Gyanglekh Rural Municipality
The Office of the Rural Municipal Executive
Sindhuli, Nepal, Bagmati Province

2021

Detailed Project Report

Structural Analysis Report
Administrative Building (Vol-III)

Empirical
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1. GENERAL DATA AND LOAD CALCULATION

1.1 Introduction

This report has been prepared as a part of the structural engineering analysis and design of the MUNICIPALITY BUILDING.″

The massive data inputs, design analysis, calculations and outputs of the result are computer aided by the Structural analysis and design software called STAAD, which is a special purpose computer program developed specifically for building structures by Research Engineers International, USA. It provides the Structural Engineer with all the tools necessary to create, modify, analyze, design, and optimize the structural elements in a building model.

Based on the final results, the designs have been performed and drawings were prepared using AutoCAD 2018.

1.2 Building Design Parameters

Nepal is located in boundary between the Indian and Tibetan plates, along which a relative shear strain of about 2 cm per year has been estimated. The Indian plate is also sub-ducting at a rate of, thought to be, about 3 cm per year. The existence of the Himalayan range with the world's highest peaks is evidence of continued uplift. As a result, Nepal is very active seismically.

Reinforced concrete buildings may fail due to the either columns are overstressed and burst due to lack of enough strength to resist the shock of the earth tremor and vibration or failure of reinforced concrete members like beams at the poor ductile detailing. Columns also do fail due to short column effect and splicing failure. Beams fail due to anchorage failure, shear failure and confinement failure.

The building consists of a RCC frame structure, which is essentially an assembly of cast-in-situ-concrete beams and columns. Floors and roof design consists of cast-in-place concrete slabs. Therefore the member sizes or structural elements, reinforcement details, joint details are considered during design process such that to meet the design standards for ductile performance of the structure.

For the design of the building, the Indian Standard criteria for earthquake resistant design IS 1893:2002 have been referred. According to the IS Code, the seismic zone for Kathmandu has been taken falling in Zone V with very severe seismic intensity (zone factor z = 0.36) and accordingly all other parameters like spectral coefficient (S_a/g) and tremor response period or fundamental natural period (T) were calculated. After that all design requirements such as seismic weight of building, lateral forces at different floor levels and different column heads, base shear, distribution of design forces to different floor levels are considered.

The characteristic compressive strength for concrete of 20 N/mm^2 (M20) was used in all structural members and characteristic strength of 500 N/mm^2 (Fe500) was used for reinforcing steel.

1.3 PRELIMINARY DESIGN:

The tentative size of structural elements are determined through the preliminary design so that after analysis the pre assumed dimensions might not deviated considerably , thus making the final design both safe and economical . Tentative size of various elements has been determined as follows:

- **SLAB**

For slab, preliminary design is done according to
deflection criteria span /effective depth = 26*modification factor. (IS456-2000 Art 23.2.1)

From deflection criteria, we have,

$$l/d \leq \alpha\beta\gamma\delta\lambda \qquad \text{(Cl.23-2.1, p.37, IS456:2000)}$$

Where,

α = Basic value of span to effective depth ratios for spans up to spans 10m.

β = a factor which accounts for correction in the values of α for spans greater than 10m

γ = a factors which depends on the stress at service and amount of steel for tension reinforcement

$$\text{For } fy = 500, \qquad fs = 0.58\, fy \times \frac{Area\ of\ cross\ section\ of\ steel\ required}{Area\ of\ cross\ section\ provide}$$

δ =a factor which depends on the area of compression reinforcement.

λ = a factor for flanged beams which depends on the ratio of web width to flange width.

- **BEAM**

Thumb rule of (d=L/12 to L/15) basis is adopted to consider the preliminary design of the beam section.

$$\frac{b}{D} = \frac{1}{2}$$

i) Depth of beam:

We have,

$$d_{beam} = \frac{1}{12} to \frac{1}{15} \text{ of span}$$

ii) Width of beam:

We have, $b_{beam} = 1/2\ to\ 2/3$ of d_{beam}

- **COLUMN**

Preliminary design of column is done consideration and interior column. For the load acting in the column, live load is decreased according to IS 875-1978.
Cross-section of the column is adopted considering the economy. Square column section is adopted in this building project as per the internal aesthetic requirements.
A percentage of steel is taken as 0.8 to 6 percentage of cross section area of column, but as taking 6% area of steel is more at a laps section so generally % of steel is taken up to 4% only..

We have,

$$P = 0.4 f_{ck} A_c + 0.67 f_y A_{sc} = 0.4 f_{ck} \left(A_g - \frac{p A_g}{100} \right) + 0.67 f_y \frac{p A_g}{100}$$

- **STAIRCASE**

Stairs is designed as per drawing. Column for stairs boxes is not included in the grid system but they are assumed to be simply tied with main frame with beam.

1.4 Dead/Live Load Calculation

Design loads (imposed and earthquake) standard are referred to Indian Standard Code of Practice IS: 875 (Part 2) 1987 for design loads for building and structures. Reduction in Imposed Loads on Floors as allowed by the IS Code has been also applied. Dead loads are calculated as per the mass and density of the structural and other building elements.

The dead loads and live loads are calculated as indicated below to start with for general guidance.
Loading assumption:

A. Dead Load

Assuming slab thickness of 120 mm
Self Load of slab = 125*25/1000
= 3.125 kN/m^2
50mm thick screed + punning on floor
Intensity = 1.00 kN/m^2
Total Dead Load = 4.125 kN/m^2
Partition Load = 1.00 kN/m^2

B. Live Load

IS: 875 (Part 2)-1987
Office building for rooms: 4 kN/m^2
For Staircase: 4 kN/m^2

Roof:
LL = 1.5 kN/ m^2

C. Column assuming size, C1 =450mmx450mm, 400mmx400mm & 350mmx350mm

D. Grid Beam & Secondary assuming size of 300mmx400mm

F. Exterior Wall assuming wall thickness of 250mm and deducting 30% for openings,

Wall Load= .23(W)*3.030(H)*19.20 = 13.38 kN/m
Wall Load = .23(W)*3.03(H)*19.20* 0.7 = 9.37 kN/m
Partition Wall Load = 0.11(W)*3.03(H)*19.20 = 6.69 kN/m

G. Parapet Wall

Load = 0.115(W)*1.1(H)*19.20
= 2.24 kN/m

1.5 Static Load Cases

SELF
LIVE
DEAD
EQX
EQZ

1.6 Seismic Load Calculation

Coefficient Calculation

Based on IS 1893 (Part 1): 2002, Criteria for earthquake resistant design of structures, Calculation of earthquake loads using Seismic coefficient method:

The design horizontal seismic coefficient,

$$A_h = Z*I*S_a/2Rg$$

Where Z=zone factor
I = Importance factor
R = Response reduction factor
S_a/g = average response acceleration coefficient

The approximate fundamental natural period of vibration (T_a) in seconds, of moment-resisting frame buildings without brick infill panels,
may be estimated by the empirical expression:

$$Ta = 0.075*h^{.75}$$

Where,
h = Height of Building in meter, includes the basement storey and

I = 1.5 (6.4.2, IS 1893 (Part 1) 2002)
Z = 0.36
$A_h = ZIS_a/2Rg$

$T_a = .075*h^{0.75}$
$= 0.075*13.92^{.75}$
=0.54 sec

S_a/g = 2.5(from graph in page no 16, 1893 (part 1)-2002)

R = 5 (Page 23)

$A_h = ZIS_a/2Rg$
$= 0.36*1.5*2.5/ (2*5)$
= 0.135

The total design lateral force or design seismic base shear (V_B) along any principal direction is determined by the following expression

$V_B = A_h*W$
=0.135*24933.92 KN
=3366.08 KN

Where, A_h = the design horizontal seismic coefficient
W = Seismic weight of the building

1.7 Design Parameters

- ***ARCHITECTURAL AND FUNCTIONAL REQUIREMENTS***

Types of building	*Office Building*
Types of structural system	*Reinforced Concrete Frame*
Number of stories	*3 Storey*
Design provision for future extension	*No*
Story Height	*3.48 m*
Height of parapet wall	*1.1 m*
Total height of the Building	*13.92 m*
Least lateral base dimension of the building	*21.92 m*
Height to least lateral base dimension ratio	*0.635*
External wall/ some internal wall	*250 mm*
Few internal wall	*115 mm*
Plaster thickness	*12 mm*

- ***CONSTRUCTION SITE***

Soil type	*Type II*
Bearing capacity	*125KN/m2*

- ***DIMENSIONS AND MATERIALS***

Slab thickness	*125mm*
Tie Beam size (mm)	*250 x 350*
Base Beam size (mm)	*300x300*
Main Beam size (mm)	*300x400*
Column size (mm)	450x450, 400x400 & *350x350*

- ***CONSTRUCTION MATERIALS***

Cement	*Ordinary Portland cement*
Grade of concrete	*M20 for the entire member*
Grade of steel reinforcement	*Fe500 for both main and shear*

- ***ASSESSMENT OF UNIT LOADS OF MATERIALS***

DENSITY OF MATERIALS

Reinforced concrete	*25.0KN/m3*
Brick masonry	*19.20KN/m3*
Partition wall	*1.00KN/m2*
Floor finishes	*1.00KN/m2*
Ceiling Plaster	*0.5KN/m2*

- ***ASSESSMENT OF LIVE LOAD***

Unit loads on floor	
Rooms	*4.0KN/m2*
Corridors	*4.0 KN/m2*
Stairs	*4.0 KN/m2*
Roof (accessible)	*1.5 KN/m2*
Roof (Non accessible)	*0.750 KN/m2*

- ***METHOD OF ANALYSIS***

Analysis method adopted for EQ resistant design	*: Seismic coefficient*
Level of design	*: Professionally engineered structure*
Total number of design load cases considered	*: 13*
Seismic zoning factor	*: 0.36*
Basic seismic coefficient	*: 0.09*
Important factor	*: 1.0*
Structural performance factor	*: 1.0*
Weight of structure	*:* 24933.92 KN
Horizontal base shear at plinth level	*: 3366.08 KN*

2. 3D STRUCTURAL ANALYSIS

2.1 Load Combinations taken in Analysis

1.1.5(DL+LL)
2. 1.2(DL+LL+EQX)
3. 1.2(DL+LL-EQX)
4. 1.2(DL+LL+EQZ)
5.1.2(DL+LL-EQZ)
6. 1.5(DL+EQX)
7. 1.5(DL-EQX)
8. 1.5(DL+EQZ)
9. 1.5(DL-EQZ)
10. 0.9DL+1.5EQX
11. 0.9DL-1.5EQX
12. 0.9DL+1.5EQZ
13. 0.9DL-1.5EQZ

2.2 Analysis Detail:

```
DEFINE MATERIAL START
ISOTROPIC M20
E 2.2365e+007
POISSON 0.17
DENSITY 25
ALPHA 1e-005
DAMP 0.05
END DEFINE MATERIAL
MEMBER PROPERTY INDIAN
776 TO 779 791 TO 794 806 TO 809 829 TO 832 PRIS YD 0.35 ZD 0.35
130 TO 132 137 TO 139 144 TO 146 151 TO 153 158 TO 160 165 TO 167 169 TO 171
-
173 TO 175 177 TO 179 181 TO 183 185 TO 187 192 TO 194 199 TO 201 -
206 TO 208 213 TO 215 220 TO 222 254 TO 256 261 TO 263 268 TO 270 -
275 TO 277 282 TO 284 289 TO 291 293 TO 295 297 TO 299 301 TO 303 -
305 TO 307 309 TO 311 316 TO 318 323 TO 325 337 TO 339 344 TO 346 -
351 TO 353 355 TO 357 359 TO 361 363 TO 365 367 TO 369 371 TO 373 -
378 TO 380 385 TO 387 399 TO 401 406 TO 408 413 TO 415 417 TO 419 -
421 TO 423 425 TO 427 429 TO 431 433 TO 435 440 TO 442 447 TO 449 -
461 TO 463 468 TO 470 475 TO 477 479 TO 481 483 TO 485 487 TO 489 -
491 TO 493 495 TO 497 502 TO 504 509 TO 511 523 TO 525 530 TO 532 -
537 TO 539 541 TO 543 545 TO 547 549 TO 551 553 TO 555 557 TO 559 -
564 TO 566 571 TO 573 578 TO 580 585 TO 587 592 TO 594 626 TO 628 -
633 TO 635 640 TO 642 647 TO 649 654 TO 656 661 TO 663 665 TO 667 -
669 TO 671 673 TO 675 677 TO 679 681 TO 683 688 TO 690 695 TO 697 -
702 TO 704 709 TO 711 716 TO 718 751 755 TO 757 760 TO 762 766 780 782 795 -
797 810 812 PRIS YD 0.4 ZD 0.3
MEMBER PROPERTY INDIAN
30 79 128 133 TO 135 140 TO 142 147 TO 149 154 TO 156 161 TO 163 188 TO 190 -
195 TO 197 202 TO 204 209 TO 211 216 TO 218 223 TO 225 250 TO 252 -
257 TO 259 264 TO 266 271 TO 273 278 TO 280 285 TO 287 312 TO 314 -
```

319 TO 321 326 TO 328 333 TO 335 340 TO 342 347 TO 349 498 TO 500 -
505 TO 507 512 TO 514 519 TO 521 526 TO 528 533 TO 535 560 TO 562 -
567 TO 569 574 TO 576 581 TO 583 588 TO 590 595 TO 597 622 TO 624 -
629 TO 631 636 TO 638 643 TO 645 650 TO 652 657 TO 659 684 TO 686 -
691 TO 693 698 TO 700 705 TO 707 712 TO 714 719 TO 721 PRIS YD 0.4 ZD 0.4
784 TO 790 799 TO 805 814 TO 820 838 841 843 TO 849 PRIS YD 0.35 ZD 0.25
MEMBER PROPERTY
374 TO 376 381 TO 383 388 TO 390 395 TO 397 402 TO 404 409 TO 411 436 TO 438
-
443 TO 445 450 TO 452 457 TO 459 464 TO 466 471 TO 473 728 729 732 TO 735 -
738 739 PRIS YD 0.45 ZD 0.45
CONSTANTS
MATERIAL M20 ALL
SUPPORTS
1 62 66 70 74 78 82 86 90 94 98 102 106 110 114 118 122 126 130 134 138 142 -
146 150 154 158 162 166 170 174 178 182 186 190 194 198 202 206 210 214 218 -
222 226 230 234 238 242 246 250 254 258 262 266 270 274 278 282 286 290 294 -
321 TO 324 FIXED
SLAVE MX MZ MASTER 171 JOINT 21 63 67 71 75 79 83 87 91 95 99 103 107 111 -
115 119 123 127 131 135 139 143 147 151 155 159 163 167 171 175 179 183 187 -
191 195 199 203 207 211 215 219 223 227 231 235 239 243 247 251 255 259 263 -
267 271 275 279 283 287 291 295 317 327 TO 331
SLAVE MX MZ MASTER 172 JOINT 41 64 68 72 76 80 84 88 92 96 100 104 108 112 -
116 120 124 128 132 136 140 144 148 152 156 160 164 168 172 176 180 184 188 -
192 196 200 204 208 212 216 220 224 228 232 236 240 244 248 252 256 260 264 -
268 272 276 280 284 288 292 296 318 332 TO 336
SLAVE MX MZ MASTER 173 JOINT 61 65 69 73 77 81 85 89 93 97 101 105 109 113 -
117 121 125 129 133 137 141 145 149 153 157 161 165 169 173 177 181 185 189 -
193 197 201 205 209 213 217 221 225 229 233 237 241 245 249 253 257 261 265 -
269 273 277 281 285 289 293 297 319 337 TO 341
SLAVE MX MZ MASTER 308 JOINT 304 305 308 TO 311 314 315 320 350 TO 354
DEFINE 1893 LOAD
ZONE 0.36 RF 5 I 1.5 SS 2 ST 1
SELFWEIGHT 1
MEMBER WEIGHT
130 131 137 138 144 145 151 152 158 159 165 166 185 186 289 290 309 310 351 -
352 371 372 380 408 413 TO 415 419 431 433 434 442 470 475 476 495 496 537 -
538 557 558 661 662 681 682 688 689 695 696 702 703 709 710 716 717 780 782 -
795 797 UNI 9.37
169 170 173 174 177 178 181 182 192 193 199 200 206 207 213 214 220 221 254 -
255 261 262 268 269 275 276 282 283 293 294 297 298 301 302 305 306 316 317 -
323 324 337 338 344 345 355 356 359 360 363 364 367 368 378 379 385 386 399 -
400 406 407 417 418 421 422 425 426 429 430 440 441 447 448 461 462 468 469 -
479 480 483 484 487 488 491 492 497 502 503 509 510 523 524 530 531 541 542 -
545 546 549 550 553 554 564 565 571 572 578 579 585 586 592 593 626 627 633 -
634 640 641 647 648 654 655 665 666 669 670 673 674 677 678 786 TO 790 801 -
802 TO 805 810 816 TO 820 UNI 6.69
132 139 146 153 160 167 187 291 311 353 373 477 539 559 663 683 690 697 704 -
711 718 751 755 TO 757 760 762 766 812 838 841 845 TO 849 UNI 2.34
FLOOR WEIGHT
YRANGE 3.48 10.5 FLOAD 4.125 XRANGE 0 22 ZRANGE 0 5.4 GY
YRANGE 3.48 10.5 FLOAD 4.125 XRANGE 0 9 ZRANGE 5.9 15.3 GY
YRANGE 3.48 10.44 FLOAD 4.125 XRANGE 13 22 ZRANGE 5.9 15.3 GY
YRANGE 3.48 10.5 FLOAD 4.125 XRANGE 0 9 ZRANGE 19 29 GY
YRANGE 3.48 10.5 FLOAD 4.125 XRANGE 13 22 ZRANGE 19 29 GY
YRANGE 3.4 10.5 FLOAD 4.125 XRANGE 0 35 ZRANGE 29 35 GY
YRANGE 3.48 10.5 FLOAD 4.125 XRANGE 4.7 9 ZRANGE 15 20 GY

YRANGE 3.48 3.48 FLOAD 4.125 XRANGE 13 22 ZRANGE 15 20 GY
YRANGE 6 10.5 FLOAD 4.125 XRANGE 13 18 ZRANGE 15 20 GY
YRANGE 13 14 FLOAD 4.125 XRANGE 17 22 ZRANGE 15 20 GY
YRANGE 13 14 FLOAD 4.125 XRANGE 0 4.8 ZRANGE 15 20 GY
YRANGE 3.48 14 FLOAD 4.125 XRANGE 21 25 ZRANGE 12 22.5 GY
YRANGE 3.48 7 FLOAD 2 XRANGE 0 22 ZRANGE 0 5.4 GY
YRANGE 3.48 7 FLOAD 2 XRANGE 0 9 ZRANGE 5.9 15.3 GY
YRANGE 3.48 7 FLOAD 2 XRANGE 13 22 ZRANGE 5.9 15.3 GY
YRANGE 3.48 7 FLOAD 2 XRANGE 0 9 ZRANGE 19 29 GY
YRANGE 3.48 7 FLOAD 2 XRANGE 13 22 ZRANGE 19 29 GY
YRANGE 3.4 7 FLOAD 2 XRANGE 0 35 ZRANGE 29 35 GY
YRANGE 3.48 7 FLOAD 2 XRANGE 4.7 9 ZRANGE 15 20 GY
YRANGE 3.48 3.48 FLOAD 2 XRANGE 13 22 ZRANGE 15 20 GY
YRANGE 6 7 FLOAD 2 XRANGE 13 18 ZRANGE 15 20 GY
YRANGE 3.48 10.5 FLOAD 2 XRANGE 21 25 ZRANGE 12 22.5 GY
YRANGE 10 10.5 FLOAD 0.375 XRANGE 0 22 ZRANGE 0 5.4 GY
YRANGE 10 10.5 FLOAD 0.375 XRANGE 0 9 ZRANGE 5.9 15.3 GY
YRANGE 10 10.44 FLOAD 0.375 XRANGE 13 22 ZRANGE 5.9 15.3 GY
YRANGE 10 10.5 FLOAD 0.375 XRANGE 0 9 ZRANGE 19 29 GY
YRANGE 10 10.5 FLOAD 0.375 XRANGE 13 22 ZRANGE 19 29 GY
YRANGE 10 10.5 FLOAD 0.375 XRANGE 0 35 ZRANGE 29 35 GY
YRANGE 10 10.5 FLOAD 0.375 XRANGE 4.7 9 ZRANGE 15 20 GY
YRANGE 10 10.5 FLOAD 0.375 XRANGE 13 18 ZRANGE 15 20 GY
YRANGE 13 14 FLOAD 0.375 XRANGE 17 22 ZRANGE 15 20 GY
YRANGE 13 14 FLOAD 0.375 XRANGE 0 4.8 ZRANGE 15 20 GY
YRANGE 13 14 FLOAD 0.375 XRANGE 21 25 ZRANGE 12 22.5 GY
LOAD 1 LOADTYPE Seismic TITLE EQX
1893 LOAD X 1
LOAD 2 LOADTYPE Seismic TITLE EQZ
1893 LOAD Z 1
LOAD 3 LOADTYPE Dead TITLE DL
SELFWEIGHT Y -1 LIST 30 79 128 130 TO 135 137 TO 142 144 TO 149 151 TO 156 -
158 TO 163 165 TO 167 169 TO 171 173 TO 175 177 TO 179 181 TO 183 -
185 TO 190 192 TO 197 199 TO 204 206 TO 211 213 TO 218 220 TO 225 -
250 TO 252 254 TO 259 261 TO 266 268 TO 273 275 TO 280 282 TO 287 -
289 TO 291 293 TO 295 297 TO 299 301 TO 303 305 TO 307 309 TO 314 -
316 TO 321 323 TO 328 333 TO 335 337 TO 342 344 TO 349 351 TO 353 -
355 TO 357 359 TO 361 363 TO 365 367 TO 369 371 TO 376 378 TO 383 -
385 TO 390 395 TO 397 399 TO 404 406 TO 411 413 TO 415 417 TO 419 -
421 TO 423 425 TO 427 429 TO 431 433 TO 438 440 TO 445 447 TO 452 -
457 TO 459 461 TO 466 468 TO 473 475 TO 477 479 TO 481 483 TO 485 -
487 TO 489 491 TO 493 495 TO 500 502 TO 507 509 TO 514 519 TO 521 -
523 TO 528 530 TO 535 537 TO 539 541 TO 543 545 TO 547 549 TO 551 -
553 TO 555 557 TO 562 564 TO 569 571 TO 576 578 TO 583 585 TO 590 -
592 TO 597 622 TO 624 626 TO 631 633 TO 638 640 TO 645 647 TO 652 -
654 TO 659 661 TO 663 665 TO 667 669 TO 671 673 TO 675 677 TO 679 -
681 TO 686 688 TO 693 695 TO 700 702 TO 707 709
SELFWEIGHT Y -1 LIST 710 TO 714 716 TO 721 728 729 732 TO 735 738 739 751 -
755 TO 757 760 TO 762 766 776 TO 780 782 784 TO 795 797 799 TO 810 812 814 -
815 TO 820 829 TO 832 838 841 843 TO 849
MEMBER LOAD
9"wall load with opening
130 131 137 138 144 145 151 152 158 159 165 166 185 186 289 290 309 310 351 -
352 371 372 380 408 413 TO 415 419 431 433 434 442 470 475 476 495 496 537 -
538 557 558 661 662 681 682 688 689 695 696 702 703 709 710 716 717 780 782 -
795 797 UNI GY -9.37
**4"wall load **

169 170 173 174 177 178 181 182 192 193 199 200 206 207 213 214 220 221 254 -
255 261 262 268 269 275 276 282 283 293 294 297 298 301 302 305 306 316 317 -
323 324 337 338 344 345 355 356 359 360 363 364 367 368 378 379 385 386 399 -
400 406 407 417 418 421 422 425 426 429 430 440 441 447 448 461 462 468 469 -
479 480 483 484 487 488 491 492 497 502 503 509 510 523 524 530 531 541 542 -
545 546 549 550 553 554 564 565 571 572 578 579 585 586 592 593 626 627 633 -
634 640 641 647 648 654 655 665 666 669 670 673 674 677 678 786 TO 790 801 -
802 TO 805 810 816 TO 820 UNI GY -6.69
4"Parapet wall
132 139 146 153 160 167 187 291 311 353 373 477 539 559 663 683 690 697 704 -
711 718 751 755 TO 757 760 762 766 812 838 841 845 TO 849 UNI GY -2.34
FLOOR LOAD
YRANGE 3.48 10.5 FLOAD -4.125 XRANGE 0 22 ZRANGE 0 5.4 GY
YRANGE 3.48 10.5 FLOAD -4.125 XRANGE 0 9 ZRANGE 5.9 15.3 GY
YRANGE 3.48 10.44 FLOAD -4.125 XRANGE 13 22 ZRANGE 5.9 15.3 GY
YRANGE 3.48 10.5 FLOAD -4.125 XRANGE 0 9 ZRANGE 19 29 GY
YRANGE 3.48 10.5 FLOAD -4.125 XRANGE 13 22 ZRANGE 19 29 GY
YRANGE 3.4 10.5 FLOAD -4.125 XRANGE 0 35 ZRANGE 29 35 GY
YRANGE 3.48 10.5 FLOAD -4.125 XRANGE 4.7 9 ZRANGE 15 20 GY
YRANGE 3.48 3.48 FLOAD -4.125 XRANGE 13 22 ZRANGE 15 20 GY
YRANGE 6 10.5 FLOAD -4.125 XRANGE 13 18 ZRANGE 15 20 GY
YRANGE 13 14 FLOAD -4.125 XRANGE 17 22 ZRANGE 15 20 GY
YRANGE 13 14 FLOAD -4.125 XRANGE 0 4.8 ZRANGE 15 20 GY
YRANGE 3.48 14 FLOAD -4.125 XRANGE 21 25 ZRANGE 12 22.5 GY
MEMBER LOAD
413 TO 415 417 TO 419 430 431 434 435 UNI GY -12
LOAD 4 LOADTYPE Live TITLE LL
FLOOR LOAD
live load for Rooms
YRANGE 3.48 7 FLOAD -4 XRANGE 0 22 ZRANGE 0 5.4 GY
YRANGE 3.48 7 FLOAD -4 XRANGE 0 9 ZRANGE 5.9 15.3 GY
YRANGE 3.48 7 FLOAD -4 XRANGE 13 22 ZRANGE 5.9 15.3 GY
YRANGE 3.48 7 FLOAD -4 XRANGE 0 9 ZRANGE 19 29 GY
YRANGE 3.48 7 FLOAD -4 XRANGE 13 22 ZRANGE 19 29 GY
YRANGE 3.4 7 FLOAD -4 XRANGE 0 35 ZRANGE 29 35 GY
YRANGE 3.48 7 FLOAD -4 XRANGE 4.7 9 ZRANGE 15 20 GY
YRANGE 3.48 3.48 FLOAD -4 XRANGE 13 22 ZRANGE 15 20 GY
YRANGE 6 7 FLOAD -4 XRANGE 13 18 ZRANGE 15 20 GY
YRANGE 3.48 10.5 FLOAD -4 XRANGE 21 25 ZRANGE 12 22.5 GY
live load for Rooms
YRANGE 10 10.5 FLOAD -1.5 XRANGE 0 22 ZRANGE 0 5.4 GY
YRANGE 10 10.5 FLOAD -1.5 XRANGE 0 9 ZRANGE 5.9 15.3 GY
YRANGE 10 10.44 FLOAD -1.5 XRANGE 13 22 ZRANGE 5.9 15.3 GY
YRANGE 10 10.5 FLOAD -1.5 XRANGE 0 9 ZRANGE 19 29 GY
YRANGE 10 10.5 FLOAD -1.5 XRANGE 13 22 ZRANGE 19 29 GY
YRANGE 10 10.5 FLOAD -1.5 XRANGE 0 35 ZRANGE 29 35 GY
YRANGE 10 10.5 FLOAD -1.5 XRANGE 4.7 9 ZRANGE 15 20 GY
YRANGE 10 10.5 FLOAD -1.5 XRANGE 13 18 ZRANGE 15 20 GY
YRANGE 13 14 FLOAD -1.5 XRANGE 17 22 ZRANGE 15 20 GY
YRANGE 13 14 FLOAD -1.5 XRANGE 0 4.8 ZRANGE 15 20 GY
YRANGE 13 14 FLOAD -1.5 XRANGE 21 25 ZRANGE 12 22.5 GY
LOAD COMB 5 1.2(DL+LL+EQX)
3 1.2 4 1.2 1 1.2
LOAD COMB 6 1.2(DL+LL-EQX)
3 1.2 4 1.2 1 -1.2
LOAD COMB 7 1.2(DL+LL+EQZ)
3 1.2 4 1.2

```
LOAD COMB 8 1.2(DL+LL-EQZ)
3 1.2 4 1.2
LOAD COMB 9 1.5(DL+EQX)
3 1.5 1 1.5
LOAD COMB 10 1.5(DL-EQX)
3 1.5 1 -1.5
LOAD COMB 11 1.5(DL+EQZ)
3 1.5
LOAD COMB 12 1.5(DL-EQZ)
3 1.5
LOAD COMB 13 0.9DL+1.5EQX
3 0.9 1 1.5
LOAD COMB 14 0.9DL-1.5EQX
3 0.9 1 -1.5
LOAD COMB 15 0.9DL+1.5EQZ
3 0.9
LOAD COMB 16 0.9DL-1.5EQZ
3 0.9
LOAD COMB 17 1.5(DL+LL)
3 1.5 4 1.5
LOAD COMB 18 (DL+LL)
3 1.0 4 1.0
PERFORM ANALYSIS
LOAD LIST ALL
PRINT STORY DRIFT
START CONCRETE DESIGN
CODE INDIAN
FC 20000 ALL
FYMAIN 500000 ALL
FYSEC 500000 ALL
MAXMAIN 25 ALL
MAXSEC 12 ALL
MINMAIN 12 ALL
MINSEC 8 ALL
RATIO 4 ALL
DESIGN COLUMN 30 79 128 133 TO 135 140 TO 142 147 TO 149 154 TO 156 -
161 TO 163 188 TO 190 195 TO 197 202 TO 204 209 TO 211 216 TO 218 -
223 TO 225 250 TO 252 257 TO 259 264 TO 266 271 TO 273 278 TO 280 -
285 TO 287 312 TO 314 319 TO 321 326 TO 328 333 TO 335 340 TO 342 -
347 TO 349 374 TO 376 381 TO 383 388 TO 390 395 TO 397 402 TO 404 -
409 TO 411 436 TO 438 443 TO 445 450 TO 452 457 TO 459 464 TO 466 -
471 TO 473 498 TO 500 505 TO 507 512 TO 514 519 TO 521 526 TO 528 -
533 TO 535 560 TO 562 567 TO 569 574 TO 576 581 TO 583 588 TO 590 -
595 TO 597 622 TO 624 629 TO 631 636 TO 638 643 TO 645 650 TO 652 -
657 TO 659 684 TO 686 691 TO 693 698 TO 700 705 TO 707 712 TO 714 -
719 TO 721 728 729 732 TO 735 738 739 776 TO 779 791 TO 794 806 TO 809 829 -
830 TO 832
DESIGN BEAM 130 TO 132 137 TO 139 144 TO 146 151 TO 153 158 TO 160 -
165 TO 167 169 TO 171 173 TO 175 177 TO 179 181 TO 183 185 TO 187 -
192 TO 194 199 TO 201 206 TO 208 213 TO 215 220 TO 222 254 TO 256 -
261 TO 263 268 TO 270 275 TO 277 282 TO 284 289 TO 291 293 TO 295 -
297 TO 299 301 TO 303 305 TO 307 309 TO 311 316 TO 318 323 TO 325 -
337 TO 339 344 TO 346 351 TO 353 355 TO 357 359 TO 361 363 TO 365 -
367 TO 369 371 TO 373 378 TO 380 385 TO 387 399 TO 401 406 TO 408 -
413 TO 415 417 TO 419 421 TO 423 425 TO 427 429 TO 431 433 TO 435 -
440 TO 442 447 TO 449 461 TO 463 468 TO 470 475 TO 477 479 TO 481 -
483 TO 485 487 TO 489 491 TO 493 495 TO 497 502 TO 504 509 TO 511 -
```

523 TO 525 530 TO 532 537 TO 539 541 TO 543 545 TO 547 549 TO 551 -
553 TO 555 557 TO 559 564 TO 566 571 TO 573 578 TO 580 585 TO 587 -
592 TO 594 626 TO 628 633 TO 635 640 TO 642 647 TO 649 654 TO 656 -
661 TO 663 665 TO 667 669 TO 671 673 TO 675 677 TO 679 681 TO 683 -
688 TO 690 695 TO 697 702 TO 704 709 TO 711 716 TO 718 751 755 TO 757 760 -
761 TO 762 766 780 782 784 TO 790 795 797 799
DESIGN BEAM 800 TO 805 810 812 814 TO 820 838 841 843 TO 849
END CONCRETE DESIGN
FINISH

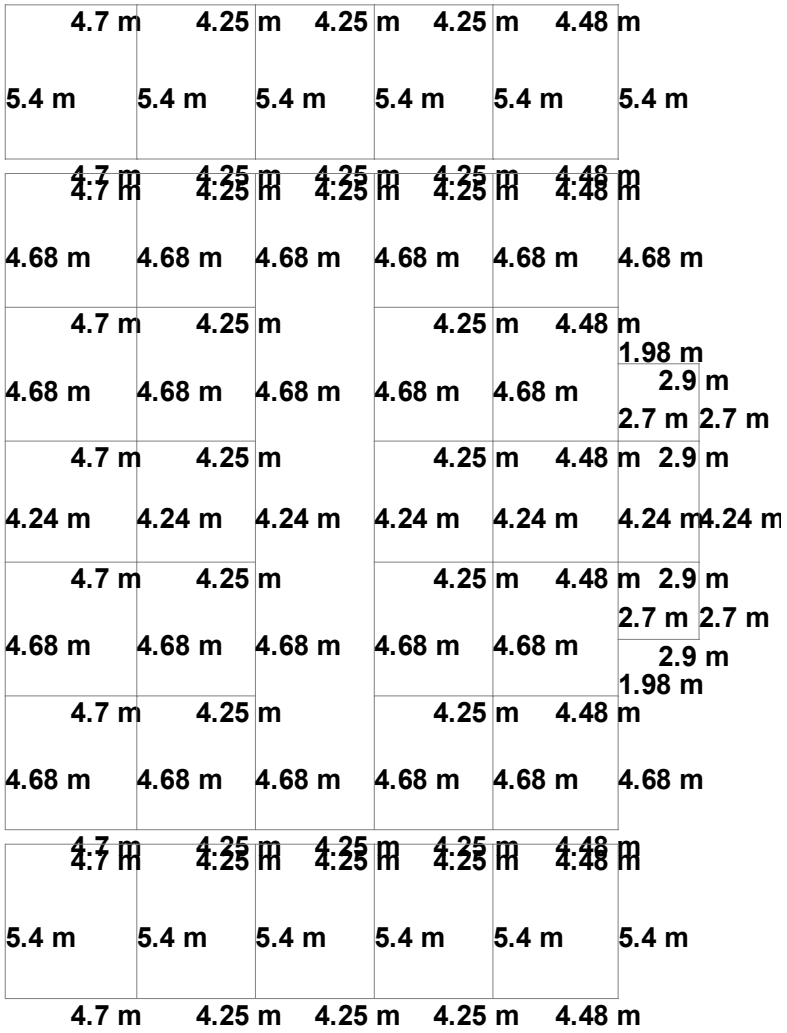

Fig: Typical Plan

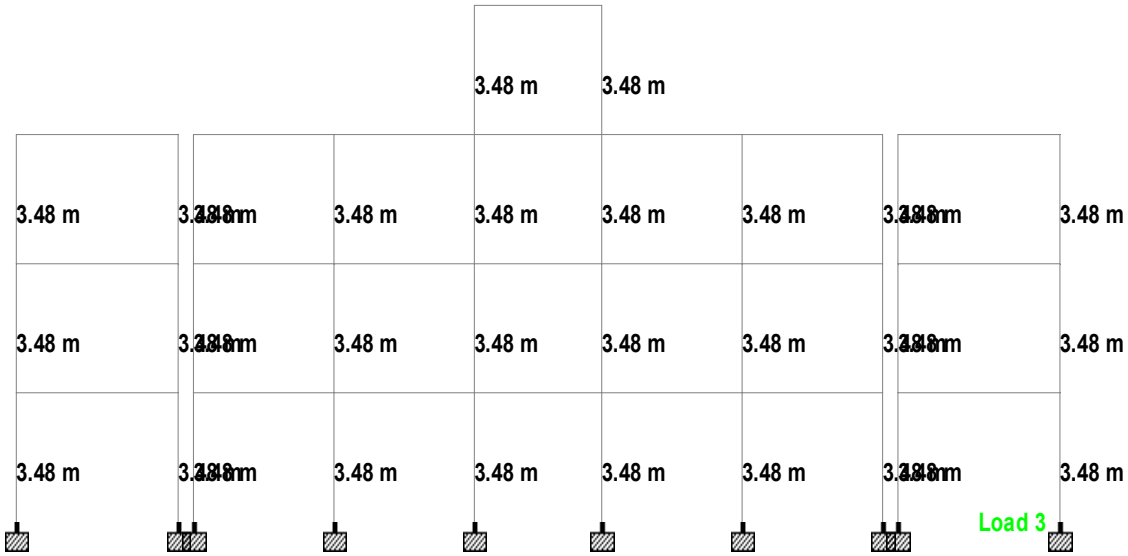

Fig: ELEVATIONAL VIEW

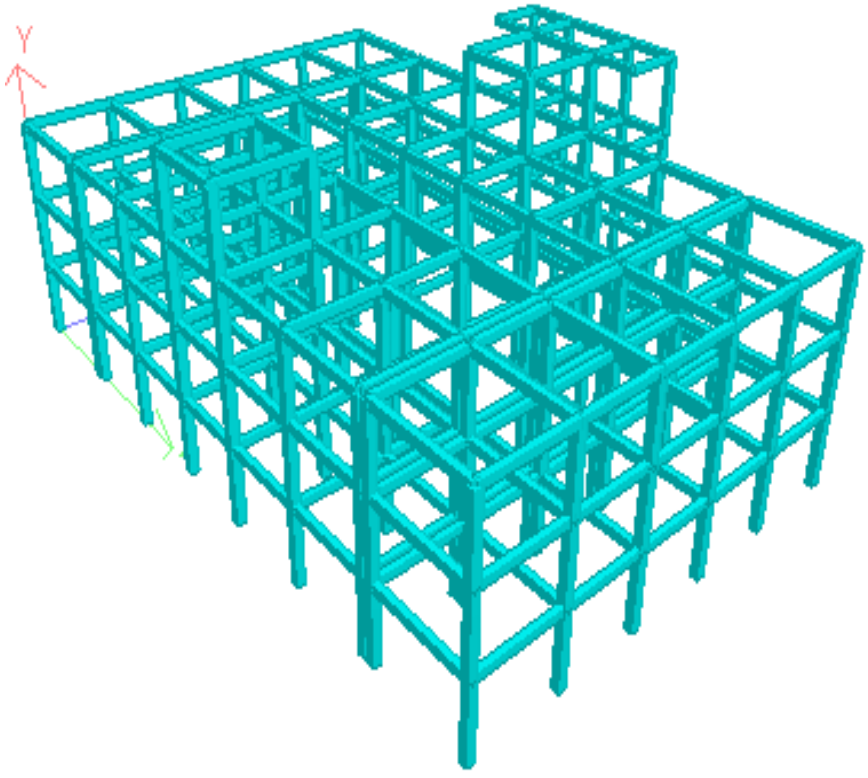

Fig: 3D VIEW

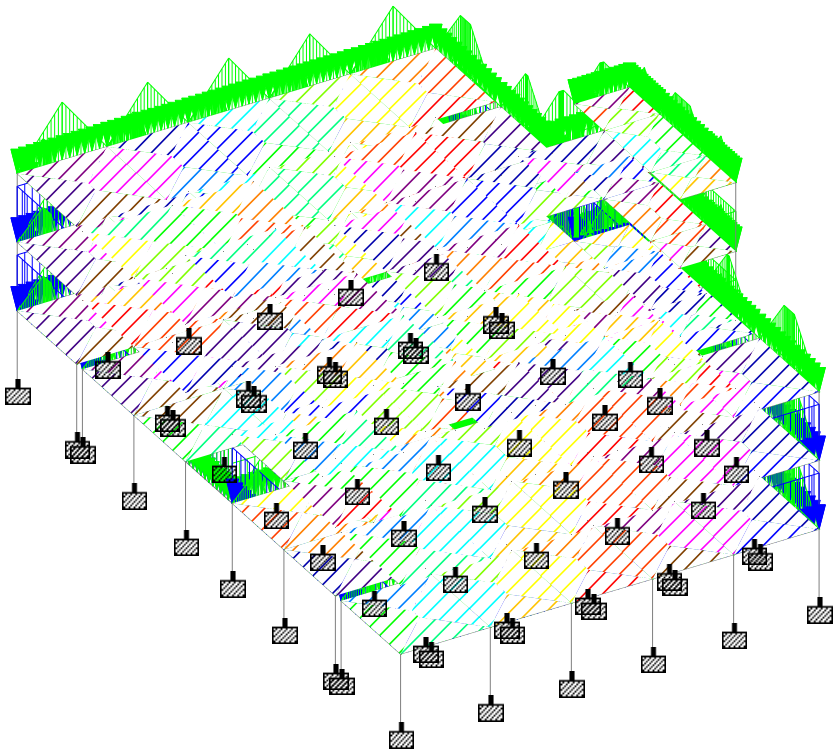

Fig: Dead Load

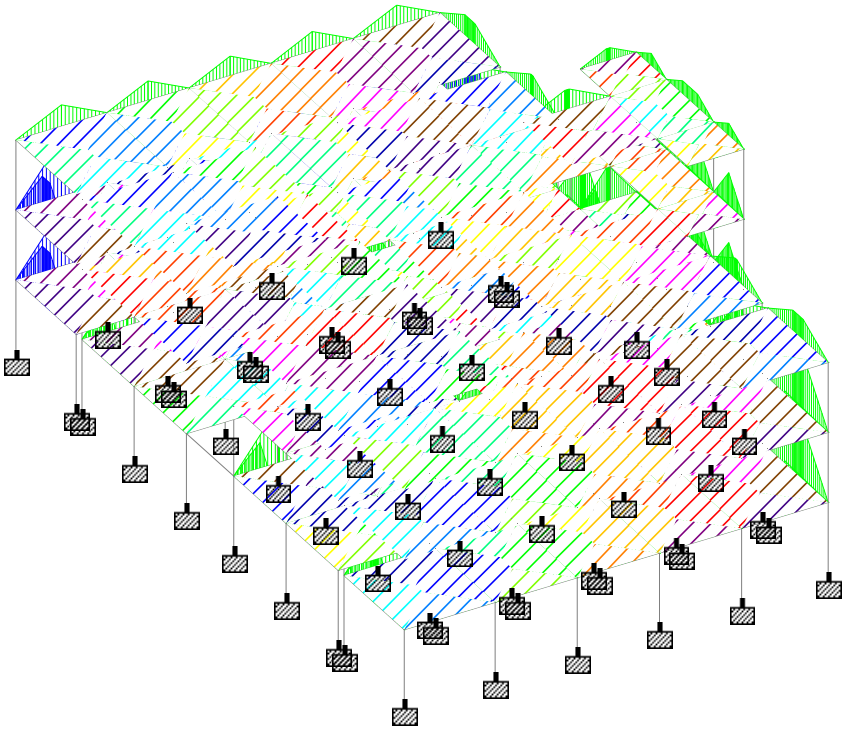

Fig: Live Load

3. RESULT OUTPUTS

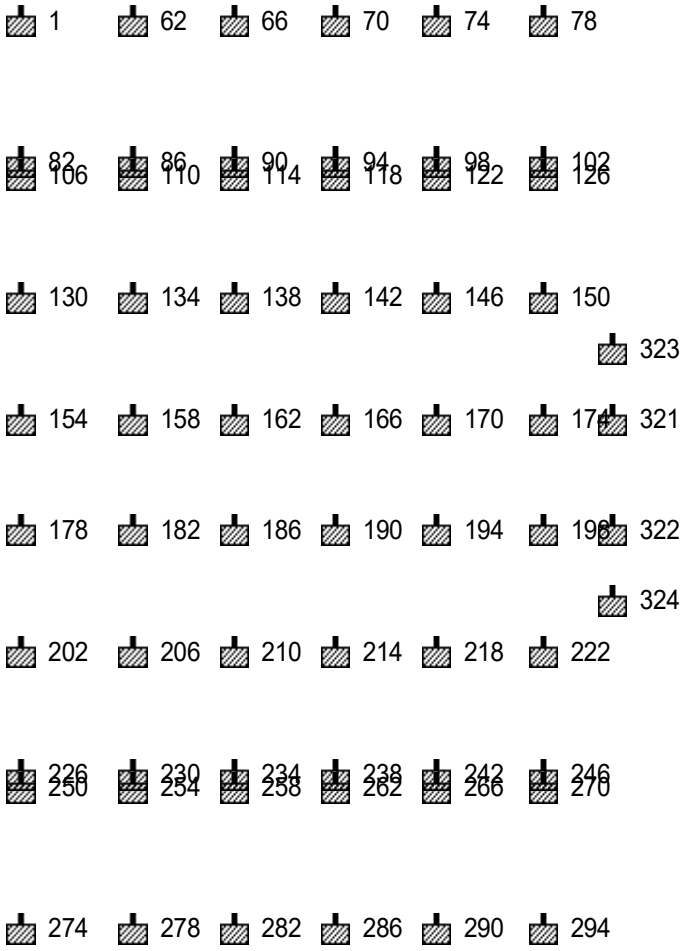

Fig: Node no.

3.1 Support Reactions

		Horizontal	Vertical	Horizontal	Moment		
Node	L/C	Fx kN	Fy kN	Fz kN	Mx kNm	My kNm	Mz kNm
1	18 (DL+LL)	0	336.07	0	0	0	-0.194
62	18 (DL+LL)	0	497.572	0	0	0	-0.194
66	18 (DL+LL)	0	480.604	0	0	0	-0.194
70	18 (DL+LL)	0	480.367	0	0	0	-0.194
74	18 (DL+LL)	0	486.834	0	0	0	-0.194
78	18 (DL+LL)	0	324.325	0	0	0	-0.194
82	18 (DL+LL)	0	318.114	0	0	0	-0.194
86	18	0	464.224	0	0	0	-0.194

	(DL+LL)						
90	18 (DL+LL)	0	448.639	0	0	0	-0.194
94	18 (DL+LL)	0	448.421	0	0	0	-0.194
98	18 (DL+LL)	0	454.368	0	0	0	-0.194
102	18 (DL+LL)	0	307.189	0	0	0	-0.194
106	18 (DL+LL)	0	291.699	0	0	0	-0.194
110	18 (DL+LL)	0	423.166	0	0	0	-0.194
114	18 (DL+LL)	0	302.727	0	0	0	-0.194
118	18 (DL+LL)	0	302.567	0	0	0	-0.194
122	18 (DL+LL)	0	414.191	0	0	0	-0.194
126	18 (DL+LL)	0	282.68	0	0	0	-0.194
130	18 (DL+LL)	0	477.121	0	0	0	-0.194
134	18 (DL+LL)	0	689.097	0	0	0	-0.194
138	18 (DL+LL)	0	413.279	0	0	0	-0.194
142	18 (DL+LL)	0	415.224	0	0	0	-0.194
146	18 (DL+LL)	0	675.929	0	0	0	-0.194
150	18 (DL+LL)	0	524.187	0	0	0	-0.194
154	18 (DL+LL)	0	550.009	0	0	0	-0.311
158	18 (DL+LL)	0	756.51	0	0	0	-0.311
162	18 (DL+LL)	0	414.876	0	0	0	-0.311
166	18 (DL+LL)	0	417.263	0	0	0	-0.311
170	18 (DL+LL)	0	764.53	0	0	0	-0.311
174	18 (DL+LL)	0	693.174	0	0	0	-0.311
178	18 (DL+LL)	0	550.009	0	0	0	-0.311
182	18 (DL+LL)	0	756.51	0	0	0	-0.311
186	18 (DL+LL)	0	414.876	0	0	0	-0.311
190	18 (DL+LL)	0	417.263	0	0	0	-0.311
194	18 (DL+LL)	0	764.53	0	0	0	-0.311
198	18 (DL+LL)	0	693.174	0	0	0	-0.311

202	18 (DL+LL)	0	477.121	0	0	0	-0.194
206	18 (DL+LL)	0	689.097	0	0	0	-0.194
210	18 (DL+LL)	0	413.279	0	0	0	-0.194
214	18 (DL+LL)	0	415.224	0	0	0	-0.194
218	18 (DL+LL)	0	675.929	0	0	0	-0.194
222	18 (DL+LL)	0	524.187	0	0	0	-0.194
226	18 (DL+LL)	0	291.699	0	0	0	-0.194
230	18 (DL+LL)	0	423.166	0	0	0	-0.194
234	18 (DL+LL)	0	302.727	0	0	0	-0.194
238	18 (DL+LL)	0	302.567	0	0	0	-0.194
242	18 (DL+LL)	0	414.191	0	0	0	-0.194
246	18 (DL+LL)	0	282.68	0	0	0	-0.194
250	18 (DL+LL)	0	318.114	0	0	0	-0.194
254	18 (DL+LL)	0	464.224	0	0	0	-0.194
258	18 (DL+LL)	0	448.639	0	0	0	-0.194
262	18 (DL+LL)	0	448.422	0	0	0	-0.194
266	18 (DL+LL)	0	454.368	0	0	0	-0.194
270	18 (DL+LL)	0	307.189	0	0	0	-0.194
274	18 (DL+LL)	0	336.07	0	0	0	-0.194
278	18 (DL+LL)	0	497.572	0	0	0	-0.194
282	18 (DL+LL)	0	480.604	0	0	0	-0.194
286	18 (DL+LL)	0	480.367	0	0	0	-0.194
290	18 (DL+LL)	0	486.834	0	0	0	-0.194
294	18 (DL+LL)	0	324.325	0	0	0	-0.194
321	18 (DL+LL)	0	311.166	0	0	0	-0.114
322	18 (DL+LL)	0	311.166	0	0	0	-0.114
323	18 (DL+LL)	0	242.129	0	0	0	-0.114
324	18 (DL+LL)	0	242.129	0	0	0	-0.114

3.2 STORY DRIFT

STORY	HEIGHT		AVG. DISP(CM)		DRIFT(CM)		RATIO
	(METE)		X	Z	X	Z	
BASE=	0.00						
1	0.00	1	0.0000	0.0000	0.0000	0.0000	L /999999
		2	0.0000	0.0000	0.0000	0.0000	L /999999
		3	0.0000	0.0000	0.0000	0.0000	L /999999
		4	0.0000	0.0000	0.0000	0.0000	L /999999
		5	0.0000	0.0000	0.0000	0.0000	L /999999
		6	0.0000	0.0000	0.0000	0.0000	L /999999
		7	0.0000	0.0000	0.0000	0.0000	L /999999
		8	0.0000	0.0000	0.0000	0.0000	L /999999
		9	0.0000	0.0000	0.0000	0.0000	L /999999
		10	0.0000	0.0000	0.0000	0.0000	L /999999
		11	0.0000	0.0000	0.0000	0.0000	L /999999
		12	0.0000	0.0000	0.0000	0.0000	L /999999
		13	0.0000	0.0000	0.0000	0.0000	L /999999
		14	0.0000	0.0000	0.0000	0.0000	L /999999
		15	0.0000	0.0000	0.0000	0.0000	L /999999
		16	0.0000	0.0000	0.0000	0.0000	L /999999
		17	0.0000	0.0000	0.0000	0.0000	L /999999
		18	0.0000	0.0000	0.0000	0.0000	L /999999
2	3.48	1	0.7107	0.0000	0.7107	0.0000	L / 489
		2	0.0000	0.7369	0.0000	0.7369	L / 472
		3	-0.0019	0.0000	0.0019	0.0000	L /186076
		4	-0.0006	0.0000	0.0006	0.0000	L /586266
		5	0.8499	0.0000	0.8499	0.0000	L / 409
		6	-0.8558	0.0000	0.8558	0.0000	L / 406
		7	-0.0030	0.0000	0.0030	0.0000	L /117705
		8	-0.0030	0.0000	0.0030	0.0000	L /117705
		9	1.0632	0.0000	1.0632	0.0000	L / 327
		10	-1.0688	0.0000	1.0688	0.0000	L / 325
		11	-0.0028	0.0000	0.0028	0.0000	L /124051
		12	-0.0028	0.0000	0.0028	0.0000	L /124051
		13	1.0643	0.0000	1.0643	0.0000	L / 327
		14	-1.0677	0.0000	1.0677	0.0000	L / 326
		15	-0.0017	0.0000	0.0017	0.0000	L /206752
		16	-0.0017	0.0000	0.0017	0.0000	L /206752
		17	-0.0037	0.0000	0.0037	0.0000	L / 94164
		18	-0.0025	0.0000	0.0025	0.0000	L /141246
3	6.96	1	1.6933	0.0000	0.9826	0.0000	L / 354
		2	0.0000	1.7684	0.0000	1.0315	L / 337
		3	-0.0061	0.0000	0.0042	0.0000	L / 82010
		4	-0.0019	0.0000	0.0013	0.0000	L /271752
		5	2.0224	0.0000	1.1725	0.0000	L / 297
		6	-2.0416	0.0000	1.1858	0.0000	L / 293
		7	-0.0096	0.0000	0.0066	0.0000	L / 52498
		8	-0.0096	0.0000	0.0066	0.0000	L / 52498
		9	2.5308	0.0000	1.4676	0.0000	L / 237
		10	-2.5492	0.0000	1.4803	0.0000	L / 235

	11	-0.0092	0.0000	0.0064	0.0000 L / 54673
	12	-0.0092	0.0000	0.0064	0.0000 L / 54673
	13	2.5345	0.0000	1.4701	0.0000 L / 237
	14	-2.5455	0.0000	1.4778	0.0000 L / 235
	15	-0.0055	0.0000	0.0038	0.0000 L / 91122
	16	-0.0055	0.0000	0.0038	0.0000 L / 91122
	17	-0.0120	0.0000	0.0083	0.0000 L / 41999
	18	-0.0080	0.0000	0.0055	0.0000 L / 62998
4	10.44	1	2.3804	0.0000	0.6871	0.0000 L / 506
	2	0.0000	2.5001	0.0000	0.7318 L / 475
	3	-0.0112	0.0000	0.0051	0.0000 L / 68572
	4	-0.0031	0.0000	0.0012	0.0000 L /279533
	5	2.8394	0.0000	0.8170	0.0000 L / 426
	6	-2.8737	0.0000	0.8321	0.0000 L / 418
	7	-0.0172	0.0000	0.0076	0.0000 L / 45887
	8	-0.0172	0.0000	0.0076	0.0000 L / 45887
	9	3.5539	0.0000	1.0231	0.0000 L / 340
	10	-3.5874	0.0000	1.0383	0.0000 L / 335
	11	-0.0168	0.0000	0.0076	0.0000 L / 45715
	12	-0.0168	0.0000	0.0076	0.0000 L / 45715
	13	3.5606	0.0000	1.0261	0.0000 L / 339
	14	-3.5807	0.0000	1.0352	0.0000 L / 336
	15	-0.0101	0.0000	0.0046	0.0000 L / 76191
	16	-0.0101	0.0000	0.0046	0.0000 L / 76191
	17	-0.0215	0.0000	0.0095	0.0000 L / 36709
	18	-0.0143	0.0000	0.0063	0.0000 L / 55064
5	13.92	1	3.1449	0.0000	0.7644	0.0000 L / 455
	2	0.0000	3.2791	0.0000	0.7790 L / 447
	3	-0.0298	0.0000	0.0186	0.0000 L / 18668
	4	-0.0057	0.0000	0.0026	0.0000 L /136388
	5	3.7312	0.0000	0.8919	0.0000 L / 390
	6	-3.8164	0.0000	0.9427	0.0000 L / 369
	7	-0.0426	0.0000	0.0254	0.0000 L / 13684
	8	-0.0426	0.0000	0.0254	0.0000 L / 13684
	9	4.6725	0.0000	1.1187	0.0000 L / 311
	10	-4.7620	0.0000	1.1746	0.0000 L / 296
	11	-0.0447	0.0000	0.0280	0.0000 L / 12445
	12	-0.0447	0.0000	0.0280	0.0000 L / 12445
	13	4.6904	0.0000	1.1298	0.0000 L / 308
	14	-4.7441	0.0000	1.1634	0.0000 L / 299
	15	-0.0268	0.0000	0.0168	0.0000 L / 20742
	16	-0.0268	0.0000	0.0168	0.0000 L / 20742
	17	-0.0533	0.0000	0.0318	0.0000 L / 10947
	18	-0.0355	0.0000	0.0212	0.0000 L / 16421

3.3 Column Design Output

C O L U M N N O. 30 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 13 END JOINT: 1 SHORT COLUMN

REQD. STEEL AREA : 2501.88 Sq.mm.
REQD. CONCRETE AREA: 157498.12 Sq.mm.

C O L U M N N O. 79 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 13 END JOINT: 41 SHORT COLUMN

STAAD SPACE -- PAGE NO. 14

REQD. STEEL AREA : 1638.18 Sq.mm.
REQD. CONCRETE AREA: 158361.81 Sq.mm.

C O L U M N N O. 128 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 1 END JOINT: 41 SHORT COLUMN

REQD. STEEL AREA : 1280.00 Sq.mm.
REQD. CONCRETE AREA: 158720.00 Sq.mm.

C O L U M N N O. 133 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 9 END JOINT: 62 SHORT COLUMN

REQD. STEEL AREA : 2394.33 Sq.mm.
REQD. CONCRETE AREA: 157605.67 Sq.mm.

C O L U M N N O. 134 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 13 END JOINT: 64 SHORT COLUMN

STAAD SPACE -- PAGE NO. 16

REQD. STEEL AREA : 1480.55 Sq.mm.
REQD. CONCRETE AREA: 158519.45 Sq.mm.

C O L U M N N O. 135 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 1 END JOINT: 64 SHORT COLUMN

REQD. STEEL AREA : 1280.00 Sq.mm.
REQD. CONCRETE AREA: 158720.00 Sq.mm.

C O L U M N N O. 140 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 10 END JOINT: 66 SHORT COLUMN

REQD. STEEL AREA : 2402.64 Sq.mm.
REQD. CONCRETE AREA: 157597.36 Sq.mm.

C O L U M N N O. 141 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 13 END JOINT: 68 SHORT COLUMN

STAAD SPACE -- PAGE NO. 18

REQD. STEEL AREA : 1477.66 Sq.mm.
REQD. CONCRETE AREA: 158522.34 Sq.mm.

C O L U M N N O. 142 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 1 END JOINT: 68 SHORT COLUMN

REQD. STEEL AREA : 1280.00 Sq.mm.
REQD. CONCRETE AREA: 158720.00 Sq.mm.

C O L U M N N O. 147 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 9 END JOINT: 70 SHORT COLUMN

REQD. STEEL AREA : 2400.30 Sq.mm.
REQD. CONCRETE AREA: 157599.70 Sq.mm.

C O L U M N N O. 148 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 14 END JOINT: 72 SHORT COLUMN

REQD. STEEL AREA : 1485.74 Sq.mm.
REQD. CONCRETE AREA: 158514.27 Sq.mm.

C O L U M N N O. 149 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 2 END JOINT: 72 SHORT COLUMN

REQD. STEEL AREA : 1280.00 Sq.mm.
REQD. CONCRETE AREA: 158720.00 Sq.mm.

C O L U M N N O. 154 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 9 END JOINT: 74 SHORT COLUMN

REQD. STEEL AREA : 2402.27 Sq.mm.
REQD. CONCRETE AREA: 157597.73 Sq.mm.

C O L U M N N O. 155 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 14 END JOINT: 76 SHORT COLUMN

REQD. STEEL AREA : 1485.65 Sq.mm.
REQD. CONCRETE AREA: 158514.34 Sq.mm.

C O L U M N N O. 156 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 2 END JOINT: 76 SHORT COLUMN

REQD. STEEL AREA : 1280.00 Sq.mm.
REQD. CONCRETE AREA: 158720.00 Sq.mm.

C O L U M N N O. 161 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 14 END JOINT: 78 SHORT COLUMN

REQD. STEEL AREA : 2536.86 Sq.mm.
REQD. CONCRETE AREA: 157463.14 Sq.mm.

C O L U M N N O. 162 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 14 END JOINT: 80 SHORT COLUMN

STAAD SPACE -- PAGE NO. 24

REQD. STEEL AREA : 1658.97 Sq.mm.
REQD. CONCRETE AREA: 158341.03 Sq.mm.

C O L U M N N O. 163 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 2 END JOINT: 80 SHORT COLUMN

REQD. STEEL AREA : 1280.00 Sq.mm.
REQD. CONCRETE AREA: 158720.00 Sq.mm.

C O L U M N N O. 188 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 13 END JOINT: 82 SHORT COLUMN

REQD. STEEL AREA : 2402.24 Sq.mm.
REQD. CONCRETE AREA: 157597.77 Sq.mm.

C O L U M N N O. 189 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 13 END JOINT: 84 SHORT COLUMN

STAAD SPACE -- PAGE NO. 26

REQD. STEEL AREA : 1549.21 Sq.mm.
REQD. CONCRETE AREA: 158450.78 Sq.mm.

C O L U M N N O. 190 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 1 END JOINT: 84 SHORT COLUMN

REQD. STEEL AREA : 1280.00 Sq.mm.
REQD. CONCRETE AREA: 158720.00 Sq.mm.

C O L U M N N O. 195 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 13 END JOINT: 86 SHORT COLUMN

REQD. STEEL AREA : 2271.28 Sq.mm.
REQD. CONCRETE AREA: 157728.72 Sq.mm.

C O L U M N N O. 196 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 13 END JOINT: 88 SHORT COLUMN

REQD. STEEL AREA : 1406.56 Sq.mm.
REQD. CONCRETE AREA: 158593.44 Sq.mm.

C O L U M N N O. 197 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 1 END JOINT: 88 SHORT COLUMN

REQD. STEEL AREA : 1280.00 Sq.mm.
REQD. CONCRETE AREA: 158720.00 Sq.mm.

C O L U M N N O. 202 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 14 END JOINT: 90 SHORT COLUMN

REQD. STEEL AREA : 2253.12 Sq.mm.
REQD. CONCRETE AREA: 157746.88 Sq.mm.

C O L U M N N O. 203 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 13 END JOINT: 92 SHORT COLUMN

REQD. STEEL AREA : 1391.51 Sq.mm.
REQD. CONCRETE AREA: 158608.50 Sq.mm.

C O L U M N N O. 204 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 1 END JOINT: 92 SHORT COLUMN

REQD. STEEL AREA : 1280.00 Sq.mm.
REQD. CONCRETE AREA: 158720.00 Sq.mm.

C O L U M N N O. 209 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 14 END JOINT: 94 SHORT COLUMN

REQD. STEEL AREA : 2271.64 Sq.mm.
REQD. CONCRETE AREA: 157728.36 Sq.mm.

C O L U M N N O. 210 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 14 END JOINT: 96 SHORT COLUMN

STAAD SPACE -- PAGE NO. 32

REQD. STEEL AREA : 1392.36 Sq.mm.
REQD. CONCRETE AREA: 158607.64 Sq.mm.

C O L U M N N O. 211 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 14 END JOINT: 97 SHORT COLUMN

REQD. STEEL AREA : 921.84 Sq.mm.
REQD. CONCRETE AREA: 115229.41 Sq.mm.

C O L U M N N O. 216 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 14 END JOINT: 98 SHORT COLUMN

REQD. STEEL AREA : 2272.11 Sq.mm.
REQD. CONCRETE AREA: 157727.89 Sq.mm.

C O L U M N N O. 217 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 14 END JOINT: 100 SHORT COLUMN

STAAD SPACE -- PAGE NO. 34

REQD. STEEL AREA : 1403.72 Sq.mm.
REQD. CONCRETE AREA: 158596.28 Sq.mm.

C O L U M N N O. 218 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 14 END JOINT: 101 SHORT COLUMN

REQD. STEEL AREA : 927.88 Sq.mm.
REQD. CONCRETE AREA: 115985.06 Sq.mm.

C O L U M N N O. 223 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 14 END JOINT: 102 SHORT COLUMN

REQD. STEEL AREA : 2443.29 Sq.mm.
REQD. CONCRETE AREA: 157556.70 Sq.mm.

C O L U M N N O. 224 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 14 END JOINT: 104 SHORT COLUMN

REQD. STEEL AREA : 1569.74 Sq.mm.
REQD. CONCRETE AREA: 158430.27 Sq.mm.

C O L U M N N O. 225 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 14 END JOINT: 105 SHORT COLUMN

REQD. STEEL AREA : 1023.93 Sq.mm.
REQD. CONCRETE AREA: 127991.84 Sq.mm.

C O L U M N N O. 250 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 13 END JOINT: 106 SHORT COLUMN

REQD. STEEL AREA : 2291.36 Sq.mm.
REQD. CONCRETE AREA: 157708.64 Sq.mm.

C O L U M N N O. 251 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 13 END JOINT: 108 SHORT COLUMN

REQD. STEEL AREA : 1450.53 Sq.mm.
REQD. CONCRETE AREA: 158549.47 Sq.mm.

C O L U M N N O. 252 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 1 END JOINT: 108 SHORT COLUMN

REQD. STEEL AREA : 1280.00 Sq.mm.
REQD. CONCRETE AREA: 158720.00 Sq.mm.

C O L U M N N O. 257 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 13 END JOINT: 110 SHORT COLUMN

REQD. STEEL AREA : 2133.89 Sq.mm.
REQD. CONCRETE AREA: 157866.11 Sq.mm.

C O L U M N N O. 258 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 2 END JOINT: 112 SHORT COLUMN

STAAD SPACE -- PAGE NO. 40

REQD. STEEL AREA : 1536.00 Sq.mm.
REQD. CONCRETE AREA: 158464.00 Sq.mm.

C O L U M N N O. 259 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 1 END JOINT: 112 SHORT COLUMN

REQD. STEEL AREA : 1280.00 Sq.mm.
REQD. CONCRETE AREA: 158720.00 Sq.mm.

C O L U M N N O. 264 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 14 END JOINT: 114 SHORT COLUMN

REQD. STEEL AREA : 2170.30 Sq.mm.
REQD. CONCRETE AREA: 157829.69 Sq.mm.

C O L U M N N O. 265 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 14 END JOINT: 116 SHORT COLUMN

STAAD SPACE -- PAGE NO. 42

REQD. STEEL AREA : 1320.30 Sq.mm.
REQD. CONCRETE AREA: 158679.70 Sq.mm.

C O L U M N N O. 266 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 2 END JOINT: 116 SHORT COLUMN

REQD. STEEL AREA : 1280.00 Sq.mm.
REQD. CONCRETE AREA: 158720.00 Sq.mm.

C O L U M N N O. 271 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 13 END JOINT: 118 SHORT COLUMN

REQD. STEEL AREA : 2166.75 Sq.mm.
REQD. CONCRETE AREA: 157833.25 Sq.mm.

C O L U M N N O. 272 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 13 END JOINT: 120 SHORT COLUMN

REQD. STEEL AREA : 1328.48 Sq.mm.
REQD. CONCRETE AREA: 158671.52 Sq.mm.

C O L U M N N O. 273 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 1 END JOINT: 120 SHORT COLUMN

REQD. STEEL AREA : 1280.00 Sq.mm.
REQD. CONCRETE AREA: 158720.00 Sq.mm.

C O L U M N N O. 278 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 2 END JOINT: 122 SHORT COLUMN

REQD. STEEL AREA : 2176.00 Sq.mm.
REQD. CONCRETE AREA: 157824.00 Sq.mm.

C O L U M N N O. 279 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 2 END JOINT: 123 SHORT COLUMN

REQD. STEEL AREA : 1536.00 Sq.mm.
REQD. CONCRETE AREA: 158464.00 Sq.mm.

C O L U M N N O. 280 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 2 END JOINT: 124 SHORT COLUMN

REQD. STEEL AREA : 1280.00 Sq.mm.
REQD. CONCRETE AREA: 158720.00 Sq.mm.

C O L U M N N O. 285 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 2 END JOINT: 126 SHORT COLUMN

REQD. STEEL AREA : 2432.00 Sq.mm.
REQD. CONCRETE AREA: 157568.00 Sq.mm.

C O L U M N N O. 286 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 2 END JOINT: 128 SHORT COLUMN

STAAD SPACE -- PAGE NO. 48

REQD. STEEL AREA : 1792.00 Sq.mm.
REQD. CONCRETE AREA: 158208.00 Sq.mm.

C O L U M N N O. 287 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 2 END JOINT: 128 SHORT COLUMN

REQD. STEEL AREA : 1280.00 Sq.mm.
REQD. CONCRETE AREA: 158720.00 Sq.mm.

C O L U M N N O. 312 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 10 END JOINT: 130 SHORT COLUMN

REQD. STEEL AREA : 2729.84 Sq.mm.
REQD. CONCRETE AREA: 157270.16 Sq.mm.

C O L U M N N O. 313 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 13 END JOINT: 132 SHORT COLUMN

STAAD SPACE -- PAGE NO. 50

REQD. STEEL AREA : 1761.69 Sq.mm.
REQD. CONCRETE AREA: 158238.31 Sq.mm.

C O L U M N N O. 314 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 1 END JOINT: 132 SHORT COLUMN

REQD. STEEL AREA : 1280.00 Sq.mm.
REQD. CONCRETE AREA: 158720.00 Sq.mm.

C O L U M N N O. 319 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 10 END JOINT: 134 SHORT COLUMN

REQD. STEEL AREA : 2837.89 Sq.mm.
REQD. CONCRETE AREA: 157162.11 Sq.mm.

C O L U M N N O. 320 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 13 END JOINT: 136 SHORT COLUMN

REQD. STEEL AREA : 1607.47 Sq.mm.
REQD. CONCRETE AREA: 158392.53 Sq.mm.

C O L U M N N O. 321 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 1 END JOINT: 136 SHORT COLUMN

REQD. STEEL AREA : 1280.00 Sq.mm.
REQD. CONCRETE AREA: 158720.00 Sq.mm.

C O L U M N N O. 326 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 14 END JOINT: 138 SHORT COLUMN

REQD. STEEL AREA : 2696.70 Sq.mm.
REQD. CONCRETE AREA: 157303.30 Sq.mm.

C O L U M N N O. 327 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 14 END JOINT: 140 SHORT COLUMN

REQD. STEEL AREA : 1806.47 Sq.mm.
REQD. CONCRETE AREA: 158193.53 Sq.mm.

C O L U M N N O. 328 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 2 END JOINT: 140 SHORT COLUMN

REQD. STEEL AREA : 1280.00 Sq.mm.
REQD. CONCRETE AREA: 158720.00 Sq.mm.

C O L U M N N O. 333 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 10 END JOINT: 142 SHORT COLUMN

REQD. STEEL AREA : 2969.82 Sq.mm.
REQD. CONCRETE AREA: 157030.17 Sq.mm.

C O L U M N N O. 334 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 13 END JOINT: 144 SHORT COLUMN

STAAD SPACE -- PAGE NO. 56

REQD. STEEL AREA : 2033.50 Sq.mm.
REQD. CONCRETE AREA: 157966.50 Sq.mm.

C O L U M N N O. 335 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 13 END JOINT: 145 SHORT COLUMN

REQD. STEEL AREA : 1346.98 Sq.mm.
REQD. CONCRETE AREA: 158653.03 Sq.mm.

C O L U M N N O. 340 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 9 END JOINT: 146 SHORT COLUMN

REQD. STEEL AREA : 3069.66 Sq.mm.
REQD. CONCRETE AREA: 156930.33 Sq.mm.

C O L U M N N O. 341 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3480.0 mm CROSS SECTION: 400.0 mm X 400.0 mm
COVER: 40.0 mm

** GUIDING LOAD CASE: 14 END JOINT: 148 SHORT COLUMN

STAAD SPACE -- PAGE NO. 58

REQD. STEEL AREA : 1863.53 Sq.mm.
REQD. CONCRETE AREA: 158136.47 Sq.mm.

3.4 Beam Design Output

B E A M N O. 130 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 4704.0 mm SIZE: 300.0 mm X 400.0 mm COVER: 25.0 mm

SUMMARY OF REINF. AREA (Sq.mm)

SECTION	0.0 mm	1176.0 mm	2352.0 mm	3528.0 mm	4704.0 mm
TOP REINF.	1367.59 (Sq. mm)	433.56 (Sq. mm)	188.19 (Sq. mm)	423.11 (Sq. mm)	1336.58 (Sq. mm)
BOTTOM REINF.	737.34 (Sq. mm)	491.31 (Sq. mm)	243.30 (Sq. mm)	509.34 (Sq. mm)	762.70 (Sq. mm)

B E A M N O. 131 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 4704.0 mm SIZE: 300.0 mm X 400.0 mm COVER: 25.0 mm

STAAD SPACE -- PAGE NO. 151

SUMMARY OF REINF. AREA (Sq.mm)

SECTION	0.0 mm	1176.0 mm	2352.0 mm	3528.0 mm	4704.0 mm
TOP REINF.	1290.37 (Sq. mm)	378.24 (Sq. mm)	0.00 (Sq. mm)	363.10 (Sq. mm)	1238.61 (Sq. mm)
BOTTOM REINF.	602.24 (Sq. mm)	430.09 (Sq. mm)	243.30 (Sq. mm)	456.36 (Sq. mm)	637.29 (Sq. mm)

B E A M N O. 132 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 4704.0 mm SIZE: 300.0 mm X 400.0 mm COVER: 25.0 mm

SUMMARY OF REINF. AREA (Sq.mm)

SECTION	0.0 mm	1176.0 mm	2352.0 mm	3528.0 mm	4704.0

mm

TOP REINF.	765.02 (Sq. mm)	209.79 (Sq. mm)	188.19 (Sq. mm)	193.88 (Sq. mm)	693.03 (Sq. mm)
BOTTOM REINF.	299.10 (Sq. mm)	227.12 (Sq. mm)	188.19 (Sq. mm)	254.16 (Sq. mm)	332.84 (Sq. mm)

B E A M N O. 137 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 4247.0 mm SIZE: 300.0 mm X 400.0 mm COVER: 25.0 mm

SUMMARY OF REINF. AREA (Sq.mm)

SECTION	0.0 mm	1061.8 mm	2123.5 mm	3185.2 mm	4247.0 mm
TOP REINF.	1386.15 (Sq. mm)	491.49 (Sq. mm)	0.00 (Sq. mm)	488.64 (Sq. mm)	1377.88 (Sq. mm)
BOTTOM REINF.	922.70 (Sq. mm)	553.48 (Sq. mm)	187.64 (Sq. mm)	558.47 (Sq. mm)	927.67 (Sq. mm)

B E A M N O. 138 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 4247.0 mm SIZE: 300.0 mm X 400.0 mm COVER: 25.0 mm

SUMMARY OF REINF. AREA (Sq.mm)

SECTION	0.0 mm	1061.8 mm	2123.5 mm	3185.2 mm	4247.0 mm
TOP REINF.	1292.36 (Sq. mm)	427.38 (Sq. mm)	0.00 (Sq. mm)	424.22 (Sq. mm)	1282.70 (Sq. mm)
BOTTOM REINF.	806.36 (Sq. mm)	482.19 (Sq. mm)	188.19 (Sq. mm)	487.63 (Sq. mm)	814.52 (Sq. mm)

B E A M N O. 139 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 4247.0 mm SIZE: 300.0 mm X 400.0 mm COVER: 25.0 mm

SUMMARY OF REINF. AREA (Sq.mm)

SECTION	0.0 mm	1061.8 mm	2123.5 mm	3185.2 mm	4247.0 mm
TOP REINF.	743.85 (Sq. mm)	234.40 (Sq. mm)	0.00 (Sq. mm)	231.18 (Sq. mm)	729.39 (Sq. mm)
BOTTOM REINF.	404.28 (Sq. mm)	260.63 (Sq. mm)	188.19 (Sq. mm)	266.10 (Sq. mm)	411.36 (Sq. mm)

B E A M N O. 144 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 4247.0 mm SIZE: 300.0 mm X 400.0 mm COVER: 25.0 mm

SUMMARY OF REINF. AREA (Sq.mm)

SECTION	0.0 mm	1061.8 mm	2123.5 mm	3185.3 mm	4247.0 mm
TOP REINF.	1389.89 (Sq. mm)	493.31 (Sq. mm)	0.00 (Sq. mm)	489.47 (Sq. mm)	1378.76 (Sq. mm)
BOTTOM REINF.	924.16 (Sq. mm)	554.01 (Sq. mm)	187.64 (Sq. mm)	560.73 (Sq. mm)	930.83 (Sq. mm)

B E A M N O. 145 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 4247.0 mm SIZE: 300.0 mm X 400.0 mm COVER: 25.0 mm

SUMMARY OF REINF. AREA (Sq.mm)

SECTION	0.0 mm	1061.8 mm	2123.5 mm	3185.3 mm	4247.0 mm
TOP REINF.	1298.36 (Sq. mm)	430.14 (Sq. mm)	0.00 (Sq. mm)	425.48 (Sq. mm)	1284.08 (Sq. mm)
BOTTOM REINF.	809.60 (Sq. mm)	482.97 (Sq. mm)	188.19 (Sq. mm)	491.01 (Sq. mm)	821.71 (Sq. mm)

B E A M N O. 146 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 4247.0 mm SIZE: 300.0 mm X 400.0 mm COVER: 25.0 mm

SUMMARY OF REINF. AREA (Sq.mm)

SECTION	0.0 mm	1061.8 mm	2123.5 mm	3185.3 mm	4247.0 mm
TOP REINF.	752.91 (Sq. mm)	237.23 (Sq. mm)	0.00 (Sq. mm)	232.45 (Sq. mm)	731.42 (Sq. mm)
BOTTOM REINF.	407.07 (Sq. mm)	261.40 (Sq. mm)	188.19 (Sq. mm)	269.50 (Sq. mm)	417.59 (Sq. mm)

B E A M N O. 151 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 4247.0 mm SIZE: 300.0 mm X 400.0 mm COVER: 25.0 mm

SUMMARY OF REINF. AREA (Sq.mm)

SECTION	0.0 mm	1061.7 mm	2123.5 mm	3185.2 mm	4247.0 mm
TOP REINF.	1389.15 (Sq. mm)	492.75 (Sq. mm)	0.00 (Sq. mm)	488.51 (Sq. mm)	1376.86 (Sq. mm)
BOTTOM REINF.	922.49 (Sq. mm)	552.87 (Sq. mm)	187.64 (Sq. mm)	560.28 (Sq. mm)	929.86 (Sq. mm)

B E A M N O. 152 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 4247.0 mm SIZE: 300.0 mm X 400.0 mm COVER: 25.0 mm

SUMMARY OF REINF. AREA (Sq.mm)

SECTION	0.0 mm	1061.7 mm	2123.5 mm	3185.2 mm	4247.0 mm
TOP	1297.14	429.28	0.00	424.03	1281.04

REINF. (Sq. mm) (Sq. mm) (Sq. mm) (Sq. mm) (Sq. mm)

BOTTOM 805.85 481.27 188.19 490.32 819.47
REINF. (Sq. mm) (Sq. mm) (Sq. mm) (Sq. mm) (Sq. mm)

B E A M N O. 153 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 4247.0 mm SIZE: 300.0 mm X 400.0 mm COVER: 25.0 mm

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SUMMARY OF REINF. AREA (Sq.mm)

SECTION 0.0 mm 1061.7 mm 2123.5 mm 3185.2 mm 4247.0 mm

TOP 751.04 236.34 0.00 230.96 726.91
REINF. (Sq. mm) (Sq. mm) (Sq. mm) (Sq. mm) (Sq. mm)

BOTTOM 403.81 259.69 188.19 268.80 415.63
REINF. (Sq. mm) (Sq. mm) (Sq. mm) (Sq. mm) (Sq. mm)

B E A M N O. 158 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 4475.0 mm SIZE: 300.0 mm X 400.0 mm COVER: 25.0 mm

SUMMARY OF REINF. AREA (Sq.mm)

SECTION 0.0 mm 1118.7 mm 2237.5 mm 3356.2 mm 4475.0 mm

TOP 1354.53 453.00 188.19 457.39 1367.51
REINF. (Sq. mm) (Sq. mm) (Sq. mm) (Sq. mm) (Sq. mm)

BOTTOM 849.81 523.59 212.89 516.03 842.02
REINF. (Sq. mm) (Sq. mm) (Sq. mm) (Sq. mm) (Sq. mm)

B E A M N O. 159 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 4475.0 mm SIZE: 300.0 mm X 400.0 mm COVER: 25.0 mm

SUMMARY OF REINF. AREA (Sq.mm)

SECTION	0.0 mm	1118.7 mm	2237.5 mm	3356.2 mm	4475.0 mm
TOP REINF.	1247.09 (Sq. mm)	389.10 (Sq. mm)	188.19 (Sq. mm)	397.14 (Sq. mm)	1276.35 (Sq. mm)
BOTTOM REINF.	705.30 (Sq. mm)	465.51 (Sq. mm)	212.89 (Sq. mm)	451.61 (Sq. mm)	686.00 (Sq. mm)

B E A M N O. 160 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 4475.0 mm SIZE: 300.0 mm X 400.0 mm COVER: 25.0 mm

SUMMARY OF REINF. AREA (Sq.mm)

SECTION	0.0 mm	1118.7 mm	2237.5 mm	3356.2 mm	4475.0 mm
TOP REINF.	699.94 (Sq. mm)	208.47 (Sq. mm)	0.00 (Sq. mm)	216.94 (Sq. mm)	737.79 (Sq. mm)
BOTTOM REINF.	363.54 (Sq. mm)	255.90 (Sq. mm)	187.17 (Sq. mm)	241.44 (Sq. mm)	345.19 (Sq. mm)

B E A M N O. 165 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 5397.0 mm SIZE: 300.0 mm X 400.0 mm COVER: 25.0 mm

SUMMARY OF REINF. AREA (Sq.mm)

SECTION	0.0 mm	1349.2 mm	2698.5 mm	4047.8 mm	5397.0 mm
TOP REINF.	694.03 (Sq. mm)	0.00 (Sq. mm)	188.19 (Sq. mm)	267.18 (Sq. mm)	697.50 (Sq. mm)
BOTTOM REINF.	582.01 (Sq. mm)	268.84 (Sq. mm)	350.89 (Sq. mm)	187.17 (Sq. mm)	0.00 (Sq. mm)

B E A M N O. 166 D E S I G N R E S U L T S

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 5397.0 mm SIZE: 300.0 mm X 400.0 mm COVER: 25.0 mm

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SUMMARY OF REINF. AREA (Sq.mm)

SECTION	0.0 mm	1349.2 mm	2698.5 mm	4047.8 mm	5397.0 mm
TOP REINF.	692.91 (Sq. mm)	0.00 (Sq. mm)	188.19 (Sq. mm)	237.28 (Sq. mm)	698.63 (Sq. mm)
BOTTOM REINF.	507.47 (Sq. mm)	237.28 (Sq. mm)	348.63 (Sq. mm)	188.19 (Sq. mm)	0.00 (Sq. mm)

Standards and Codes of Practice:

1. Indian Standards Code of Practice For Plain & Reinforced Concrete IS: 456-2000; Bureau of Indian Standards (BIS), July 2000, New Delhi
2. Design Aids for Reinforced Concrete IS: 456-1978 Special Publication: 16 Bureau of Indian Standards (BIS), New Delhi
3. Nepal National Building Code, NBC 105: 1994, Department of Housing and Physical Planning.
4. Handbook on Concrete reinforcement and Detailing, Special Publication: 34 [SP: 34 –1987].
5. Explanatory Handbook on Code for Earthquake Engineering IS: 1893 – 2002, Beau of Indian Standards (BIS), New Delhi.
6. Ductile Detailing of Reinforced Concrete Structures subjected to Seismic forces- Indian Code of Practice IS 13920: 1993, Beau of Indian Standards (BIS), New Delhi.

Design of Combined foundation

Pleft(X)(unfactored)	303.00	KN	Area req	6.01	CG/from Left of Forc
Pright(Y)(Unfactored)	448.00	KN	Width prov	2.00	m
Soil bearing	125	KN/mm2	Total Length	3.00	Check Value
Cent Col Size	0.4	m	provided length	3	m
Cornor Col Size	0.4	m	Left Projection	**1.27**	**1.47**
Dist betw. Col. Center to cente	0.05	m	Right Projection	**1.27**	**1.47**

			0.03	
Max P	672			
Net upward soil pressure =	187.75	KN/m^2	2.99035	
Net upward soil pressure along length =	375.50	KN/m		
			maxim projection	
B.M under colm X=	405.80	KN-m	1.47	
B.M under colm Y=	405.80	KN-m		
dis	1.21	from left		
dis	1.79	from right		
Maximum hooging Moments	393.13	KN-m	from left	
Maximum hooging Moments	386.65	KN-m	from right	
max moments	405.80	KN-m		
d calculated from moments =	271.14	mm		

Check for two way shear ok

D= 600 Ast mim.= 1305.6

d= 544 mm mm^2

1714.86 1714.86

2.29779E-05 Ast^2 -1 Ast 1714.86 =0

Ast at bottom 1788.35 mm^2 1788.35 mm^2

12 dia spacing = 126.37 provide spacing 125 mm

2001.58 1968.55

2.29779E-05 Ast^2 -1 Ast 2001.58

Ast At top Ast. 2103.23 mm^2 2103.23 mm^2

12 dia spacing = 107.45 mm provide spacing 125 mm

Grade of concrete **M** 20

Check for one way shear

at d distance (Vu)= 272.68

Nominal shear stress(Tv)= 0.25

% of tension steel p = 12 dia 0.17

shear strength of M20 concrete for above % steel = 0.32 Ok for 12 dia.

Check for two way shear

concreate capacity = 2296602.81 N

From load = 504689.22 N
check ok

lateral distance 0.8

Transverse reinforcement

W= 336 KN/m Ast min = 971.3664
B.M = 107.52 KN-M mm2

transverse reinforcement dis.(l 1488 mm 454.36
3.08843E-05 Ast^2 -1 Ast 454.36

Ast. Required 460.92 mm^2 971.37 mm^2

12 dia spacing = 173.10 mm provide spacing= 125.00 mm
for 12 dia.

Design of Staircase

Code uses	IS:456-2000			
Conctrete Grade	M20	fck =	20	N/mm2
Reinforcement Grade	Fe500	fy =	500	N/mm2

Width of Staircase: 1800.0 mm

A) Analysis:

First flight detail

Total Floor to floor height		3.48	m
Height for one flight		1.74	m
Total No. of riser (assuming 174 mm depth of riser)	174 mm	10.000	Nos.
Adopt :			
No. of risers		10.000	Nos.
Height of Riser		174	mm
Breadth of Tread		300	mm
Effective Span Leff		4500.0	mm

A) Analysis:

Second flight detail

Total Floor to floor height		3.48	m
Height for one flight		1.74	m
Total No. of riser (assuming 174 mm depth of riser)	174 mm	10.000	Nos.
Adopt :			
No. of risers		10.00	Nos.
Height of Riser		174	mm
Breadth of Tread		300	mm
Effective Span Leff		4500	mm

B) Load Calculation:

The Span of staircase	4500 mm		
Assume the overall depth of waist slab, D	**125 mm**		
Dia of Reinforcement Provided	12 mm		
Assume the effective depth of waist slab, d	104 mm	Clear cover =	15 mm

1.Slopes

Step Section	0.5	0.30	0.17	0.03	25.00	0.65	
Inclined Section	1.0	0.35	0.13	0.04	25.00	1.08	
Step Finish (Marble)	1.0	0.47	0.019	0.01	28.00	0.25	Thickness of finishing
Bottom Ceiling Plaster	1.0	0.35	0.015	0.01	20.40	0.11	Thickness of plaster
Dead Load of step, 1m in width and 300mm in length						**2.10**	
Dead Load per m^2 on plan	2.1 * 1000/300					7.00	KN/m2
Live Load						4.00	KN/m2
Total Load (DL + LL)						**11.00**	**KN/m2**
Factored Load (multiplying factor = 1.5)	1.5					**16.50**	**KN/m2**
Taking 1800mm width of slab						**29.70**	**KN/m**

2. Landing A

Self weight			0.13	25.00	3.13	
Ceiling Plaster			0.015	20.40	0.31	Thickness of plaster
Marble Finishing			0.019	28.00	0.53	Thickness of finishing
Total Dead Load					**3.97**	
Live Load					**4.00**	
Total Load (DL + LL)					**7.97**	**KN/m2**
Factored Load (multiplying factor = 1.5)	1.5				**11.96**	**KN/m2**
Taking 1800mm width of slab					**21.52**	**KN/m**

3. Landing B

In the distance of 1800 - 150=1650mm, the total factored load will be same as on landing A, I.e. 21.52KN/m. In distance of 150mm from the wall, there will be no live load. In distance equal to 150mm from the wall and a distance equal to 75mm inside, the wall. Only dead load will be considered.

Factored Load (multiplying factor = 1.5)	1.5	**5.96**	**KN/m2**
Taking 1800mm width of slab		**10.72**	**KN/m**

C) Design of flight:

1. Bending Moments

Distance in mm	0	750	750	3750.0	3750	4350	4350	4500
x in m	0	0.75	0.75	3.75	3.75	4.35	4.35	4.5
load KN/m	21.52	21.52	29.70	29.70	21.52	21.52	10.72	10.72

Reaction at A, RA 0.75)/2+21.52*(4.35-3.75)*(3.75+(4.35-3.75)/2+10.72*(4.5-4.35)*(4.35+(4.5-4.35)/2)/4.5 **59.097 KN**

Reaction at B, RB **60.663 KN**

Let the point of zero SF be at x distance from A

dMx/dx=0, Vx=0

Mx=RA*x-21.52*0.75*(x-0.75/2)-29.7*(x-0.75)^2

Vx=RA-21.52*0.75-29.7*2*(x-0.75)

Solving Vx=0, x=(RA-21.52*0.75)/(29.7*2)+0. **x= 1.48 m**

i.e. 1.48m from the Support A

Maximum B.M. occurs at X distance from A

B.M. Max= 53.80 KN-m

Check for effective depth, d

d=√(M/(0.134*fck*b))

d= 105.61 mm

Overall depth, D= 120.61 <125mm OK

Overall depth, D= 125 mm

Reinforcement Calculation:

Main Bar,

B.M.=0.87*fy*Ast(d-fy*Ast/fck*b)

	Ast1	Ast2
53801730	45240	-6.042

Solving quadratic equation

Ast= 1482.933

Adopt	Dia. In mm	X-Section in mm2	Spacing in mm
	12	113.10	137.3

Adopt spacing 125 mm

12mm dia. Bars @ 125mm c/c

Temperature Reinforcement/ Distribution bar

provide 0.12% steel (minimum) (0.12% of bd)

I.e. 224.64 mm2

	Dia. In mm	Cross Section in mm2	Spacing in mm
Spacing	8	50.27	403

8mm dia. Bars @ 400mm c/c

D) Check:

1. Check for shear

Maximum Shear Force, Vu=wl/2 **60.66 KN** Max of Reactions

Minimum Shear stress (Tv) = Vu/(bd) **0.32 N/mm2**

Percentage of Steel = Ast*100/bd 0.87 %

				100As/bd	**M20**
From Table, Maximum Shear Stress: for 0.87% and M20				0.5	0.48
&" (From IS 456:2000 table 19 page 73)"	**0.598**	**N/mm2**	By interpol	0.75	0.56
Value of k:	**1.3**			**D**	**k**
(from IS 456:2000 40.2 page 72)				125	1.3

Tc' = kTc **0.778 N/mm2 >Tv (0.32) OK**

2. Check for Development Length

Ld= σ_s*Ø/(4T_{bd}) **56.6 Ø** M20

Tbd from IS 456:2000 26.2.1.1 Page 43 For deformed bar increase by 60% 1.2

M1= 0.87*Ast*fy(d-Ast*fy/(b*fc **64.53 KN-m**

Lo= 104 12Ø or d which ever is greater

Ld< 1.3*M1/V+Lo **1486.93 mm**

56.64Ø< 679.69 mm

Ø< 26.25 mm

26.25 mm dia. is greater than dia. Provided OK

Design of Two way slab (IS 456:2000) (Limit State Method)

1 Analysis:

Short span B or Lx = 4.70 m
Long Span L or Ly = 5.40 m

Input Data:

Size of Slab is = 5.40 4.70 sq. m
Slab is contineous over T-Beam
Material use
Concrete M20 20 N/mm2
Steel Fe500 500 N/mm2 xu/d = 0.46

2 Effective Span:

Lx = 4.70 m
Ly = 5.40 m
Ly/Lx= 1.1 < 2 Two Way Slab
From preliminary design the overall depth is **D = 125 mm**

3 Calculation of Load:

I) Dead Load (DL)

I Slab
Thickness 125 mm 25 KN/m3
Dead load of Slab = 25 KN/m3 * 0.125m = 3.125 KN/m2
ii Screeding
Thickness 30 mm 20.4 KN/m3
Dead load of Screeding = 20.4 KN/m3 * 0.03m = 0.612 KN/m2
iii 19mm thick Marble Flooring
Thickness 19 mm 27 KN/m3
Dead load of 19mm thick Marble Flooring = 27 KN/m3 * 0.019m = 0.513 KN/m2
iv Cement Plaster
Thickness 12.5 mm 20.4 KN/m3
Dead load of Cement Plaster = 20.4 KN/m3 * 0.0125m = 0.255 KN/m2
Total of (I + ii + iii + iv) 4.51 KN/m2

I) Live Load (LL)

For residential **4 KN/m2**

Total Design Load (DL + LL) 8.51 KN/m2
The Factored Load (Wu) = 1.5*Design Load = **12.765 KN/m2** 1.5 Factor

Critical Support Condition:

Two Adjacent Edges Discontinous 4
Consider one meter width of slab along short span & along long span.

4 Calculation of Moments:

	Short Span		Long Span	
-ve moment at contineous edge (support)	α_{x1}	0.05300	α_{y1}	0.047
+ve moment at mid span	α_{x2}	0.04000	α_{y2}	0.035

Along Short Span:
-ve moment at contineous edge (support)
-Mx = αx1*wu*lx2 **14.94 KN-m**
-My = αy1*wu*lx2 **13.25 KN-m**
Along Long Span:
+ve moment at mid span
+Mx = αx2*wu*lx2 **11.28 KN-m**
+My = αy2*wu*lx2 **9.87 KN-m**

5 Depth Calculation:

Minimum depth of slab is calculated considering maximum bending moment.
Here obs maximum bending moment is Mu= 14.94 **KN-m**
Depth Required (d) = sqrt(Mu/(0.36*xumax/d*(1-.42*xumax/d)*b*fck)) **74.79 mm** OK
Overall depth
D=d+Ø/2+clear cover **95.79 mm**
Hence, for safe design adopt above more depth D= **125 mm**
Effective Depth (main) dx= D-$Ø_1$/2-clear cover **104 mm**
Effective Depth (secondary) dy= D-clear cover-main steel dia-$Ø_2$/2 **95 mm**

6 Reinforcement Calculation:

	Moment			
	Support		Mid Span	
	-ve Mx	-ve My	+ve Mx	+ve My
Moment (KN-m)	14.94	13.25	11.28	9.87
Solving quadratic equation Mu=0.87fyAstd(1-Astfy/bdfck)				
a = 0.87*fy^2/(b*fck)	10.88	10.88	10.88	10.88
b=-0.87fyd	-45240.00	-41325.00	-45240.00	-41325.00
c=Mu	14944879.05	13253005.95	11279154.00	9869259.75
x=(-b+-sqrt(b2-4ac))/2a				
x1=(-b+sqrt(b2-4ac))/2a	3798.18	3446.39	3893.63	3543.92
x2=(-b-sqrt(b2-4ac))/2a	361.82	353.61	266.37	256.08
Astx (mm2) =	**361.82**	**353.61**	**266.37**	**256.08**
Ast req. (mm2)	361.82	353.61	266.37	256.08
Min As(0.12%bD) mm2	150	150	150	150
Ast Actually required as per minimum reinforcement (mm2)	**361.82**	**353.61**	**266.37**	**256.08**
Spacing =b*area of one bar/Ast	217.07	222.11	294.85	306.70
3d	312	312	312	312
300	300	300	300	300
Adopt the spacing (min of above three)	217.07	222.11	294.85	300.00
Spacing provided in mm	**150**	**150**	**150**	**150**
Ast provided (mm2)	523.60	523.60	335.10	335.10
% of Ast (Provided)	0.42	0.42	0.27	0.27
Main Reinforcement	10Ø @ 150mm c/c	10Ø @ 150mm c/c	8Ø @ 150mm c/c	8Ø @ 150mm c/c

Minimum of 3d or 300

7 Check:

7.1 Minimum Reinforcement

Min As(0.12%bD) mm2 — 150 mm2 — <Astx(+ve),Asty(+ve),Astx(-ve),Asty(-ve)

7.2 Check for Shear

In slab shear is checked along short edge.

Max Shear Force (V) = w*lx/2 — 30.00 KN

Γ_v=V/bd — 0.288 N/mm2

% of steel provided — 0.42 %

% of steel=(100*Asty/2)/bd

Shear capacity of section without reinforcement

Γc from table	100As/bd	M20		
	0.25	0.36		
	0.5	0.48	0.44	**N/mm2**

Shear strength for slab Γ' = kΓc

The provided Depth of slab (D) = 125.00 mm

	D	k		
Since the depth of slab <150mm the valu	125	1.3	**1.30**	
Γ' = kΓc			**0.57**	**N/mm2 > Γv** **Safe in shear**

7.3 Check for Development length

Ld<=1.3M1/V+Lo

a) At short edge

Ld= σ_s*Ø/(4T_{bd}) — **56.64 Ø** M20

Tbd from IS 456:2000 26.2.1.1 Page 43 — For deformed bar increase by 60% — 1.2

M1= 0.87*Asty/2*fy(d-Asty/2*fy/(b*fck)) — **11.47 KN-m**

Lo= 96 — 12Ø or d which ever is greater

Ld<=1.3M1/V+Lo — **593.12 mm**

56.64Ø= — **566.41 mm**

OK in development length

At long edge

Ld= σ_s*Ø/(4T_{bd}) — **56.64 Ø** M20

1.2

M1= 0.87*Asty/2*fy(d'-Asty/2*fy/(b*fck)) — **10.07 KN-m**

Lo= 96 — 12Ø or d which ever is greater

Ld<=1.3M1/V+Lo — **532.55 mm**

56.64Ø= — **453.13 mm**

OK in development length

7.4 Check for deflection

From deflection criteria, we have,

l/d<=αβγδλ

where,

α = Basic value of span to effective depth ratios for spans up to spans 10m

α = 26 (Since span<10m)

β = a factor which accounts for correction in the values of α for spans greater than 10m

		β =	1	
γ = a factor which depends on the stress at service and amount of steel for tension reinforcement				
Area of steel of required			361.82	mm2
Area of steel of provided			523.60	mm2
% of steel provided			0.42	%
	fs=0.58*fy*Ast req./Ast provided		200.39	N/mm2
	from graph (γ) =		1.9	
δ = a factor which depends on the area of compression reinforcement.				
		δ =	1	
λ = a factor for flanged beams which depends on the ratio of web width to the flange width				
		λ =	1	
lx/d permissible		**αβγδλ=**	49.40	
lx/d provided = 4700/104 =			45.19	**Safe in deflection**

8 **Summary:**

Overall Depth of slab = 125 mm

Main Bar:

Astx +ve = 8Ø @ 150mm c/c

Astx -ve = 10Ø @ 150mm c/c

Asty +ve = 8Ø @ 150mm c/c

Asty -ve = 10Ø @ 150mm c/c

Design of isolated foundation

Pleft(X)(unfactored)	242.00	KN	Area req	2.13
		KN	Width prov	1.46
Soil bearing	125	KN/mm2	Total Length	1.46
Cent Col Size	0.35	m	provided length	1.5
Cornor Col Size	0.35	m	Left Projection	
Dist betw. Col. Center to center		m	Right Projection	

CG/from Left of	0
m	
Check Value	0.35
m	
	maxim projection
	0.000

Max P	363				
Net upward soil pressure =	161.33	KN/m^2			
BENDING MOMENT about x-x passing through the face of the colu	40.01	KN/m			
d calculated from moments =	98.30	mm			
	Check for two way shear			ok	
D=	450			Ast mim.=	709.2
d=	394	mm			mm^2
7.250	Ast^2	171390	Ast	40005625.00	=0
Ast at bottom	235.77	mm^2	709.20	mm^2	
12 dia spacing =	232.52		provide spacing	125	mm
Grade of concrete **M**	20				
Check for one way shear					
at d distance (Vu)=	43.80	kN			
Nominal shear stress(Tv)=	0.07	N/mm2			
% of tension steel p = 12 dia	0.23				
shear strength of M20 concrete for above % steel =			0.34	Ok	for 12 dia.
Check for two way shear					
concreate capacity =	1310944.05	N			
From load =	273696.19	N			
check	ok				

Development length			
Ld=	566.41	mm	
Ld available	615	>	566.41
			Ok

Design of isolated foundation

Pleft(X)(unfactored)	336.00	KN	Area req	2.96
		KN	Width prov	1.72
Soil bearing	125	KN/mm2	Total Length	1.72
Cent Col Size	0.35	m	provided length	1.85
Cornor Col Size	0.35	m	Left Projection	
Dist betw. Col. Center to center		m	Right Projection	

CG/from Left of	0
m	
Check Value	0.35
m	
	maxim projection
	0.000

Max P	504				
Net upward soil pressure =	147.26	KN/m^2			
BENDING MOMENT about x-x passing through the face of the colu	76.62	KN/m			
d calculated from moments =	122.50	mm			
	Check for two way shear			ok	
D=	550			Ast mim.=	1096.68
d=	494	mm			mm^2
5.878	Ast^2	214890	Ast	76621621.62	=0
Ast at bottom	360.11	mm^2	1096.68	mm^2	
12 dia spacing =	177.18		provide spacing	125	mm
Grade of concrete **M**	20				
Check for one way shear					
at d distance (Vu)=	69.74	kN			
Nominal shear stress(Tv)=	0.08	N/mm2			
% of tension steel p = 12 dia	0.18				
shear strength of M20 concrete for above % steel =			0.34	Ok	for 12 dia.
Check for two way shear					
concreate capacity =	1864594.48	N			
From load =	399100.85	N			
check	ok				

Development length			
Ld=	566.41	mm	
Ld available	790	>	566.41
			Ok

Design of isolated foundation

Pleft(X)(unfactored)	498.00	KN	Area req	4.38
		KN	Width prov	2.09
Soil bearing	125	KN/mm2	Total Length	2.09
Cent Col Size	0.4	m	provided length	2.1
Cornor Col Size	0.4	m	Left Projection	
Dist betw. Col. Center to center		m	Right Projection	

CG/from Left of	0
m	
Check Value	0.4
m	
	maxim projection
	0.000

Max P	747				
Net upward soil pressure =	169.39	KN/m^2			
BENDING MOMENT about x-x passing through the face of the colu	128.50	KN/m			
d calculated from moments =	148.90	mm			
	Check for two way shear			ok	
D=	550			Ast mim.=	1244.88
d=	494	mm			mm^2
5.179	Ast^2	214890	Ast	128501785.71	=0
Ast at bottom	606.86	mm^2	1244.88	mm^2	
12 dia spacing =	190.02		provide spacing	125	mm
Grade of concrete **M**	20				
Check for one way shear					
at d distance (Vu)=	126.63	kN			
Nominal shear stress(Tv)=	0.12	N/mm2			
% of tension steel p = 12 dia	0.18				
shear strength of M20 concrete for above % steel =			0.34	Ok	for 12 dia.
Check for two way shear					
concreate capacity =	1975056.23	N			
From load =	611619.21	N			
check	ok				

Development length			
Ld=	566.41	mm	
Ld available	890	>	566.41
			Ok

Design of isolated foundation

Pleft(X)(unfactored)	550.00	KN	Area req	4.84
		KN	Width prov	2.20
Soil bearing	125	KN/mm2	Total Length	2.20
Cent Col Size	0.4	m	provided length	2.2
Cornor Col Size	0.4	m	Left Projection	
Dist betw. Col. Center to center		m	Right Projection	

CG/from Left of	0
m	
Check Value	0.4
m	
	maxim projection
	0.000

Max P	825				
Net upward soil pressure =	170.45	KN/m^2			
BENDING MOMENT about x-x passing through the face of the colu	151.88	KN/m			
d calculated from moments =	158.15	mm			
	Check for two way shear			ok	
D=	550			Ast mim.=	1304.16
d=	494	mm			mm^2
4.943	Ast^2	214890	Ast	151875000.00	=0
Ast at bottom	718.64	mm^2	1304.16	mm^2	
12 dia spacing =	190.62		provide spacing	125	mm
Grade of concrete **M**	20				
Check for one way shear					
at d distance (Vu)=	152.25	kN			
Nominal shear stress(Tv)=	0.14	N/mm2			
% of tension steel p = 12 dia	0.18				
shear strength of M20 concrete for above % steel =			0.34	Ok	for 12 dia.
Check for two way shear					
concreate capacity =	1975056.23	N			
From load =	688766.59	N			
check	ok				

Development length			
Ld=	566.41	mm	
Ld available	940	>	566.41
			Ok

Design of isolated foundation

Pleft(X)(unfactored)	765.00	KN	Area req	6.73
		KN	Width prov	2.59
Soil bearing	125	KN/mm2	Total Length	2.59
Cent Col Size	0.45	m	provided length	2.6
Cornor Col Size	0.45	m	Left Projection	
Dist betw. Col. Center to center		m	Right Projection	

CG/from Left of	0
m	
Check Value	0.45
m	
	maxim projection
	0.000

Max P	1147.5				
Net upward soil pressure =	169.75	KN/m^2			
BENDING MOMENT about x-x passing through the face of the colu	255.02	KN/m			
d calculated from moments =	188.51	mm			
	Check for two way shear			ok	
D=	600			Ast mim.=	1697.28
d=	544	mm			mm^2
4.183	Ast^2	236640	Ast	255015324.52	=0
Ast at bottom	1099.00	mm^2	1697.28	mm^2	
12 dia spacing =	172.74		provide spacing	125	mm
Grade of concrete **M**	20				
Check for one way shear					
at d distance (Vu)=	234.35	kN			
Nominal shear stress(Tv)=	0.17	N/mm2			
% of tension steel p = 12 dia	0.17				
shear strength of M20 concrete for above % steel =			0.34	Ok	for 12 dia.
Check for two way shear					
concreate capacity =	2418244.91	N			
From load =	979782.35	N			
check	ok				

Development length			
Ld=	566.41	mm	
Ld available	1115	>	566.41
			Ok

Design of Combined foundation

Pleft(X)(unfactored)	292.00	KN	Area req	4.88	CG/from Left of Forc
Pright(Y)(Unfactored)	318.00	KN	Width prov	1.65	m
Soil bearing	125	KN/mm2	Total Length	2.96	Check Value
Cent Col Size	0.4	m	provided length	3	m
Cornor Col Size	0.4	m	Left Projection	**1.27**	**1.47**
Dist betw. Col. Center to cente	0.05	m	Right Projection	**1.27**	**1.47**

				0.03	
Max P	477				
Net upward soil pressure =	184.85	KN/m^2		2.99787	
Net upward soil pressure along length =	305.00	KN/m			
				maxim projection	
B.M under colm X=	331.30	KN-m		1.47	
B.M under colm Y=	331.30	KN-m			
dis	1.44	from left			
dis	1.56	from right			
Maximum hooging Moments	331.08	KN-m	from left		
Maximum hooging Moments	330.07	KN-m	from right		
max moments	331.30	KN-m			
d calculated from moments =	269.72	mm			

Check for two way shear ok

D=	600				Ast mim.=	1077.12	
d=	544	mm				mm^2	
					1400.03	1400.03	
2.7852E-05	Ast^2		-1	Ast	1400.03	=0	
Ast at bottom	1459.35	mm^2		1459.35	mm^2		
12 dia spacing =	127.76		provide spacing	125	mm		
					1685.67	1680.50	
2.7852E-05	Ast^2		-1	Ast	1685.67		
Ast At top Ast.	1773.25	mm^2		1773.25	mm^2		
12 dia spacing =	105.15	mm	provide spacing	125	mm		

Grade of concrete **M**	20			
Check for one way shear				
at d distance (Vu)=	222.63			
Nominal shear stress(Tv)=	0.25			
% of tension steel p = 12 dia	0.17			
shear strength of M20 concrete for above % steel =		0.32	Ok	for 12 dia.

Check for two way shear

concreate capacity = 2296602.81 N

From load = 312274.86 N
check ok

lateral distance 0.625

Transverse reinforcement

W= 289.090909 KN/m Ast min = 971.3664
B.M = 56.46 KN-M mm2

transverse reinforcement dis.(l 1488 mm 238.60
3.08843E-05 Ast^2 -1 Ast 238.60

Ast. Required 240.39 mm^2 971.37 mm^2

12 dia spacing = 173.10 mm provide spacing= 125.00 mm
for 12 dia.

Design of Combined foundation

Pleft(X)(unfactored)	464.00	KN	Area req	7.10	CG/from Left of Forc
Pright(Y)(Unfactored)	423.00	KN	Width prov	2.25	m
Soil bearing	125	KN/mm2	Total Length	3.15	Check Value
Cent Col Size	0.4	m	provided length	3.15	m
Cornor Col Size	0.4	m	Left Projection	**1.35**	**1.55**
Dist betw. Col. Center to cente	0.05	m	Right Projection	**1.35**	**1.55**

			0.02	
Max P	696			
Net upward soil pressure =	187.72	KN/m^2	3.15231	
Net upward soil pressure along length =	422.38	KN/m		
			maxim projection	
B.M under colm X=	508.14	KN-m	1.55	
B.M under colm Y=	508.14	KN-m		
dis	1.65	from left		
dis	1.50	from right		
Maximum hooging Moments	506.17	KN-m	from left	
Maximum hooging Moments	507.64	KN-m	from right	
max moments	508.14	KN-m		
d calculated from moments =	286.05	mm		

Check for two way shear ok

D=	600			Ast mim.=	1468.8	
d=	544	mm			mm^2	
			2147.32		2147.32	
2.04248E-05	Ast^2	-1	Ast	2147.32	=0	
Ast at bottom	2250.79	mm^2	2250.79	mm^2		
12 dia spacing =	112.96		provide spacing	125	mm	
			2577.09		2584.56	
2.04248E-05	Ast^2	-1	Ast	2584.56		
Ast At top Ast.	2737.63	mm^2	2737.63	mm^2		
12 dia spacing =	92.87	mm	provide spacing	125	mm	

Grade of concrete **M**	20				
Check for one way shear					
at d distance (Vu)=	340.93				
Nominal shear stress(Tv)=	0.28				
% of tension steel p = 12 dia	0.17				
shear strength of M20 concrete for above % steel =			0.32	Ok	for 12 dia.

Check for two way shear

concreate capacity = 2296602.81 N

From load = 528711.61 N
check ok

lateral distance 0.925

Transverse reinforcement

W= 309.333333 KN/m
B.M = 132.34 KN-M

Ast min = 971.3664 mm2

transverse reinforcement dis.(l 1488 mm 559.23

3.08843E-05 Ast^2 -1 Ast 559.23

Ast. Required 569.24 mm^2 971.37 mm^2

12 dia spacing = 173.10 mm provide spacing= 125.00 mm
for 12 dia.

Design of Two way slab (IS 456:2000) (Limit State Method)

1 Analysis:

Short span B or Lx = 4.70 m
Long Span L or Ly = 5.40 m

Input Data:

Size of Slab is = 5.40 4.70 sq. m
Slab is contineous over T-Beam
Material use
Concrete M20 20 N/mm2
Steel Fe500 500 N/mm2 xu/d = 0.46

2 Effective Span:

Lx = 4.70 m
Ly = 5.40 m
Ly/Lx= 1.1 < 2 Two Way Slab
From preliminary design the overall depth is **D = 125 mm**

3 Calculation of Load:

I) Dead Load (DL)

I Slab
Thickness 125 mm 25 KN/m3
Dead load of Slab = 25 KN/m3 * 0.125m = 3.125 KN/m2
ii Screeding
Thickness 30 mm 20.4 KN/m3
Dead load of Screeding = 20.4 KN/m3 * 0.03m = 0.612 KN/m2
iii 19mm thick Marble Flooring
Thickness 19 mm 27 KN/m3
Dead load of 19mm thick Marble Flooring = 27 KN/m3 * 0.019m = 0.513 KN/m2
iv Cement Plaster
Thickness 12.5 mm 20.4 KN/m3
Dead load of Cement Plaster = 20.4 KN/m3 * 0.0125m = 0.255 KN/m2
Total of (I + ii + iii + iv) 4.51 KN/m2

I) Live Load (LL)

For residential **4 KN/m2**

Total Design Load (DL + LL) 8.51 KN/m2
The Factored Load (Wu) = 1.5*Design Load = **12.765 KN/m2** 1.5 Factor

Critical Support Condition:

Two Adjacent Edges Discontinous 4
Consider one meter width of slab along short span & along long span.

4 Calculation of Moments:

	Short Span		Long Span	
-ve moment at contineous edge (support)	α_{x1}	0.05300	α_{y1}	0.047
+ve moment at mid span	α_{x2}	0.04000	α_{y2}	0.035

Along Short Span:
-ve moment at contineous edge (support)
-Mx = αx1*wu*lx2 **14.94 KN-m**
-My = αy1*wu*lx2 **13.25 KN-m**
Along Long Span:
+ve moment at mid span
+Mx = αx2*wu*lx2 **11.28 KN-m**
+My = αy2*wu*lx2 **9.87 KN-m**

5 Depth Calculation:

Minimum depth of slab is calculated considering maximum bending moment.
Here obs maximum bending moment is Mu= 14.94 **KN-m**
Depth Required (d) = sqrt(Mu/(0.36*xumax/d*(1-.42*xumax/d)*b*fck)) **74.79 mm** OK
Overall depth
D=d+Ø/2+clear cover **95.79 mm**
Hence, for safe design adopt above more depth D= **125 mm**
Effective Depth (main) dx= D-$Ø_1$/2-clear cover **104 mm**
Effective Depth (secondary) dy= D-clear cover-main steel dia-$Ø_2$/2 **95 mm**

6 Reinforcement Calculation:

	Moment			
	Support		Mid Span	
	-ve Mx	-ve My	+ve Mx	+ve My
Moment (KN-m)	14.94	13.25	11.28	9.87
Solving quadratic equation Mu=0.87fyAstd(1-Astfy/bdfck)				
a = 0.87*fy^2/(b*fck)	10.88	10.88	10.88	10.88
b=-0.87fyd	-45240.00	-41325.00	-45240.00	-41325.00
c=Mu	14944879.05	13253005.95	11279154.00	9869259.75
x=(-b+-sqrt(b2-4ac))/2a				
x1=(-b+sqrt(b2-4ac))/2a	3798.18	3446.39	3893.63	3543.92
x2=(-b-sqrt(b2-4ac))/2a	361.82	353.61	266.37	256.08
Astx (mm2) =	**361.82**	**353.61**	**266.37**	**256.08**
Ast req. (mm2)	361.82	353.61	266.37	256.08
Min As(0.12%bD) mm2	150	150	150	150
Ast Actually required as per minimum reinforcement (mm2)	**361.82**	**353.61**	**266.37**	**256.08**
Spacing =b*area of one bar/Ast	217.07	222.11	294.85	306.70
3d	312	312	312	312
300	300	300	300	300
Adopt the spacing (min of above three)	217.07	222.11	294.85	300.00
Spacing provided in mm	**150**	**150**	**150**	**150**
Ast provided (mm2)	523.60	523.60	335.10	335.10
% of Ast (Provided)	0.42	0.42	0.27	0.27
Main Reinforcement	10Ø @ 150mm c/c	10Ø @ 150mm c/c	8Ø @ 150mm c/c	8Ø @ 150mm c/c

Minimum of 3d or 300

7 Check:

7.1 Minimum Reinforcement

Min As(0.12%bD) mm2 — 150 mm2 — <Astx(+ve),Asty(+ve),Astx(-ve),Asty(-ve)

7.2 Check for Shear

In slab shear is checked along short edge.

Max Shear Force (V) = w*lx/2 — 30.00 KN

Γ_v=V/bd — 0.288 N/mm2

% of steel provided — 0.42 %

% of steel=(100*Asty/2)/bd

Shear capacity of section without reinforcement

Γc from table	100As/bd	M20		
	0.25	0.36		
	0.5	0.48	0.44	**N/mm2**

Shear strength for slab Γ' = kΓc

The provided Depth of slab (D) = 125.00 mm

	D	k		
Since the depth of slab <150mm the valu	125	1.3	**1.30**	
Γ' = kΓc			**0.57**	**N/mm2 > Γv** **Safe in shear**

7.3 Check for Development length

Ld<=1.3M1/V+Lo

a) At short edge

Ld= σ_s*Ø/(4T_{bd}) — **56.64 Ø** M20

Tbd from IS 456:2000 26.2.1.1 Page 43 — For deformed bar increase by 60% — 1.2

M1= 0.87*Asty/2*fy(d-Asty/2*fy/(b*fck)) — **11.47 KN-m**

Lo= 96 — 12Ø or d which ever is greater

Ld<=1.3M1/V+Lo — **593.12 mm**

56.64Ø= — **566.41 mm**

OK in development length

At long edge

Ld= σ_s*Ø/(4T_{bd}) — **56.64 Ø** M20

1.2

M1= 0.87*Asty/2*fy(d'-Asty/2*fy/(b*fck)) — **10.07 KN-m**

Lo= 96 — 12Ø or d which ever is greater

Ld<=1.3M1/V+Lo — **532.55 mm**

56.64Ø= — **453.13 mm**

OK in development length

7.4 Check for deflection

From deflection criteria, we have,

l/d<=αβγδλ

where,

α = Basic value of span to effective depth ratios for spans up to spans 10m

α = 26 (Since span<10m)

β = a factor which accounts for correction in the values of α for spans greater than 10m

		β =	1	
γ = a factor which depends on the stress at service and amount of steel for tension reinforcement				
Area of steel of required			361.82	mm2
Area of steel of provided			523.60	mm2
% of steel provided			0.42	%
	fs=0.58*fy*Ast req./Ast provided		200.39	N/mm2
	from graph (γ) =		1.9	
δ = a factor which depends on the area of compression reinforcement.				
		δ =	1	
λ = a factor for flanged beams which depends on the ratio of web width to the flange width				
		λ =	1	
lx/d permissible		**αβγδλ=**	49.40	
lx/d provided = 4700/104 =			45.19	**Safe in deflection**

8 **Summary:**

Overall Depth of slab = 125 mm

Main Bar:

Astx +ve = 8Ø @ 150mm c/c

Astx -ve = 10Ø @ 150mm c/c

Asty +ve = 8Ø @ 150mm c/c

Asty -ve = 10Ø @ 150mm c/c

Design of isolated foundation

Pleft(X)(unfactored)	242.00	KN	Area req	2.13
		KN	Width prov	1.46
Soil bearing	125	KN/mm2	Total Length	1.46
Cent Col Size	0.35	m	provided length	1.5
Cornor Col Size	0.35	m	Left Projection	
Dist betw. Col. Center to center		m	Right Projection	

CG/from Left of	0
m	
Check Value	0.35
m	
	maxim projection
	0.000

Max P	363				
Net upward soil pressure =	161.33	KN/m^2			
BENDING MOMENT about x-x passing through the face of the colu	40.01	KN/m			
d calculated from moments =	98.30	mm			
	Check for two way shear			ok	
D=	450			Ast mim.=	709.2
d=	394	mm			mm^2
7.250	Ast^2	171390	Ast	40005625.00	=0
Ast at bottom	235.77	mm^2	709.20	mm^2	
12 dia spacing =	232.52		provide spacing	125	mm
Grade of concrete **M**	20				
Check for one way shear					
at d distance (Vu)=	43.80	kN			
Nominal shear stress(Tv)=	0.07	N/mm2			
% of tension steel p = 12 dia	0.23				
shear strength of M20 concrete for above % steel =			0.34	Ok	for 12 dia.
Check for two way shear					
concreate capacity =	1310944.05	N			
From load =	273696.19	N			
check	ok				

Development length			
Ld=	566.41	mm	
Ld available	615	>	566.41
			Ok

Design of isolated foundation

Pleft(X)(unfactored)	336.00	KN	Area req	2.96
		KN	Width prov	1.72
Soil bearing	125	KN/mm2	Total Length	1.72
Cent Col Size	0.35	m	provided length	1.85
Cornor Col Size	0.35	m	Left Projection	
Dist betw. Col. Center to center		m	Right Projection	

CG/from Left of	0
m	
Check Value	0.35
m	
	maxim projection
	0.000

Max P	504				
Net upward soil pressure =	147.26	KN/m^2			
BENDING MOMENT about x-x passing through the face of the colu	76.62	KN/m			
d calculated from moments =	122.50	mm			
	Check for two way shear			ok	
D=	550			Ast mim.=	1096.68
d=	494	mm			mm^2
5.878	Ast^2	214890	Ast	76621621.62	=0
Ast at bottom	360.11	mm^2	1096.68	mm^2	
12 dia spacing =	177.18		provide spacing	125	mm
Grade of concrete **M**	20				
Check for one way shear					
at d distance (Vu)=	69.74	kN			
Nominal shear stress(Tv)=	0.08	N/mm2			
% of tension steel p = 12 dia	0.18				
shear strength of M20 concrete for above % steel =			0.34	Ok	for 12 dia.
Check for two way shear					
concreate capacity =	1864594.48	N			
From load =	399100.85	N			
check	ok				

Development length			
Ld=	566.41	mm	
Ld available	790	>	566.41
			Ok

Design of isolated foundation

Pleft(X)(unfactored)	498.00	KN	Area req	4.38
		KN	Width prov	2.09
Soil bearing	125	KN/mm2	Total Length	2.09
Cent Col Size	0.4	m	provided length	2.1
Cornor Col Size	0.4	m	Left Projection	
Dist betw. Col. Center to center		m	Right Projection	

CG/from Left of	0
m	
Check Value	0.4
m	
	maxim projection
	0.000

Max P	747				
Net upward soil pressure =	169.39	KN/m^2			
BENDING MOMENT about x-x passing through the face of the colu	128.50	KN/m			
d calculated from moments =	148.90	mm			
	Check for two way shear			ok	
D=	550			Ast mim.=	1244.88
d=	494	mm			mm^2
5.179	Ast^2	214890	Ast	128501785.71	=0
Ast at bottom	606.86	mm^2	1244.88	mm^2	
12 dia spacing =	190.02		provide spacing	125	mm
Grade of concrete **M**	20				
Check for one way shear					
at d distance (Vu)=	126.63	kN			
Nominal shear stress(Tv)=	0.12	N/mm2			
% of tension steel p = 12 dia	0.18				
shear strength of M20 concrete for above % steel =			0.34	Ok	for 12 dia.
Check for two way shear					
concreate capacity =	1975056.23	N			
From load =	611619.21	N			
check	ok				

Development length			
Ld=	566.41	mm	
Ld available	890	>	566.41
			Ok

Design of isolated foundation

Pleft(X)(unfactored)	550.00	KN	Area req	4.84
		KN	Width prov	2.20
Soil bearing	125	KN/mm2	Total Length	2.20
Cent Col Size	0.4	m	provided length	2.2
Cornor Col Size	0.4	m	Left Projection	
Dist betw. Col. Center to center		m	Right Projection	

CG/from Left of	0
m	
Check Value	0.4
m	
	maxim projection
	0.000

Max P	825				
Net upward soil pressure =	170.45	KN/m^2			
BENDING MOMENT about x-x passing through the face of the colu	151.88	KN/m			
d calculated from moments =	158.15	mm			
	Check for two way shear			ok	
D=	550			Ast mim.=	1304.16
d=	494	mm			mm^2
4.943	Ast^2	214890	Ast	151875000.00	=0
Ast at bottom	718.64	mm^2	1304.16	mm^2	
12 dia spacing =	190.62		provide spacing	125	mm
Grade of concrete **M**	20				
Check for one way shear					
at d distance (Vu)=	152.25	kN			
Nominal shear stress(Tv)=	0.14	N/mm2			
% of tension steel p = 12 dia	0.18				
shear strength of M20 concrete for above % steel =			0.34	Ok	for 12 dia.
Check for two way shear					
concreate capacity =	1975056.23	N			
From load =	688766.59	N			
check	ok				

Development length			
Ld=	566.41	mm	
Ld available	940	>	566.41
			Ok

Design of isolated foundation

Pleft(X)(unfactored)	765.00	KN	Area req	6.73
		KN	Width prov	2.59
Soil bearing	125	KN/mm2	Total Length	2.59
Cent Col Size	0.45	m	provided length	2.6
Cornor Col Size	0.45	m	Left Projection	
Dist betw. Col. Center to center		m	Right Projection	

CG/from Left of	0
m	
Check Value	0.45
m	
	maxim projection
	0.000

Max P	1147.5				
Net upward soil pressure =	169.75	KN/m^2			
BENDING MOMENT about x-x passing through the face of the colu	255.02	KN/m			
d calculated from moments =	188.51	mm			
	Check for two way shear			ok	
D=	600			Ast mim.=	1697.28
d=	544	mm			mm^2
4.183	Ast^2	236640	Ast	255015324.52	=0
Ast at bottom	1099.00	mm^2	1697.28	mm^2	
12 dia spacing =	172.74		provide spacing	125	mm
Grade of concrete **M**	20				
Check for one way shear					
at d distance (Vu)=	234.35	kN			
Nominal shear stress(Tv)=	0.17	N/mm2			
% of tension steel p = 12 dia	0.17				
shear strength of M20 concrete for above % steel =			0.34	Ok	for 12 dia.
Check for two way shear					
concreate capacity =	2418244.91	N			
From load =	979782.35	N			
check	ok				

Development length			
Ld=	566.41	mm	
Ld available	1115	>	566.41
			Ok

Design of Combined foundation

Pleft(X)(unfactored)	292.00	KN	Area req	4.88	CG/from Left of Forc
Pright(Y)(Unfactored)	318.00	KN	Width prov	1.65	m
Soil bearing	125	KN/mm2	Total Length	2.96	Check Value
Cent Col Size	0.4	m	provided length	3	m
Cornor Col Size	0.4	m	Left Projection	**1.27**	**1.47**
Dist betw. Col. Center to cente	0.05	m	Right Projection	**1.27**	**1.47**

				0.03	
Max P	477				
Net upward soil pressure =	184.85	KN/m^2		2.99787	
Net upward soil pressure along length =	305.00	KN/m			
				maxim projection	
B.M under colm X=	331.30	KN-m		1.47	
B.M under colm Y=	331.30	KN-m			
dis	1.44	from left			
dis	1.56	from right			
Maximum hooging Moments	331.08	KN-m	from left		
Maximum hooging Moments	330.07	KN-m	from right		
max moments	331.30	KN-m			
d calculated from moments =	269.72	mm			

Check for two way shear ok

D=	600				Ast mim.=	1077.12	
d=	544	mm				mm^2	
					1400.03	1400.03	
2.7852E-05	Ast^2		-1	Ast	1400.03	=0	
Ast at bottom	1459.35	mm^2		1459.35	mm^2		
12 dia spacing =	127.76		provide spacing	125	mm		
					1685.67	1680.50	
2.7852E-05	Ast^2		-1	Ast	1685.67		
Ast At top Ast.	1773.25	mm^2		1773.25	mm^2		
12 dia spacing =	105.15	mm	provide spacing	125	mm		

Grade of concrete **M**	20			
Check for one way shear				
at d distance (Vu)=	222.63			
Nominal shear stress(Tv)=	0.25			
% of tension steel p = 12 dia	0.17			
shear strength of M20 concrete for above % steel =		0.32	Ok	for 12 dia.

Check for two way shear

concreate capacity = 2296602.81 N

From load = 312274.86 N
check ok

lateral distance 0.625

Transverse reinforcement

W= 289.090909 KN/m Ast min = 971.3664
B.M = 56.46 KN-M mm2

transverse reinforcement dis.(l 1488 mm 238.60
3.08843E-05 Ast^2 -1 Ast 238.60

Ast. Required 240.39 mm^2 971.37 mm^2

12 dia spacing = 173.10 mm provide spacing= 125.00 mm
for 12 dia.

Design of Combined foundation

Pleft(X)(unfactored)	464.00	KN	Area req	7.10	CG/from Left of Forc
Pright(Y)(Unfactored)	423.00	KN	Width prov	2.25	m
Soil bearing	125	KN/mm2	Total Length	3.15	Check Value
Cent Col Size	0.4	m	provided length	3.15	m
Cornor Col Size	0.4	m	Left Projection	**1.35**	**1.55**
Dist betw. Col. Center to cente	0.05	m	Right Projection	**1.35**	**1.55**

			0.02	
Max P	696			
Net upward soil pressure =	187.72	KN/m^2	3.15231	
Net upward soil pressure along length =	422.38	KN/m		
			maxim projection	
B.M under colm X=	508.14	KN-m	1.55	
B.M under colm Y=	508.14	KN-m		
dis	1.65	from left		
dis	1.50	from right		
Maximum hooging Moments	506.17	KN-m	from left	
Maximum hooging Moments	507.64	KN-m	from right	
max moments	508.14	KN-m		
d calculated from moments =	286.05	mm		

Check for two way shear ok

D=	600			Ast mim.=	1468.8	
d=	544	mm			mm^2	
			2147.32		2147.32	
2.04248E-05	Ast^2	-1	Ast	2147.32	=0	
Ast at bottom	2250.79	mm^2	2250.79	mm^2		
12 dia spacing =	112.96		provide spacing	125	mm	
			2577.09		2584.56	
2.04248E-05	Ast^2	-1	Ast	2584.56		
Ast At top Ast.	2737.63	mm^2	2737.63	mm^2		
12 dia spacing =	92.87	mm	provide spacing	125	mm	

Grade of concrete **M**	20				
Check for one way shear					
at d distance (Vu)=	340.93				
Nominal shear stress(Tv)=	0.28				
% of tension steel p = 12 dia	0.17				
shear strength of M20 concrete for above % steel =			0.32	Ok	for 12 dia.

Check for two way shear

concreate capacity = 2296602.81 N

From load = 528711.61 N
check ok

lateral distance 0.925

Transverse reinforcement

W= 309.333333 KN/m
B.M = 132.34 KN-M

Ast min = 971.3664 mm2

transverse reinforcement dis.(l 1488 mm 559.23

3.08843E-05 Ast^2 -1 Ast 559.23

Ast. Required 569.24 mm^2 971.37 mm^2

12 dia spacing = 173.10 mm provide spacing= 125.00 mm
for 12 dia.