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Official Property Record



## STRUCTURAL STABILITY CERTIFICATE

Date : 28.06.2024

Site Location at Plot no 3, 4, 5, 6, 7, 8, 9, 10, 11 & 12, S.no 60/1A1A & 64/3A1, Moondramkattalai village, Kundrathur taluk, Kancheepuram district, Kundrathur Municipality Limit

It is Certificate that the proposed Residential Building “**MP Greenbay**” Stilt + 3 Floors - **8 blocks** Owned by **M/s. MP Developers** is designed as per the Indian code of practice for Concrete Construction IS 456:2000, where the grade of concrete used for all Structural elements is M20. Loading standards followed for design are IS875 part-I (DEAD LOAD), IS-875 part-II (LIVE LOAD).

Thus, analysis check has been made and we found it is structurally stable and safe for construction.

  
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## CERTIFICATE

This is Certified that the construction of a Residential Buildings  
"MP Greenbay" Stilt + 3 Floors - **8 blocks** at Plot no 3, 4, 5, 6, 7, 8, 9, 10, 11 & 12,  
S.no 60/1A1A & 64/3A1, Moondramkattalai village, Kundrathur taluk,  
Kancheepuram district, Kundrathur Municipality Limit is designed to resist Dead load  
and Live load, check has been made and found safe and

I hereby certify that,

1. The least dimension of the column is 230mm
2. The min grade of concrete is M20
3. The design analysis using the code of practice for  
loading Standards as per IS-875 part I & II and IS 456.

  
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## 1. DESIGN ASSUMPTION

### a) STRUCTURAL SYSTEM

The structural system for the "PROPOSED RESIDENTIAL BUILDING AT Plot No. 3, 4, 5, 6, 7, 8, 9, 10, 11 & 12, S.No 60/1A1A & 64/3a1, Moondramkattalai village, Kundrathur Municipality Limit.", consists of Stilt + 3 upper floors and OHT. The total height of the building is about 12 m from Stilt floor level. The structure is supported on shallow foundation below basement level as per the soil test report recommendation.

## 2. DESIGN LOADS

### a) Dead Load:

Dead Load considered on slab: Self Weight + 1.5 kN/m<sup>2</sup> for Floor Finish.

|                     |                                        |
|---------------------|----------------------------------------|
| Wall load           | = 6 kN/m (230mm AAC BLOCK thick)       |
| Wall load           | = 3kN/m (115mm AAC BLOCK thick)        |
| Wall load (Parapet) | = 4kN/m (115mm BRICK WALL thick)       |
| Staircase load      | = 15 kN/m (RCC staircase)              |
| Sunken load         | = 4kN/m <sup>2</sup>                   |
| Water Tank/LIFT     | = 15kN/m <sup>2</sup> (1500 mm height) |
| Floor finish        | = 2kN/m <sup>2</sup> (Terrace)         |

### b) Roof Live Load:

The super imposed load or otherwise live load is assessed based on the occupancy classifications as per IS = 0.75 kN/m<sup>2</sup> on Solar panel roof.

|                              |                                           |
|------------------------------|-------------------------------------------|
| Live Load considered on slab | = 2 kN/m <sup>2</sup>                     |
| Live Load considered on slab | = 3 kN/m <sup>2</sup> (Lobby & Staircase) |
| Live Load considered on slab | = 1.5 kN/m <sup>2</sup> (Terrace)         |

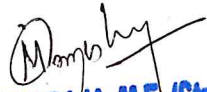
## 3. LOAD COMBINATIONS

### Strength combinations:

➤ 1.5DL + 1.5 LL

### Serviceability combinations:

➤ DL + LL

  
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4. **DESIGN METHODOLOGY**

All structures have been designed according to the Limit State Method as specified in IS: 456-2000. Appropriate loads and its combinations, as per relevant clauses in IS 456:2000 code, for the most unfavorable effects are chosen for design.

5. **MATERIALS**

The self-weight of the various elements is computed based on the built weight of materials as given below: -

| Materials           | Unit weight in kN/m <sup>3</sup> |
|---------------------|----------------------------------|
| Steel               | 78.5                             |
| Plain concrete      | 24                               |
| Reinforced concrete | 25                               |
| Soil                | 18                               |
| Red brick           | 20                               |
| AAC BLOCK           | 8                                |

6. **CONCRETE**

All the concrete items for the construction have the following characteristics

Grade of Concrete = M20

Aggregate = 20mm and down size, mechanically crushed Aggregate.

7. **STEEL**

Steel reinforcement shall be of Grade Fe500 & Fe550 conforming to IS: 1786-2008.

8. **COVER TO REINFORCEMENT**

The clear cover to main reinforcement shall be as follows.

|            |                             |
|------------|-----------------------------|
| Foundation | = Bottom: 50mm, Sides: 50mm |
| Slab       | = 20mm                      |
| Columns    | = 40mm                      |
| Beams      | = 25mm                      |

9. **FOUNDATION SYSTEM**

Foundation systems are based on recommendations given as per soil investigation report by BOOSHNAM AASSOCIATES PVT. LTD.

10. **STRUCTURAL ANALYSIS**

The Building structures are analyzed using STAAD for various load combination as per Indian Codes.

  
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## COLUMN DESIGN

### General Data

|                            |   |                                   |        |
|----------------------------|---|-----------------------------------|--------|
| Column No.                 | : | C7 (GRID7/B)                      |        |
| Level                      | : | 5 m To 6.5 m(PLINTH TO FF LVL)    |        |
| Frame Type                 | = | Non-Ductile                       |        |
| Response Reduction Factor  | = | 3                                 |        |
| Design Code                | = | IS 456 + IS 13920 - 2016          |        |
| Grade Of Concrete          | = | M20                               | N/sqmm |
| Grade Of Steel             | = | Fe500                             | N/sqmm |
| Column B                   | = | 230                               | mm     |
| Column D                   | = | 450                               | mm     |
| Clear Cover                | = | 40                                | mm     |
| Clear Floor Height @ B     | = | 3620                              | mm     |
| Clear Floor Height @ D     | = | 3470                              | mm     |
| No Of Floors               | = | 1                                 |        |
| No Of Columns In Group     | = | 1                                 |        |
| Column Type                | : | Braced                            |        |
| Minimum eccentricity check | : | Simultaneously (Both Axis)        |        |
| Code defined D/B ratio     | : | 4                                 |        |
| D/B Ratio                  | : | 1.96 <= 4 Hence, Design as Column |        |

### Flexural Design (Analysis Forces)

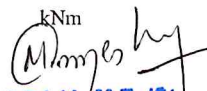
|                                    |   |                                          |     |
|------------------------------------|---|------------------------------------------|-----|
| Analysis Reference No.             | = | 25                                       |     |
| Critical Analysis Load Combination | : | 4                                        |     |
| Load Combination                   | = | [2] : 1.5 (LOAD 1: DL) +1.5 (LOAD 2: LL) |     |
| Critical Location                  | = | Top Joint                                |     |
| Put (top joint)                    | = | 1017.93                                  | kN  |
| Muxt (top joint)                   | = | 46.83                                    | kNm |
| Muyt (top joint)                   | = | 4.58                                     | kNm |
| Vuxt (top joint)                   | = | 1.76                                     | kN  |
| Vuyt (top joint)                   | = | -15.83                                   | kN  |
| Pub (bottom joint)                 | = | 1032.56                                  | kN  |
| Muxb (bottom joint)                | = | -16.48                                   | kNm |
| Muyb (bottom joint)                | = | -2.47                                    | kNm |
| Vuxb (bottom joint)                | = | 1.76                                     | kN  |
| Vuyb (bottom joint)                | = | -15.83                                   | kN  |

### Minimum Eccentricity Check

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

Minimum Eccentricity Along D:

|                      |   |                                   |     |
|----------------------|---|-----------------------------------|-----|
| Minimum Eccentricity | = | Unsupported Length / 500 + D / 30 |     |
|                      | = | 21.94                             | mm  |
| Minimum Eccentricity | > | 20                                | mm  |
| Mminx (top)          | = | Pu x Minimum Eccentricity         |     |
|                      | = | 22.33                             | kNm |
| Mminx (bottom)       | = | Pu x Minimum Eccentricity         |     |
|                      | = | 22.65                             | kNm |

  
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|                                |   |                                   |  |  |     |  |
|--------------------------------|---|-----------------------------------|--|--|-----|--|
| Minimum Eccentricity Along B : |   |                                   |  |  |     |  |
| Minimum Eccentricity           | = | Unsupported Length / 500 + B / 30 |  |  |     |  |
|                                | = | 14.91                             |  |  | mm  |  |
| Minimum Eccentricity           | > | 20                                |  |  | mm  |  |
| MminY (top)                    | = | Pu x Minimum Eccentricity         |  |  |     |  |
|                                | = | 20.36                             |  |  | kNm |  |
| MminY (bottom)                 | = | Pu x Minimum Eccentricity         |  |  |     |  |
|                                | = | 20.65                             |  |  | kNm |  |

#### Slenderness Check

|                            |   |       |  |  |  |            |
|----------------------------|---|-------|--|--|--|------------|
| Max Slenderness Ratio(L/B) | = | 15.74 |  |  |  |            |
|                            | < | 60    |  |  |  | (Hence Ok) |

Column Is Braced Along D

Slenderness Check Along D:

|                         |   |                                  |  |  |  |  |
|-------------------------|---|----------------------------------|--|--|--|--|
| Effective Length Factor | = | 1                                |  |  |  |  |
| Slenderness Ratio       | = | Effective Length / D             |  |  |  |  |
|                         | = | 7.71, Column not Slender Along D |  |  |  |  |

Column Is Braced Along B

Slenderness Check Along B:

|                         |   |                               |  |  |  |  |
|-------------------------|---|-------------------------------|--|--|--|--|
| Effective Length Factor | = | 1                             |  |  |  |  |
| Slenderness Ratio       | = | Effective Length / B          |  |  |  |  |
|                         | = | 15.74, Column Slender Along B |  |  |  |  |

|                            |   |                        |  |  |     |  |
|----------------------------|---|------------------------|--|--|-----|--|
| Slenderness moment along B | = | (Pu B/ 2000) (Ley/B)^2 |  |  |     |  |
|                            | = | 29                     |  |  | kNm |  |

Design slenderness moment along B

|     |   |        |  |  |    |  |
|-----|---|--------|--|--|----|--|
| Puz | = | 1520.2 |  |  | kN |  |
| Pb  | = | 372.63 |  |  | kN |  |

|                                             |   |                              |  |  |  |  |
|---------------------------------------------|---|------------------------------|--|--|--|--|
| Reduction factor 'k' for slenderness moment | = | (Puz - Pu) / (Puz - Pb) <= 1 |  |  |  |  |
|                                             | = | 0.44 <= 1, Hence k=0.44      |  |  |  |  |

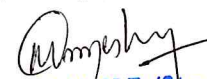
|        |   |        |  |  |     |  |
|--------|---|--------|--|--|-----|--|
| Mslndy | = | k x 29 |  |  |     |  |
|        | = | 12.69  |  |  | kNm |  |

#### Calculation of Design Moment

| Direction               | Manalysis | Mmin (Abs) | Mdesign | Minit  | Mslndx (Abs) | Mdesign-final |
|-------------------------|-----------|------------|---------|--------|--------------|---------------|
|                         | A         | B          | C       | D      | E            | F             |
| Major Axis Mux (top)    | 46.83     | 22.33      | 46.83   | ---    | 0            | 46.83         |
| Major Axis Mux (bottom) | -16.48    | 22.65      | -22.65  | ---    | 0            | -22.65        |
| Minor Axis Muy (top)    | 4.58      | 20.36      | 20.36   | -20.53 | 12.69        | -33.23        |
| Minor Axis Muy (bottom) | -2.47     | 20.65      | -20.65  | -20.53 | 12.5         | -33.03        |

Where

- A = Moments directly from analysis
- B = Moments due to minimum eccentricity
- C = Maximum of analysis moment and min. eccentricity = Max (A,B)
- D = Initial moment = 0.4 x Min (top, bottom) ± 0.6 x Max (top, bottom) [As per sign requirement]
- E = Moment due to slenderness effect
- F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

  
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### Final Critical Design Forces

|     |   |         |     |
|-----|---|---------|-----|
| Pu  | = | 1017.93 | kN  |
| Mux | = | 46.83   | kNm |
| Muy | = | -33.23  | kNm |

### Resultant Moment (Combined Action)

#### Moment Capacity Check

|                        |   |                            |     |
|------------------------|---|----------------------------|-----|
| Pt Calculated          | = | 1.55                       |     |
| Reinforcement Provided | = | 4-T20 + 4-T16              |     |
| Load Angle             | = | $\tan^{-1}(M_{uy}/M_{ux})$ |     |
|                        | = | 35.36                      | deg |
| MRes                   | = | 57.42                      | kNm |
| MCap                   | = | 61.2                       | kNm |
| Capacity Ratio         | = | MRes/ MCap                 |     |
|                        | = | 0.9 <= 1                   |     |

### Shear Design (Analysis Forces)

#### Design for shear along D

|                                         |   |                                                 |        |
|-----------------------------------------|---|-------------------------------------------------|--------|
| Critical Analysis Load Combination      | : | 4                                               |        |
| Critical Load Combination               | = | [2] : 1.5 (LOAD 1: DL) +1.5 (LOAD 2: LL)        |        |
| Design shear force, Vuy                 | = | -15.831                                         | kN     |
| Pu                                      | = | 1017.93                                         | kN     |
| Deff                                    | = | 402                                             | mm     |
| Design shear stress, Tvy                | = | $V_{uy} / (B \times Deff)$                      | N/sqmm |
|                                         | = | 0.1712                                          | N/sqmm |
| Pt                                      | = | 0.777                                           | %      |
| Design shear strength, Tc               | = | 0.5675                                          | N/sqmm |
| Shear Strength Enhancement Factor       | = | $1 + 3 \times P_u / (B \times D \times F_{ck})$ |        |
|                                         | = | 2.4753                                          |        |
| Shear Strength Enhancement Factor (max) | = | 1.5                                             |        |
| Shear Strength Enhancement Factor       | = | 1.5                                             |        |
| Enhanced shear strength, Tc-e           | = | 0.8512                                          | N/sqmm |
| Design shear check                      | = | $T_{vy} < T_c \times \text{Enhancement factor}$ |        |

Link for Shear Design along D are not required

#### Design for shear along B

|                                    |   |                                          |    |
|------------------------------------|---|------------------------------------------|----|
| Critical Analysis Load Combination | : | 4                                        |    |
| Critical Load Combination          | = | [2] : 1.5 (LOAD 1: DL) +1.5 (LOAD 2: LL) |    |
| Design shear force, Vux            | = | 1.7625                                   | kN |
| Pu                                 | = | 1017.93                                  | kN |

  
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|                                                       |   |                                                 |        |
|-------------------------------------------------------|---|-------------------------------------------------|--------|
| Beff                                                  | = | 182                                             | mm     |
| Design shear stress, $T_{vx}$                         | = | $V_{ux} / (D \times Beff)$                      | kN     |
|                                                       | = | 0.0215                                          | N/sqmm |
| Pt                                                    | = | 0.777                                           | %      |
| Design shear strength, $T_c$                          | = | 0.5675                                          | N/sqmm |
| Shear Strength Enhancement Factor                     | = | $1 + 3 \times P_u / (B \times D \times F_{ck})$ |        |
|                                                       | = | 2.4753                                          |        |
| Shear Strength Enhancement Factor (max)               | = | 1.5                                             |        |
| Shear Strength Enhancement Factor                     | = | 1.5                                             |        |
| Enhanced shear strength, $T_{c-e}$                    | = | 0.8512                                          | N/sqmm |
| Design shear check                                    | = | $T_{vx} < T_c \times \text{Enhancement factor}$ |        |
| <b>Link for Shear Design along B are not required</b> |   |                                                 |        |

#### 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 |    |
|                  | = | 4                             | mm |

Criterion for spacing of normal links

|                                |   |     |    |
|--------------------------------|---|-----|----|
| Min. Longitudinal Bar dia X 16 | = | 256 | mm |
| Min. dimension of column       | = | 230 | mm |
| Max. 300 mm                    | = | 300 | mm |
| Provided spacing               | = | 225 | mm |

**Table For Links**

|           | Required      |              |                | Provided    |              |
|-----------|---------------|--------------|----------------|-------------|--------------|
|           | Normal Design | Shear Design | Ductile Design | Normal Zone | Ductile Zone |
| Link Dia. | 8             | ---          | ---            | 8           | ---          |
| Spacing   | 225           | ---          | ---            | 225         | ---          |

  
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**BEAM DESIGN**

|                         |                   |        |
|-------------------------|-------------------|--------|
| Grid                    | : (7/A-K)         |        |
| Beam No                 | : RB3             |        |
| Beam Length             | : 7450            | mm     |
| Breadth (B)             | : 230             | mm     |
| Depth (D)               | : 530             | mm     |
| Effective Depth (d)     | : 475             | mm     |
| Design Code             | : IS 456          |        |
| Beam Type               | : Regular Beam    |        |
| Grade Of Concrete (Fck) | : M20             | N/sqmm |
| Grade Of Steel          | : Fe500           | N/sqmm |
| Clear Cover (Cmin)      | : 25              | mm     |
| Es                      | : $2 \times 10^5$ | N/sqmm |

| <b>Flexure Design</b>   |                    |                |              |                 |            |                |
|-------------------------|--------------------|----------------|--------------|-----------------|------------|----------------|
|                         | <b>Beam Bottom</b> |                |              | <b>Beam Top</b> |            |                |
|                         | <b>Left</b>        | <b>Mid</b>     | <b>Right</b> | <b>Left</b>     | <b>Mid</b> | <b>Right</b>   |
| Critical L/C - Analysis | 4                  | 4              | 4            | 4               | 4          | 4              |
| Critical L/C - RCDC     | 2                  | 2              | 2            | 2               | 2          | 2              |
| Mu (kNm)                | 15.17              | 148.61         | 18.2         | 167.96          | -          | 215.67         |
| Tu (kNm)                | 0.34               | 0.34           | 0.34         | 0.34            | 0.34       | 0.34           |
| M <sub>Tu</sub> (kNm)   | 0.66               | 0.66           | 0.66         | 0.66            | 0.66       | 0.66           |
| Mud (kNm)               | 15.83              | 149.27         | 18.86        | 168.62          | 0.66       | 216.33         |
| MuLim (kNm)             | 138                | 138            | 138          | 138             | 138        | 138            |
| R                       | 0.305              | 2.876          | 0.363        | 3.249           | 0.013      | 4.169          |
| Ptmin (%)               | 0.2                | 0.2            | 0.2          | 0.2             | 0.2        | 0.2            |
| Ptcllc (%)              | 0.2                | 0.811          | 0.2          | 0.908           | 0.2        | 1.147          |
| Pcccllc (%)             | 0                  | 0.061          | 0            | 0.168           | 0.003      | 0.429          |
| PtPrv (%)               | 0.368              | 0.863          | 0.552        | 0.943           | 0.368      | 1.15           |
| AstCalc (sqmm)          | 218.5              | 885.87         | 218.5        | 991.78          | 218.5      | 1252.9         |
| AstPrv (sqmm)           | 402.12             | 942.48         | 603.18       | 1030.44         | 402.12     | 1256.64        |
| Reinforcement Provided  | 2-T16              | 3-T16<br>3-T12 | 3-T16        | 2-T20<br>2-T16  | 2-T16      | 2-T20<br>2-T20 |

  
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| <b>Shear Design</b>                                   |             |            |              |
|-------------------------------------------------------|-------------|------------|--------------|
|                                                       | <b>Left</b> | <b>Mid</b> | <b>Right</b> |
| Critical L/C - Analysis                               | 4           | 4          | 4            |
| Critical L/C - RCDC                                   | 2           | 2          | 2            |
| PtPrv (%)                                             | 0.943       | 0.863      | 1.15         |
| Vu (kN)                                               | 139.04      | 69.13      | 191.36       |
| Tu (kNm)                                              | 0.34        | 0.34       | 0.34         |
| V <sub>Tu</sub> (kN)                                  | 2.35        | 2.35       | 2.35         |
| V <sub>ut</sub> (kN)                                  | 141.39      | 71.49      | 193.72       |
| T <sub>v</sub> (N/sqmm)                               | 1.29        | 0.65       | 1.77         |
| T <sub>c</sub> (N/sqmm)                               | 0.61        | 0.59       | 0.65         |
| V <sub>c</sub> (kN)                                   | 66.59       | 64.45      | 71.47        |
| V <sub>us</sub> =V <sub>ut</sub> -V <sub>c</sub> (kN) | 74.8        | 7.04       | 122.25       |
| Legs                                                  | 2           | 2          | 2            |
| Stirrup Rebar                                         | 8           | 8          | 8            |
| Asv Torsion (sqmm)                                    | 347.583     | 177.375    | 473.61       |
| Asv Torsion Prv (sqmm)                                | 591.41      | 591.41     | 718.14       |
| Asv Reqd (sqmm/m)                                     | 436.13      | 254.81     | 712.78       |
| SvCalc (mm)                                           | 170         | 170        | 140          |
| SvPrv (mm)                                            | 170         | 170        | 140          |
| Asv Total Prv (sqmm)                                  | 591.41      | 591.41     | 718.14       |

#### Maximum Spacing Criteria

##### Basic

|              |       |    |
|--------------|-------|----|
| Spc1 = 0.75d | = 356 | mm |
| Spc2         | = 300 | mm |

##### For Torsion

|                      |       |    |
|----------------------|-------|----|
| (X1 = 190, Y1 = 490) |       |    |
| Spc3 = X1            | = 190 | mm |
| Spc4 = (X1+Y1)/4     | = 170 | mm |

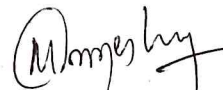
#### SFR Design

|            |                                                        |     |
|------------|--------------------------------------------------------|-----|
| Beam Width | = 230                                                  | mm  |
| Beam Depth | = 530                                                  | mm  |
| Torsion    | = 0.34 > 0                                             | kNm |
|            | Beam Depth > 750 Or Torsion > 0,<br>Hence SFR Provided |     |

|               |           |      |
|---------------|-----------|------|
| Asr           | = 121.9   | sqmm |
| SFR Provided  | = 1-T10EF |      |
| ASFR Provided | = 157.08  | sqmm |

#### Spacing Criteria

|                     |         |    |
|---------------------|---------|----|
| Provided Spacing    | = 185.7 | mm |
| 1. <= beam Width    | = 230   | mm |
| 2. Not Greater Than | = 300   | mm |

  
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| PLOT-12                                                                                                                                                                                                                                                                                                                                                   |                                  | Level: + FF LVL       |                                       |                                       |                        |     |     |     |                        |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|-----------------------|---------------------------------------|---------------------------------------|------------------------|-----|-----|-----|------------------------|
| Along Grid : (7-A/F)                                                                                                                                                                                                                                                                                                                                      |                                  | slab Reff. S3         |                                       |                                       |                        |     |     |     |                        |
| INPUT DATA                                                                                                                                                                                                                                                                                                                                                |                                  |                       |                                       |                                       |                        |     |     |     |                        |
| Slab                                                                                                                                                                                                                                                                                                                                                      |                                  | Loads                 |                                       |                                       |                        |     |     |     |                        |
| Shorter Span                                                                                                                                                                                                                                                                                                                                              | Lx = 3.700 m                     | Dead Load             | DL = 3.13 kN/m <sup>2</sup>           |                                       |                        |     |     |     |                        |
| Longer Span                                                                                                                                                                                                                                                                                                                                               | Ly = 5.950 m                     | Live load             | LL = 2.00 kN/m <sup>2</sup>           |                                       |                        |     |     |     |                        |
| Thickness of Slab                                                                                                                                                                                                                                                                                                                                         | D = 125 mm                       | Floor Finishes        | FF = 1.50 kN/m <sup>2</sup>           |                                       |                        |     |     |     |                        |
| Clear Cover                                                                                                                                                                                                                                                                                                                                               | d' = 20 mm                       | False Ceiling Load    | = 0.25 kN/m <sup>2</sup>              |                                       |                        |     |     |     |                        |
| Ly/Lx ratio                                                                                                                                                                                                                                                                                                                                               | k = 1.61 Two-Way Slab            | Total Load            | w = 6.88 kN/m <sup>2</sup>            |                                       |                        |     |     |     |                        |
| Panel Type                                                                                                                                                                                                                                                                                                                                                |                                  | Materials             |                                       |                                       |                        |     |     |     |                        |
| Basic L/d ratio                                                                                                                                                                                                                                                                                                                                           | = 26                             | Grade of Concrete     | = 20 N/mm <sup>2</sup>                |                                       |                        |     |     |     |                        |
| Edge Condition:                                                                                                                                                                                                                                                                                                                                           | = 9                              | Grade of Reinf. Steel | = 500 N/mm <sup>2</sup>               |                                       |                        |     |     |     |                        |
| Four Edges Discontinuous                                                                                                                                                                                                                                                                                                                                  |                                  | Young's Modulus E     | 2.24E+04 N/mm <sup>2</sup>            |                                       |                        |     |     |     |                        |
| DESIGN                                                                                                                                                                                                                                                                                                                                                    |                                  |                       |                                       |                                       |                        |     |     |     |                        |
| Direction                                                                                                                                                                                                                                                                                                                                                 | BM Coefficients<br>(IS:456-2000) | Flexural Design       |                                       |                                       | dia & Required Spacing |     |     |     | Provided Reinforcement |
|                                                                                                                                                                                                                                                                                                                                                           |                                  | Mu<br>kNm             | Ast <sub>req</sub><br>mm <sup>2</sup> | Ast <sub>pro</sub><br>mm <sup>2</sup> | 8                      | 10  | 12  | 16  |                        |
| Shorter Span                                                                                                                                                                                                                                                                                                                                              | $\alpha_x (-) = 0.0000$          | 0.000                 | 121                                   | 452                                   | 300                    | 300 | 297 | 291 | 8 @ 125 Safe           |
|                                                                                                                                                                                                                                                                                                                                                           | $\alpha_x (+) = 0.0938$          | 13.236                | 328                                   | 452                                   | 153                    | 239 | 297 | 291 | 8 @ 125 Safe           |
| Longer Span                                                                                                                                                                                                                                                                                                                                               | $\alpha_y (-) = 0.0000$          | 0.000                 | 121                                   | 302                                   | 279                    | 270 | 261 | 243 | 8 @ 200 Safe           |
|                                                                                                                                                                                                                                                                                                                                                           | $\alpha_y (+) = 0.0560$          | 7.906                 | 189                                   | 302                                   | 266                    | 270 | 261 | 243 | 8 @ 200 Safe           |
| CHECK FOR DEFLECTION                                                                                                                                                                                                                                                                                                                                      |                                  |                       |                                       |                                       |                        |     |     |     |                        |
| Area of Steel required = 328 mm <sup>2</sup><br>Area of Steel Provided = 452 mm <sup>2</sup><br>Steel stress of service load = 210.27 N/mm <sup>2</sup><br>Provided reinforcement (%) = 0.45%<br>Modification ratio MF = 1.462<br>Effective depth required for deflection point of view<br>$d_{req} = 97.35459$ mm<br>Eff. depth provided d = 101 mm Safe |                                  |                       |                                       |                                       |                        |     |     |     |                        |
| SLAB SUMMARY                                                                                                                                                                                                                                                                                                                                              |                                  |                       |                                       |                                       |                        |     |     |     |                        |
| Shorter Span: Provide T 8 @ 125 mm c/c + 1 T 8 Extra between the two cranked bars<br>Longer Span: Provide T 8 @ 200 mm c/c + 1 T 8 Extra between the two cranked bars                                                                                                                                                                                     |                                  |                       |                                       |                                       |                        |     |     |     |                        |
| CHECK FOR SHEAR                                                                                                                                                                                                                                                                                                                                           |                                  |                       |                                       |                                       |                        |     |     |     |                        |
| Max Shear Force = 19 KN<br>Actual Shear stress $\tau_v = 0.189$ N/mm <sup>2</sup><br>$P_t$ of A <sub>st</sub> = 0.45%<br>Design Shear Stress $\tau_c = 0.46$ N/mm <sup>2</sup><br>Shear is less than Design Shear Stress, Hence Safe against shear                                                                                                        |                                  |                       |                                       |                                       |                        |     |     |     |                        |
| NOTES                                                                                                                                                                                                                                                                                                                                                     |                                  |                       |                                       |                                       |                        |     |     |     |                        |
| 1. Crank alternate bars at 0.3 times the respective span.<br>2. Provide 12mm dia chairs at 1000mm c/c in both directions.<br>3. Provide 6 mm thick cover blocks at 600mm c/c in both directions.                                                                                                                                                          |                                  |                       |                                       |                                       |                        |     |     |     |                        |
| <div style="border: 1px solid black; padding: 5px; margin: 10px auto; width: 80%;"> <b>Reinforcement Summary:</b><br/>         Along Shorter Span<br/><br/>         Provided T8@ 125mm c/c<br/><br/>         Along Longer Span<br/><br/>         Provided T8@ 200mm c/c       </div>                                                                      |                                  |                       |                                       |                                       |                        |     |     |     |                        |

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| GRID                                      | 4/D | F1-FOOTING |            |
|-------------------------------------------|-----|------------|------------|
| Longer dimension of column L              |     |            | 450        |
| Shorter dimension of column B             |     |            | 230        |
| Unfactored axial load P                   |     |            | 844        |
| Unfactored moment in longer direction M1  |     |            | 1.86       |
| Unfactored moment in shorter direction M2 |     |            | 3.16       |
| Net soil bearing capacity                 |     |            | 130        |
| Gross safe bearing capacity               |     |            | 175        |
| Height of footing below NGL               |     |            | 2.5        |
| Unit weight of soil                       |     |            | 18         |
| Total load on footing                     |     |            | 1185       |
| Gross pressures and check for tension     |     |            |            |
| P1                                        | 166 | ok         |            |
| P2                                        | 167 | ok         |            |
| P3                                        | 169 | ok         | No tension |
| P4                                        | 168 | ok         |            |
| Required area                             |     |            | 6.8        |
| Provided area                             |     |            | 7.0692     |
| Longer dimension of footing L1            |     |            | 2.74       |
| Shorter dimension of footing B1           |     |            | 2.58       |
| Overall depth of footing D                |     |            | 600        |
| Effective depth of footing d              |     |            | 550        |
| Edge depth of footing ed                  |     |            | 380        |
| Cover to the main reinforcement           |     |            | 50         |
| Grade of concrete fck                     |     |            | 20         |
| Grade of steel fy                         |     |            | 500        |
| Diameter of bars                          |     |            | 12         |
| LONGER MOMENTS                            |     |            |            |
| Maximum pressure Pmax                     |     |            | 121        |
| Minimum pressure Pmin                     |     |            | 120        |
| Cantilever length                         |     |            | 1.15       |
| Average pressure                          |     |            | 121        |
| Moment M11                                |     |            | 204        |
| Effective width for moment                |     |            | 0.52       |
| Mu/bd <sup>2</sup>                        |     |            | 1.93       |
| Required percentage of steel              |     |            | 0.51       |
| Minimum steel area                        |     |            | 1547.4     |
| Provided steel area Ast                   |     |            | 1467       |
| Spacing of reinforcement                  |     |            | 180        |
| SHORTER MOMENTS                           |     |            |            |
| Maximum pressure Pmax                     |     |            | 121        |
| Minimum pressure Pmin                     |     |            | 119        |
| Cantilever length                         |     |            | 1.18       |
| Average pressure                          |     |            | 121        |
| Moment M22                                |     |            | 228        |
| Effective width for moment                |     |            | 0.74       |
| Required percentage of steel              |     |            | 0.41       |
| Minimum steel area                        |     |            | 1670.52    |
| Provided steel area Ast                   |     |            | 1629       |
| Spacing of reinforcement                  |     |            | 180        |
| CHECK FOR ONE-WAY SHEAR                   |     |            |            |
| Longitudinal Direction                    |     |            |            |
| Effective width at the section            |     |            | 1330       |
| Effective depth at the section            |     |            | 444        |
| Shear Area at the section                 |     |            | 1074902    |
| Pressure at distance d from the face      |     |            | 120.8      |
| Shear force at the section                |     |            | 186        |
| Shear stress at the section Tv            |     |            | 0.259      |
| pt for shear stress                       |     |            | 0.144      |

  
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|                                      |  |  |         |
|--------------------------------------|--|--|---------|
| Allowable shear stress Tc            |  |  | 0.282   |
| Revised pt from shear requirement    |  |  | 0.120   |
| Revised area of steel Ast            |  |  | 1290    |
| Spacing of reinforcement             |  |  | 220.000 |
| Transverse Direction                 |  |  |         |
| Effective width at the section       |  |  | 1526    |
| Effective depth at the section       |  |  | 433     |
| Shear Area at the section            |  |  | 1116134 |
| Pressure at distance d from the face |  |  | 121     |
| Shear force at the section           |  |  | 203     |
| Shear stress at the section Tv       |  |  | 0.273   |
| pt for shear stress                  |  |  | 0.150   |
| Allowable shear stress Tc            |  |  | 0.287   |
| Revised pt from shear requirement    |  |  | 0.120   |
| Revised area of steel Ast            |  |  | 1339    |
| Spacing of reinforcement             |  |  | 230.000 |
|                                      |  |  |         |
| CHECK FOR PUNCHING SHEAR             |  |  |         |

  
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