | 2944.88 | mm² | |
| | | = | 6 | 25 | 2944.88 | mm² | |
| Area of Steel($A_{sc}$) | | = | 5889.75 | mm² | | | |
| Area of Concrete($A_c$) | | = | 166610.25 | mm² | | | |
| | $P_u$ | = | 3213971.741 | N | | | |
| | P | = | 2142647.827 | N | | | |
| | Say | = | **214.26** | **Tonne** | | | |
| % of Reinforcement | **0.8** | < | **3.41** | < | **4** | % | |
| | | **SAFE** | | **SAFE** | | | |
| Column Load | 214.26 | > | 200.00 | **Mt** | | | |
| | | **SAFE** | | | | | |

**Lateral Ties:**

As per IS 456-2000: Clause 26.5.3.2.c-Page 49

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Diameter shall not be less than | | = | 25 / 4 | | | | |
| | | = | 6.25 | mm dia | | | |
| Provide | | = | 8 | mm dia | | | |
| **Spacing** | | | | | | | |
| Shall not be more than following | | | | | | | |
| Least dimension of column | | = | 230 | mm | | | |
| 16x Smallest dia of column rod | | = | 400 | mm | | | |
| Not more than | | = | 300 | mm | | | |
| Minimum of above | | = | **230** | mm | | | |
| Provide | 8 | @ | 150 | mm C/c | | | |

**Development length in compression**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Ld | = | Ø *σs / 4*$T_{bd}$ | | | | |
| | Ø | = | Dia of bar | = | 25.00 | mm | |
| (Fy/1.15) | σs | = | Stress in bar | = | 360.87 | N/mm² | (0.87*Fy) |
| Page 43,26.2.1.1 | $T_{bd}$ | = | Bond stress | = | 2.8 | N/mm² | |
| | Ld | = | 25 / 4 | 360.8696 / 2.8 | | | |
| | Ld | = | 805.512 | mm | | | |

**SUMMARY**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Column size | | = | 230 | x | 750 | | |
| Rebar | | = | 6 | 25 | | | |
| | | | 6 | 25 | | | |
| Lateral tie | 8 | @ | **150** | mm C/c | | | |

Bond stress for **Compression** 43,IS 456-2000

| Grade of concrete | Type | M20 | M25 | M30 | M35 | M40 & above |
|---|---|---|---|---|---|---|
| Design Bond Stress,N/mm² | Plain | 1.5 | 1.75 | 1.875 | 2.125 | 2.375 |
| | Deformed | 2.4 | 2.8 | 3 | 3.4 | 3.8 |

## Pile Design

Pile capacity as per soil report

| Dia"mm" | Safe Load in "Mt" |
|---|---|
| 550 | 60 |
| 600 | 70 |

| | | | |
|---|---|---|---|
| Pile depth | | | 18 M |
| Actual Load from the column | | = | 2000 kN |
| Add pile cap weight-5% | | = | 100 kN |
| Total weight on pile | | = | 2100 kN |
| Dia of pile adopted | | = | 600 mm |
| Capacity of pile as per soil report | | = | 70 T |
| Number of pile to be provided | | = | 2100 |
| | | = | 700 |
| No. of pile | | = | 3.00 No |
| Say | | = | 3 Nos |
| **Rebar Calculation** | | = | |
| Provide minimum rebar | | = | 0.6 % |
| Area of rebar | | = | 1696.25 $mm^2$ |
| Provide | 8 | 20 | |
| | 0 | 16 | |
| "$A_{st}$" Provided | 2512.96 | > | 1696.25 $mm^2$ |
| | | **Safe** | |
| %age of steel provided | | | **0.89 %** |

**Lateral Ties:**

As per IS 456-2000; Clause 26.5.3.2.c-Page 49

| | | | |
|---|---|---|---|
| Diameter shall not be less than | | = | 20 |
| | | | 4 |
| | | = | 5 mm dia |
| Provide | | = | 8 mm dia |

**Spacing**

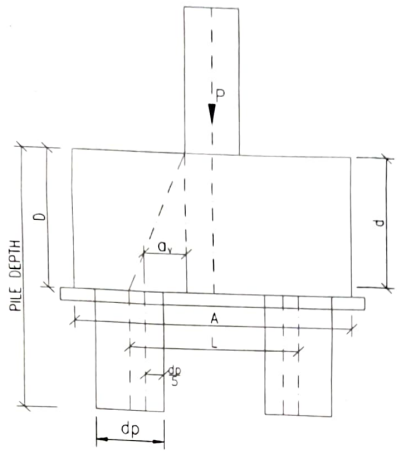
| | | | |
|---|---|---|---|
| Shall not be more than following | | | |
| Least dimension of column | | = | 600 mm |
| 16x Smallest dia of column rod | | = | 320 mm |
| Not more than | | = | 300 mm |
| Minimum of above | | = | 300 mm |
| Provide | 8 | @ | 150 mm C/c |

**Summary**

| | | | |
|---|---|---|---|
| Pile size | | = | 600 mm |
| No. Of pile | | = | 3 No |
| Rebar | 8 | NOS | Y 20 |
| Lateral tie | 8 | @ | **150** mm C/c |

**PILE CAP DESIGN : 3 Pile**

Ref: Limit state design of Reinforced Concrete-P.C.Vargheese
P-483




| | | | | | |
|---|---|---|---|---|---|
| Load on Column | P | = | **200** Mt | | |
| Factored load | | = | 3000 kN | | |
| Column size | a,b | = | 300 | 750 mm | |
| No of pile | | = | 3 No | | |
| Load per pile | | = | 1000 kN | | |
| Pile diameter | $d_p$ | = | 600 mm | | |
| Distance between pile | L | = | 1800 mm | 1800 | |
| Pilecap size | | = | 2700 mm | 2700 | |
| | | = | 2450 mm | 2458.8 | |
| Depth of pile cap | | = | 1200 mm | 1300 | |
| Effective cover | | = | 68 mm | | |
| Effective depth | d | = | 1132 mm | d | |
| | $f_y$ | = | 415 N/mm$^2$ | | |
| | $f_{ck}$ | = | 25 N/mm$^2$ | | |

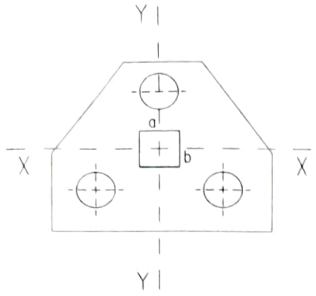
**Check for Compression :**

| | | | | | |
|---|---|---|---|---|---|
| Area of pile cape | = | 5.23 | m$^2$ | | |
| Wt.of pile cape | = | 5.23 | 1.2 | 25 | |
| | = | 156.9 | | | |
| Pile cap Load taken by one pile | = | 52.30 kN | | | |
| Column load taken by one pile | = | 200 | = | 66.67 kN | |
| | = | 3 | | | |
| Load Taken by pile inc . Colum +cap | = | 66.67 | + | 5.23 | |
| | = | 71.90 | | | |
| Pile capacity as per load test/soil report | = | 75 | > | 71.90 Mt | |
| | | | **Safe** | | |
| | $a_v$ | = | 345 | | |
| | $a_v/d$ | = | 0.30 | < | 2 |

Adopt Truss theory

Tensile forces along X-X axis = 541997.9 N

Tensile forces along Y-Y axis = 484025.3 N




T parallel to xx = $\frac{p}{36Ld}\left[4L^2 + b^2 - 3a^2\right]$

T parallel to yy = $\frac{p}{18Ld}\left[2L^2 - b^2\right]$

Area of steel-XX axis = 1501.17 $mm^2$

Area of steel-YY axis = 1340.60 $mm^2$

Area of steel = 1501.17 $mm^2$

Minimum area of steel = 4160.1 $mm^2$ 0.15%

**Area of reinforcement atBottom** = 4160.10 $mm^2$

Provide

| | |
|---|---|
| 12 | 25 |
| 0 | 16 |

Area of steel provided 5889.75 > 4160.1 $mm^2$

Design is **Safe**

**Check for Shear**

**%ge of steel** = 0.21 %

Asper clause 40.5.1 of IS456-2000 page-74

Enhanced shear stress $T_c'$

$T_c'$ = $T_c$ x 2d/ $a_v$

| **% of steel** | **$T_c$** |
|---|---|
| 0.15 | 0.29 |
| 0.25 | 0.36 |

As per clause 40.2 (P73) of IS 456-2000

For 0.21 0.33

$T_c$ = 0.33 $N/mm^2$

$T_c'$ = $\frac{Tc \times 2 \times d}{a_v}$

$T_c'$ = $\frac{0.33 \times 2 \times \mathbf{1132}}{345}$

= 2.19 $N/mm^2$

$T_c'$ 2.19 < 3.05 $N/mm^2$

**Safe**

Shear stress 1.08 < **2.19** $N/mm^2$

**Safe**

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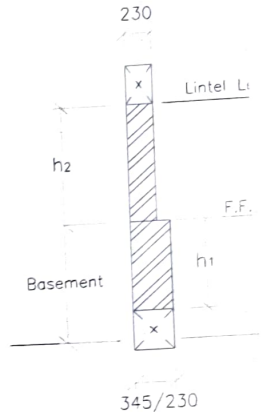
## PLINTH BEAM

| | | | |
|---|---|---|---|
| Span | = | 6.32 | m |
| Wall thickness-Below basement | = | 0.23 | m |
| Wall height | = | 0.75 | m |
| Wall thick-above basement | = | 0.25 | m |
| Wall height | = | 0 | m |
| Beam Size b | = | 230 | mm |
| D | = | 450 | mm |
| d' | = | 46 | mm |
| d | = | 404 | mm |
| $F_y$ | = | 415 | N/mm² |
| $F_{ck}$ | = | 25 | N/mm² |

l/16 = **395** mm
d'/d = 0.114




## LOAD CALCULATIONS:

| | | | |
|---|---|---|---|
| Self wt = b x D x 1 x 25 | = | 2.59 | kN/m |
| Brick masonry weight below basement | = | 3.45 | kN/m |
| Brick masonry weight above basement | = | 0 | |
| Max Udl | w = | 6.04 | kN/m |
| Max B.M at Mid span | = | $(wl^2/20)$ | |

| | | |
|---|---|---|
| 6.04 | 6.32 | 6.32 |
| | 20 | |

BM = 12.06 kN.M

SF = wl/3 ( 0.5 x w x l)

| | | |
|---|---|---|
| 6.04 | x | 6.32 |
| | 3 | |

SF = 12.72 kN

$M_u/bd^2$ =

| | | |
|---|---|---|
| 1.5 | 12.06 | 1000000 |
| 230.00 | 404 | 404 |

= **0.48** N/mm²

Refer SP 16 ,Page 86.Pt = **0.137** % $P_c$ = 0.1

$A_{st}$ =

| | | |
|---|---|---|
| 0.137 | 230 | 404 |
| | 100 | |

Ast = 127 mm² = 93 mm²

Provide

| | |
|---|---|
| 2 | 16 |
| 1 | 16 |
| 0 | 16 |

"$A_{st}$" Provided 603.11 > 126.94 **SAFE**

| | |
|---|---|
| 2 | 16 |
| 1 | 16 |
| 0 | 12 |

603.1104 > 92.92 **SAFE**

Min.Reint = $(0.87 \times b \times d / F_y)$ mm²

| | | |
|---|---|---|
| 0.870 | 230 | 404 |
| | 415 | |

Min.Reint = 194.796 mm²

"$A_{st}$" Provided 603.1 > 194.8 mm² **SAFE**

## CHECK FOR SHEAR STRENGTH

$T_c$ Max = $0.62 * sqrt(F_{ck})$

| | |
|---|---|
| 0.62 | 5 |

= 3.10 N/mm²

As per clause 40.2 (P73) of IS 456-2000

Percentage of steel $P_t$ = **0.65** %

Shear strength = $kT_c$

k = 1

| % of steel | $T_c$ |
|---|---|
| 0.5 | 0.49 |
| 0.75 | 0.57 |

For 0.65 0.54

$kT_c$ = 1.00 X 0.54 < 3.10 N/mm²

$kT_c$ = 0.54 N/mm² **SAFE**

Now $T_v$ = $V_u/b.d$ X 12.72

Nominal Shear stress $V_u$ = 1.5 19.079 kN

$T_v$ = $V_u/b.d$

$T_v$ =

| | |
|---|---|
| 19.08 | 1000 |
| 230.00 | 404 |

0.21 < 3.10 N/mm²

$T_v$ = **SAFE**

0.54 N/mm²

0.21 < $kT_c$

$T_v$ < **SAFE**

Total shear strength $V_u$ = 19078.50 N

Shear contribution by concrete $T_c b.d$ =

| | | |
|---|---|---|
| 0.54 | 230 | 404 |

49963.1328

Shear contribution by stps $V_{us}$ = $V_u$ - $T_c$ b.d

19078.50 - 49963.13

-30884.63 N

-475 mm C/C

Provide Y 8 =

Area or 2 legged stps a = 101 mm²

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Spacing of stirrups = $\frac{0.87 * Fy * a * d}{V_{us}}$

| | | | |
|---|---|---|---|
| 0.87 | 415 | 101 | 404 |
| | -30884.63 | | |

= -475 mm C/C

Provide shear Rebar without considering conc. shear — Y 8 — 769 mm C/C

Area of 2 legged stps — a = 101 mm²

$= \frac{0.87 * Fy * a * d}{V_s}$

| | | | |
|---|---|---|---|
| 0.87 | 415 | 101 | 404 |
| | 19078.50 | | |

= **769 mm C/C**

$V_{us}/d$ = $\frac{-30884.63}{404.00}$ | 10 | 1000

= -0.764 kN/cm

**Minimum Stirrups Reinforcement** — Y 8

$A_{sv}$ = 100.52 mm²

$S_v$ = 0.87*Fy*Asv/0.4*b

$= \frac{0.87 \quad 415 \quad 101}{0.4 \quad 230.00}$

$= \frac{36292.16832}{92}$

= **394 mm C/C**

**Maximum Spacing of Stirrups** = 0.75 *d

= 303 mm

= 300 mm

Least of above 300 mm

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | Y | 8 | | |
| | | | | @ | | |
| Provide | 394 | > | 200 | < | 300 | |
| | | **SAFE** | | **SAFE** | | |
| | 531 | > | 200 | < | 769 | |
| | | **SAFE** | | **SAFE** | | |

**Development length in Tension**

Ld = $\frac{\emptyset * \sigma s}{4 * T_{bd}}$

Ø = Dia of bar = 16 mm

(0.87*Fy) σs = Stress in bar(Fy/1.15) = 360.87 N/mm²

Page 43,26.2.1.1 $T_{bd}$ = Bond stress = 2.24 N/mm²

Ld = $\frac{16 \quad 360.8695652}{4 \quad 2.24}$

Ld = 644.4 mm

Bond stress for **tension** P 43,IS 456-2000

| Grade of concrete | Type | M20 | M25 | M30 | M35 | M40 & above |
|---|---|---|---|---|---|---|
| Design Bond Stress,N/mm² | Plain | 1.2 | 1.4 | 1.5 | 1.7 | 1.9 |
| | Deformed | 1.92 | 2.24 | 2.4 | 2.72 | 3.04 |

**Centre Beam-Continues**

| | | | | | |
|---|---|---|---|---|---|
| Span | = | 6.32 m | | | |
| Lateral span | = | 4.21 m | | | |
| Wall height | = | 2.45 m | | | |
| Wall thickness | = | 0.25 m | | | |
| b | = | 230 mm | | | |
| D | = | 600 mm | l/12.5 | **506** | mm |
| d' | = | 50 mm | d'/d = | 0.091 | |
| d | = | 550 mm | | | |
| $f_y$ | = | 415 N/mm² | | | |
| $f_{ck}$ | = | 25 N/mm² | | | |

**Slab Load:**

| | | | | |
|---|---|---|---|---|
| Self wt | = | 3.125 | kN/m² | slab thk 0.125 m |
| Live Load | = | 2 | kN/m² | |
| Floor Finish | = | 1.5 | kN/m² | |
| Mish. Load | = | 1 | kN/m² | |
| | | 7.625 | kN/m² | |

**Load Calculations:**

| | | | |
|---|---|---|---|
| Brick work/ AAC Block | = | **20** | kN/m³ |
| Self wt = b x D x 1 x 25 | = | 3.45 | kN/m |
| Brick work: | = | 10.4125 | kN/m |
| Udl for slab | = | 21.41 | kN/m |
| Max Udl | w = | 35.27 | kN/m |

$M_u$ Limit = $0.138\ f_{ck}\ bd^2$

| 0.138 | 25 | 230 | 302500 |
|---|---|---|---|

= 240033750.00 Nmm

240.03 > 192.11

$M_u$ limit > $M_u$

**Singly Reinforced**

"d" - reqd = 492.05 < 550 mm

**Safe**

Max B.M at Mid span = $(wl^2/13)$

| 35.27 | 6.32 | 6.32 |
|---|---|---|
| | 13 | |

BM = 108.37 kN.M

$M_u$ Midspan = **162.56 kN.M**

Max B.M at Support = $(wl^2/11)$

| 35.27 | 6.32 | 6.32 |
|---|---|---|
| | 11 | |

BM = 128.08 kN.M

$M_u$ Support = **192.11 kN.M**

SF = wl/2 ( 0.5 x w x l)

| 35.27 | x | 6.32 |
|---|---|---|
| | 2 | |

SF **111.46 kN**

$M_u/bd^2$ @Mid span =

| 1.5 | 108.37 | 1000000 |
|---|---|---|
| 230.00 | 550 | 550 |

= **2.34** N/mm²

$M_u/bd^2$ @Support =

| 1.5 | 128.08 | 1000000 |
|---|---|---|
| 230.00 | 550 | 550 |

= **2.76 N/mm²**

Rebar @ Mid span

| | $P_t$ | $P_c$ | |
|---|---|---|---|
| Refer SP 16 ,Page 86,Pt = | 0.738 | 0.37 | **0.738** % |

$A_{st}$ =

| 0.738 | 230 | 550 |
|---|---|---|
| | 100 | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Ast | = | 933 | $mm^2$ | | | = | 467 | $mm^2$ |
| Provide | | 3 | 20 | | | | 3 | 20 | |
| | | 2 | 16 | | | | 0 | 16 | |
| | | 0 | 16 | | | | 0 | 16 | |
| "$A_{st}$" Provided | | 1344.43 | > | 933.34 | $mm^2$ | | 942.36 | > | 466.67 |
| | | **1.06** | **Safe** | | | | **0.74** | **Safe** | |

Rebar @ Support

| | | $P_t$ | $P_c$ | |
|---|---|---|---|---|
| Refer SP 16 ,Page 86,Pt | = | 0.899 | 0.450 | 0.899 % |

| | | | | |
|---|---|---|---|---|
| $A_{st}$ | = | 0.899 | 230 | 550 |
| | | | 100 | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Ast | = | 1138 | $mm^2$ | | = | 569 | $mm^2$ |
| Provide | | 3 | 20 | | | 3 | 16 | |
| | | 2 | 16 | | | 0 | 16 | |
| | | 0 | 16 | | | 0 | 16 | |
| "$A_{st}$" Provided | | 1344.43 | > | 1137.83 | $mm^2$ | 603.1104 | > | 568.91 |
| | | **1.06** | **Safe** | | | **0.48** | **Safe** | |

**Min.Reinf** = 0.87 x b x d / $F_y$ $mm^2$

| | | | |
|---|---|---|---|
| = | 0.870 | 230 | 550 |
| | | 415 | |

Min.Reinf = 265.193 $mm^2$

"$A_{st}$" Provided 1344.4336 > 265.193 $mm^2$

**Safe**

**Min. % of steel required**

As per Cl.26.5.1.1 IS456:2000 = 0.205 %

As per Cl.6.2.1 IS13920:1993 = 0.290 % (0.24 √ fck ) /fy)

$p_{t\,min}$ = **0.290** % < 1.06 %

**Safe**

**Max. % of steel to be used** =

As per Cl.26.5.1.1 IS456:2000 = 4.000 %

As per Cl.6.2.1 IS13920:1993 = 2.500 %

$p_{t\,max}$ = **2.500** % > 1.06 %

**Safe**

**CHECK FOR SHEAR STRENGTH**

As per clause 40.2 (P73) Tc Max = 0.62 *sqrt(Fck)

of IS 456-2000 = 0.62 | 5

= 3.10 $N/mm^2$

Percentage of steel $P_t$ = **1.06** %

**Permissible shear stress in concrete ($kt_c$) for solid slabs in limit state design method**

Ref IS 456:2000 Cl 40.2.1.1, Table 19

| $f_{ck}$ $N/mm^2$ | $p_t$ % | D of slab | k | $k\,t_c$ $N/mm^2$ |
|---|---|---|---|---|
| 25 | 1.06 | 600 | 1.00 | 0.66 |

Now $kT_c$ = 0.66 $N/mm^2$ < 3.10 $N/mm^2$

Nominal Shear stress $T_v$ = $V_u/b.d$ **Safe**

$V_u$ = 1.5 X 111.46

167.188

$T_v$ = $V_u/b.d$

= 167.19 | 1000

230.00 | 550

= 1.32 < 3.10 $N/mm^2$

**Safe**

1.32 > 0.66 $N/mm^2$

$T_v$ > $kT_c$

Provide shear Bar

Total shear strength $V_u$ =

Shear contribution by concrete $T_c b.d$ = 167188.33 N

| | | |
|---|---|---|
| 0.66 | 230 | 550 |

Shear contribution by stps $V_{us}$ = 83490

$V_u$ - $T_c$ b.d

167188.33 - 83490

Minimum shear resistance 0.4bd = 83698.33 N

= 50600.00 N

Provide = 83698.33 N

Y 10 373 mm C/C

Area or 2 legged stps a = 157 $mm^2$

Spacing of stirrups = $\frac{0.87 * Fy * a * d}{V_{us}}$

| | | | |
|---|---|---|---|
| 0.87 | 415 | 157 | 550 |
| | 83698.33 | | |

= **373** mm C/C

Provide shear Rebar without considering conc. shear

Y 10 **187** mm C/C

a = 157 $mm^2$

= $\frac{0.87 * Fy * a * d}{V_u}$

| | | | |
|---|---|---|---|
| 0.87 | 415 | 157 | 550 |
| | 167188.33 | | |

= **187 mm C/C**

**Minimum Stirrups Reinforcement**

Y 10

$A_{sv}$ = 157.06 $mm^2$

$S_v$ = 0.87*Fy*Asv/0.4*b

| | | |
|---|---|---|
| 0.87 | 415 | 157 |
| 0.4 | 230.00 | |

$\frac{56706.513}{92}$

= **616 mm C/C**

**Maximum Spacing of Stirrups** = 0.75 *d

= 412.5 mm

= 300 mm

Least of above 300 mm

Y 10 @ 150

Provide 616 > **Safe** < 300 **Safe**

**SLAB DESIGN**

**Location:** **ONE WAY SLAB**

| | | | | | |
|---|---|---|---|---|---|
| $L_x$ | = | 3.28 | m | | |
| $L_y$ | = | 6.73 | m | | |
| $f_{ck}$ | = | 25 | N/mm² | | |
| $f_y$ | = | 415 | N/mm² | | |
| $L_y/L_x$ | = | 2.05 | > | 2 | |

**One Way Slab**

| | | | | |
|---|---|---|---|---|
| **Span** | = | 3.28 | m | |
| Slab thickness | = | 125 | mm | 102.50 Span/32 |
| Cover | = | 20 | mm | |
| Effective depth | = | 105 | mm | |
| Concrete wt | = | 25 | kN/m³ | |
| Live Load on Slab | = | 2 | kN/m² | |
| Floor finish | = | 1.5 | kN/m² | |

**Design Load:**

| | | | | |
|---|---|---|---|---|
| slab weight | = | 3.13 | kN/m² | |
| Live + Floor finish Load | = | 3.5 | kN/m² | |
| Total Load | | 6.63 | kN/m² | |
| Max. BM | = | 7.13 | kNM | |
| $M_u$ | = | 10691160 | Nmm | |
| $M_u$ limit | = | 38036250 | Nmm | $(0.138 f_{ck}\, bd^2)$ |

$M_u$ < $M_u$ limit

**Singly reinforced**

"d" - reqd under compression = 55.67 < 105 mm

**Hence OK**

$M_u/b.d^2$ = **0.97** N/mm²

SP16, Table 2,Page 48,

$$Pt = 50\left(1 - \sqrt{1 - \frac{4.6\,\frac{Mu}{bd^2}}{\frac{fy}{fck}}}\right)$$

| | | | |
|---|---|---|---|
| $P_t$ | = | **0.282** | % |
| Area of steel | = | 296.01 | mm² |
| Minimum area of steel-0.12% | = | 126 | mm² |
| Hence area of steel | = | 296.01 | mm² |

Adopt

Y 10 @ 125 **mm C/C**

628.24 > 296.01 mm²

**Safe**

**Distribution Steel**

Minimum area of steel-0.12% = 126 mm²

Adopt

Y 10 @ 150 **mm C/C**

523.53 > 126 mm²

**Safe**

**Check for Shear strength**

As per clause 40.2 (P72)
of IS 456-2000

Percentage of steel $P_t$ = **0.598**

Shear strength = $kT_c$

**Permissible shear stress in concrete ($kt_c$) for solid slabs in limit state design method**

Ref IS 456:2000 Cl 40.2.1.1, Table 19

| $f_{ck}$ N/mm² | $p_t$ % | D of slab | k | $k\,t_c$ N/mm² |
|---|---|---|---|---|
| 25 | 0.60 | 125 | 1.30 | 0.69 |

Nominal Shear stress $T_v = V_u/b.d$

$V_u = 16.30$ kN

$T_v = 0.16$ N/mm²

$0.16 < 0.69$ N/mm²

$T_v < kT_c$

**SAFE**

**Check for Defflection**

Live Load $2 < 3.01$ kN/m²

**Defflection calculation is Not Necessary**

$A_{st}$ required = 296.01 mm²

$A_{st}$ Provided = 628.24 mm²

Steel stress for service Load $F_s = 0.58 \times F_y \times \frac{A_{st}\ \text{required}}{A_{st}\ \text{Provided}}$

As per Fig-4,IS 456-2000,Page38

| | | |
|---|---|---|
| 0.58 | 415 | 296.01 |
| | 628.24 | |

$F_s$ = **113.41 N/mm²**

Percentage of steel provided = **0.60 %**

Modification factor-Fig-4

Asper IS 456-2000-Page 38

| $f_y$ N/mm² | $f_s$ N/mm² | $p_{t\,req.}$ % | $p_{t\,prov.}$ % | $MF_t$ IS 456 Fig 4 |
|---|---|---|---|---|
| **415** | 113.41 | **0.282** | **0.60** | 2.00 |

Effective depth ratio

For,Simply supported = 20

Continues = 26

Cantilever = 7

(Lx/d) Max = 26 x 2.000 = 52.00

(Lx/d)Provided = $\frac{3280}{105}$ = 31.24

(Lx/d) Max $52 >$ 31.24 (Lx/d)Provided

**Safe**

**Maximum diameter of bars for slabs**

Ref IS 456-2000 Cl 26.5.2.2

| D of slab mm | dia of bar mm | Result Cl 26.5.2.2 |
|---|---|---|
| **125** | **10** | Ok |

| overall depth of slab in mm | 300 or more | 275 | 250 | 225 | 200 | 175 | 150or less |
|---|---|---|---|---|---|---|---|
| k | 1 | 1.05 | 1.1 | 1.15 | 1.2 | 1.25 | 1.3 |

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**STAIRECASE -DOG LEGGED MODEL**

**Location:**

| | | | | | |
|---|---|---|---|---|---|
| $L_x$ | = | 5.41 | m | | |
| $F_{ck}$ | = | 25 | $N/mm^2$ | | |
| $F_y$ | = | 415 | $N/mm^2$ | | |
| Step weight | | 20 | $kN/m^3$ | | |
| Landing width | = | 1.2 | | | |
| Slope length | = | 3.01 | | | |
| Step tread | = | 0.25 | m | | |
| Step riser | = | 0.165 | m | | |
| Slope length for one step | = | 0.300 | m | | |
| Number of tread | = | 3.01 | | | |
| | = | 0.25 | | | |
| | = | 12.04 | No | | |
| Say | = | 11 | No | | |
| Aditional slope length per flight | = | 11 | x | 0.050 | |
| | = | 0.54 | | | |
| Effective length | = | 5.95 | m | | |
| Concrete wt | = | 25 | $kN/m^3$ | | |
| Waist slab thickness | = | 0.140 | m | (Assumed) | |
| **Loads:** | | | | | |
| Dead load of Waist slab | = | 3.5 | $kN/m^2$ | | |
| Ceiling finish | = | 0.25 | $kN/m^2$ | | |
| Sub total | = | 3.75 | $kN/m^2$ | | |
| Dead Load on plan area | = | 3.75 | x | 0.300 | |
| | | | | 0.25 | |
| | = | 4.49 | $kN/m^2$ | | |
| Brick load | = | 0.165 | x | 20 | |
| | | | | 2 | |
| | | 1.65 | $kN/m^2$ | | |
| Live load | = | 3 | $kN/m^2$ | | |
| Floor finish | = | 1.5 | $kN/m^2$ | | |
| Total load on staire | = | 10.64 | $kN/m^2$ | | |
| Maximum BM($w \times l^2/12$) | = | 10.64 | x | 5.95 $^2$ | |
| | = | | | 12 | |
| | = | 31.45 | kN.M | | |
| $M_u$ | = | 1.5 x | 31451734 | | |
| | | 47177600.97 | Nmm | | |

| | | |
|---|---|---|
| 47177600.97 | | |
| 0.138 | 25 | 1000 |

13674.67

| | | | |
|---|---|---|---|
| sqrt | = | 116.94 | mm |
| Cover | = | 20.00 | mm |
| Total | = | 136.94 | mm |
| Provide | = | 140.00 | mm |
| d | | 117.00 | |

| | | |
|---|---|---|
| 47177600.97 | | |
| 1000.00 | 117.00 | 117.00 |

3.45

As per SP16, Table 2,Page 48,

| | | | | | | |
|---|---|---|---|---|---|---|
| $P_t$ | = | **1.190** | % | | | |
| Area of steel | = | 1.190158197 | x | 1000 | x | 117.00 |

100

= 1392.49 $mm^2$

Adopt

**Y** 16 @ 140 **mm C/C**

1436 > 1392 $mm^2$

**Safe**

**Distributer:**

Provide minimum steel = 0.12%

| | | |
|---|---|---|
| **0.12** | 1000 | 117.00 |
| | 100 | |

= **140.4** $mm^2$

Adopt

**Y** 10 @ 150 **mm C/C**

524 > 140 $mm^2$

**Safe**

**Check for Shear strength**

As per clause 40.2 (P72)
of IS 456-2000

Percentage of steel $P_t$ = $\frac{1435.98 \times 100}{1000 \times 117.00}$

$P_t$ = **1.23 %**

Shear strength = $kT_c$

k = 1.2

IS456-2000,Page73,table19

| **% of steel** | **$T_c$** |
|---|---|
| 1 | 0.64 |
| 1.25 | 0.7 |

For **1.23** 0.69 $N/mm^2$

$kT_c$ = 1.200 x 0.695

0.833

Nominal Shear stress $T_v$ = $V_u/b.d$

$V_u$

| | | |
|---|---|---|
| 1.5 | 5.95 | 10.64 |
| | 2 | |

$V_u$ = 47.5345 kN

$T_v$ $\frac{47.5345 \times 1000}{1000 \times 117.00}$

$T_v$ = 0.4063 < 0.8335

$T_v$ < $kT_c$

SAFE

SUMMARY

Waist slab thick = **140.00 mm**

Main Rebar = **Y 16** @ 140 **mm C/C**

Distributer = Y 10 @ 150 **mm C/C**

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## SUNSHADE DESIGN

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | Grade of concrete | | $F_{ck}$ | = | **25** | $N/mm^2$ | |
| 2 | grade of steel | | Fy | = | **415** | $N/mm^2$ | |
| 3 | Width of sunshade | | | = | **0.6** | m | |
| 4 | Sunshade thickness - | $t_{max}$ | | = | 0.075 | m | **75** mm |
| | | $t_{min}$ | | = | 0.1 | m | **100** mm |
| | | average | | = | 0.0875 | | 87.5 |
| | | cover | | = | 0.014 | | **15** |
| | | effective depth d | | = | 0.061 | m | 61 mm |
| 5 | Self weight of sunshade | | | = | 2.19 | $kN/m^2$ | |
| | Finishes | | | = | 1 | $kN/m^2$ | |
| | Live load | | | = | 0.75 | $kN/m^2$ | |
| | | | Total | | 3.94 | $kN/m^2$ | |
| 6 | Maximum BM | $W L^2/2$ | | = | 0.71 | kN.M | |
| | | "d" req | | = | 16.02 | < | 61 mm |
| | | | | | **SAFE** | | |
| 7 | $M_u/ bd^2$ | | | = | **0.29** | $N/mm^2$ | |
| | | $P_t$ | | = | **0.085** | | |
| | Area of steel | | | = | 51.85 | $mm^2$ | |
| | Adopt | | | | | | |
| | | **Y 10** | | | **140** | **mm C/C** | |
| | | 560.93 | | > | 51.85 | $mm^2$ | |
| | | | | **Safe** | | | |

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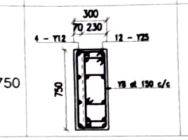
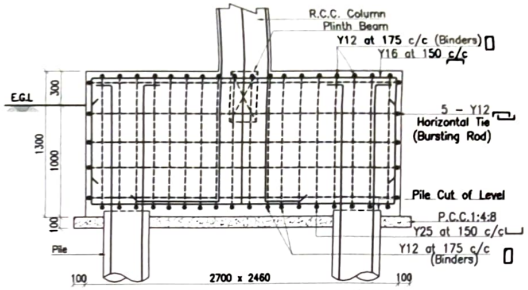
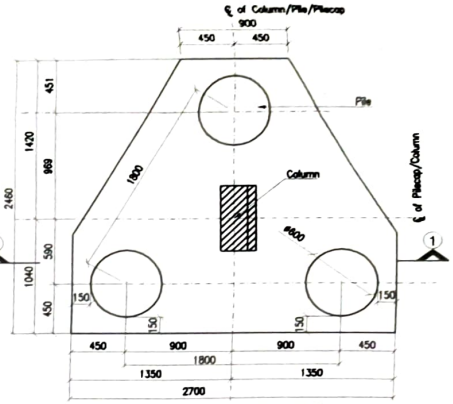
| Marked As | Column Schedule | Tie Arrangement |
|---|---|---|
| C1<br>300 x 750 |  |  |

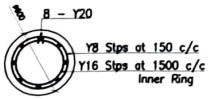




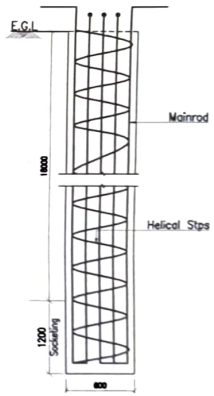

C.S. of Pile Cap PC1
Size 2700 x 2460 x1300
Section "1 - 1"



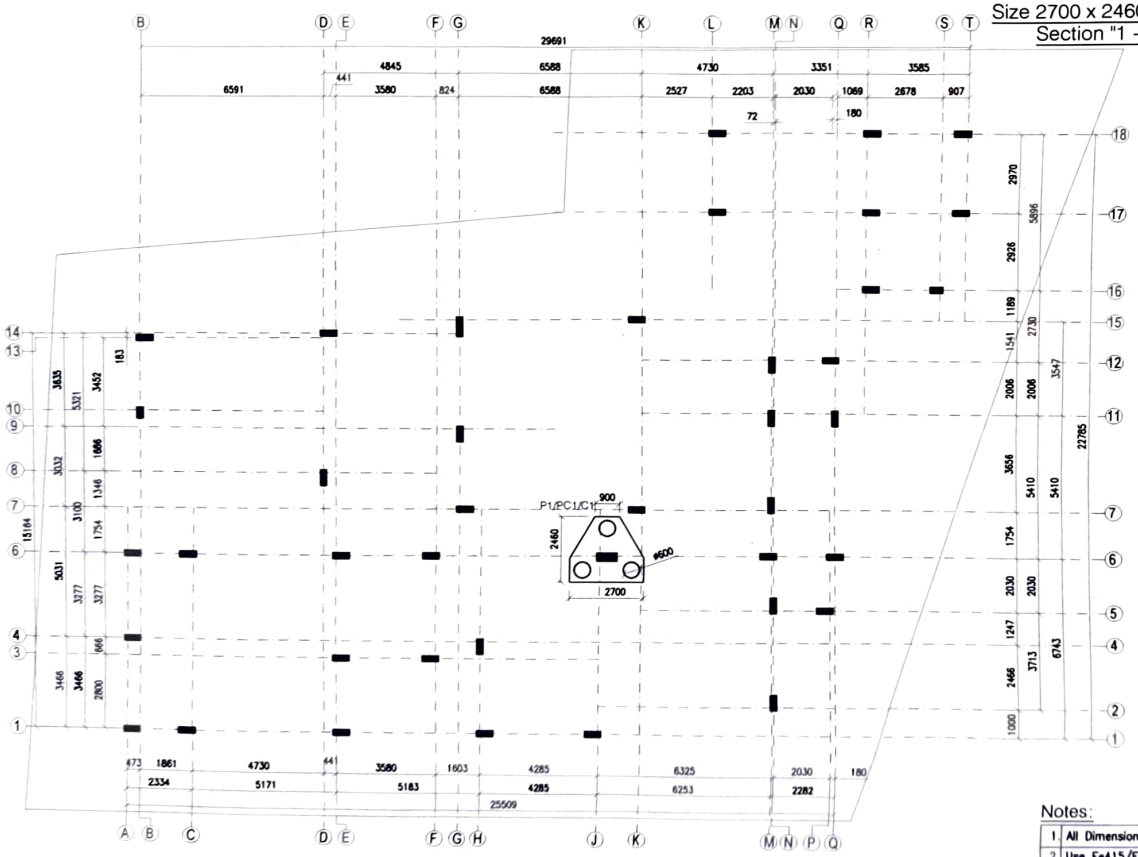

Plan of Pile Cap PC1
Size 2700 x 2460




C.S. of Pile P1
Size 600 Ø




L.S. of Pile P1
Size 600 Ø




Pile , Pilecap & Column Layout
(For Stilt +5 Floors)

Notes:

| | |
|---|---|
| 1. | All Dimensions Are In MM. |
| 2. | Use Fe415/Fe500 Grade Steel. |
| 3. | Use Mix M30 For Pile. |
| 4. | Clear Cover To The Reinforcement For Footing:50mm Column:40mm,Beam:30mm,Slab:20mm,Rcc Wall:20mm. |

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Site Address:-

The Proposed Construction of Stilt Floor Parking + 5 Floors Residential Building (Height - 18.0m) With 25 Dwelling Units at Door No : 2(1),4(2) Silambu Street, Padmanaba Nagar, Arumbakkam, Chennai 600094.Comprised in T.S.No : 79 / 17&79/18 ( Old T.S. No : 79 Part) , Block No : 1, Puliyur Village With in the limit Greater Chennai Corporation.

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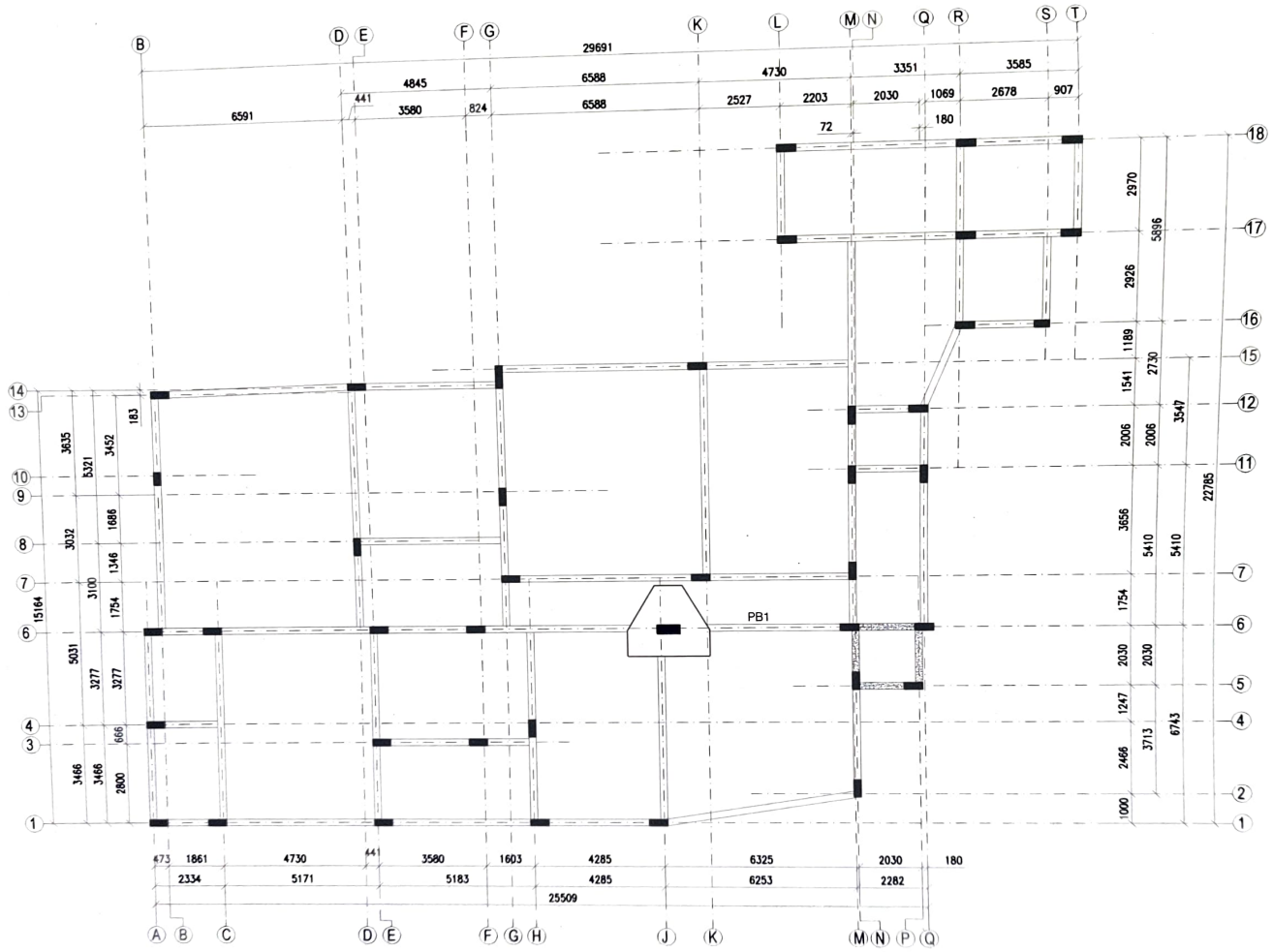
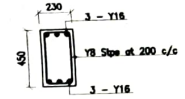



Plinth Beam Layout




C.S. of Plinth Beam PB1
Size 230 x 450

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Notes:

1. All Dimensions Are In MM.
2. Use Fe415/Fe500 Grade Steel.
3. Use Mix M30 For Pile.
4. Clear Cover To The Reinforcement For Footing:50mm Column:40mm,Beam:30mm,Slab:20mm,Rcc Wall:20mm.

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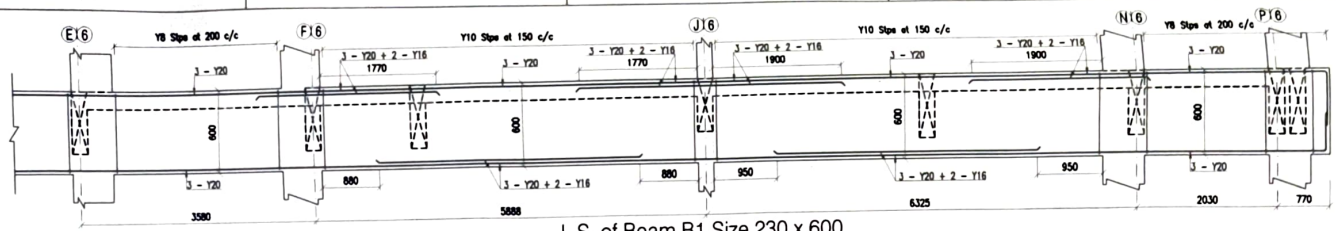
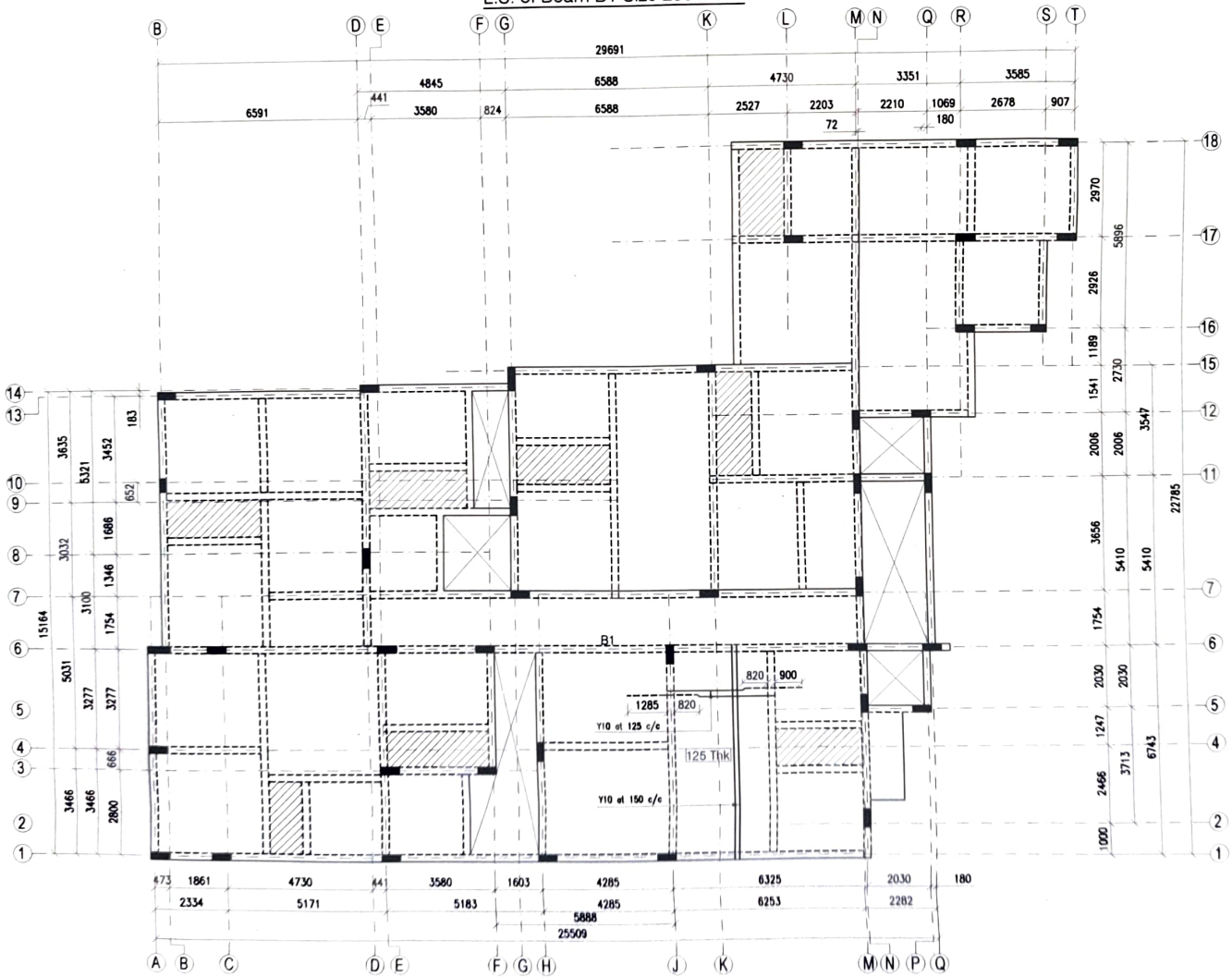



L.S. of Beam B1 Size 230 x 600




Roof Beam & Slab Layout

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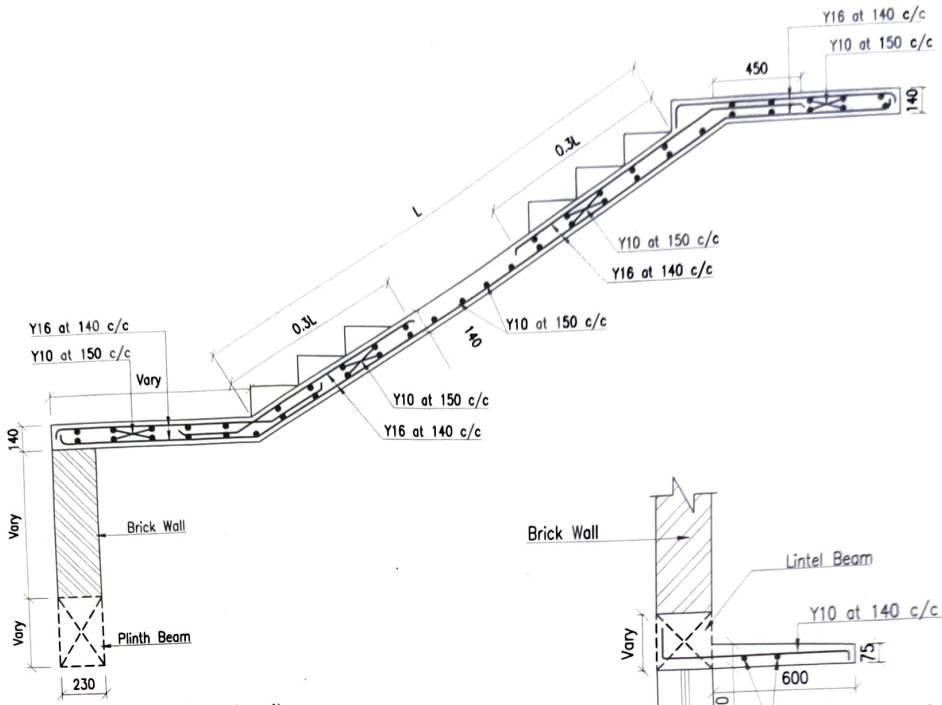


Detail of Staircase (Typical)




Sunshade Detail (Typ)

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Notes:

| | |
|---|---|
| 1. | All Dimensions Are In MM. |
| 2. | Use Fe415/Fe500 Grade Steel. |
| 3. | Use Mix M25 For all Works |
| 4. | Clear Cover To The Reinforcement For Footing:50mm Column:40mm,Beam:30mm,Slab:20mm,Rcc Wall:20mm. |

Site Address:-

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