Analysis and Design of Apartment Building(G+3) by STAAD PRO

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Abstract : After the IT revolution in India after the millennium year 2000, increasing inflation for urban property prompted builders to promote apartments as respectable alternative to boardinghouses. To classify them from tenements, these early apartments were modeled after Parisian apartments and were referred to as 'French flats'. This project involves the study and design of the development of apartments. It is a framed structure and structural elements such as slab, beam, column, footing, staircase and design have been analysed with reference to the latest trends in STAADPRO software technologies and with reference to IS 456:2000, IS 8751987 (Part 1, 2, 3) and SP16 for load calculation.MS Excel also arrived at the expected cost of the project. This design project presents an in-depth knowledge of apartment building planning, research and development.

I.INTRODUCTION

An **Apartment** (American English), **Flat** (British English) or **Unit** (Australian English), is a self – contained housing unit (a type of residential real estate) that occupies only part of building, generally a single level. Such a building may be called an apartment building, apartment complex, flat complex, block of flats, tower block, high-rise or, occasionally mansion block(in British English), especially if it is consist of many apartment for rent .In Scotland, it is called a block of flats or, if it is traditional sandstone building, a tenement, which has a pejorative connotation elsewhere. Apartments may be owned by an owner /occupier, by leasehold tenure or rented by tenants (two types of housing tenure)

In some parts of the world, the world apartments refers to a new purpose – built self-contained unit in an older building , An industrial, warehouse , or commercial space converted to an apartment is commonly called a loft, although some modern lofts are built by design . An apartment consisting of the top floor of a high – rise apartment building can be called a penthouse.

In this project it is proposed to multistoried building for the purpose of student studies. The area of the proposed building is 500 m^2. The heights of the each floor are 3.2m from floor level to the bottom of roof slab. The main outer walls and cross walls are 230mm thick brick masonry in cement mortar.

This design project contains the following:

1. A good foundation provided at sufficient depth.
2. Suitable electrical arrangements, water supply and drainage facilities are Provided.
3. Good ventilation and lightening by providing doors and windows.
4. This project incorporates planning and designing, drafting of all essential and calculation have been done in accordance with IS-456:2000 and SP-16:1978 by limit state method.

II. LITERATURE REVIEW

1. Nasreen. M. Khan (2016), *Analysis And Design Of Apartment Building* , IJISET - International Journal of Innovative Science, Engineering & Technology, Vol. 3 Issue 3, ISSN 2348 – 7968 ,pp 526-555. Design of apartments (B+G+8), beam, column, slab, stair case, water tank and an isolated footing are done using Auto cadd2016 and stadd.pro. The whole building design had carried out according to IS code for seismic resistant design and the building had considered fixed at base. Structural element for design had assumed as square or rectangular in section.

2. Ranjeet. P1, DVS. Narshima Rao2, Md Akram Ullah Khan3, 2016, DESIGN OF A RESIDENTIAL BUILDING FOR 2BHK WITH 2 BLOCKS, IJRET: International Journal of Research in Engineering and Technology, eISSN: 2319-1163 | pISSN: 2321-7308, pp 51-55. Analyze and designing of a multistoried framed structure for G+4 floors. The analysis of multistoried residential apartment is designed by limited state method. The analysis of frame would be done by kani's method then it is proposed to design the structural elements according to IS 456-2000. They calculated the lateral displacement and story drift in all the cases. It was observed that Multi- storeyed R.C.C. Buildings with shear wall is economical as compared to without shear wall.

3.Shaikh Ibrahim1, Md Arifuzzaman2, Jisan Ali Mondal3, Md Taukir Alam4, Sanuwar Biswas5, Sagar Biswas, 2019 , Design and Analysis of Residential Building, International Research Journal of Engineering and Technology (IRJET) ,e-ISSN: 2395-0056 , p-ISSN: 2395-0072,pp 2733-2740.Analysis and design of G+4 residential building structure by using IS-Code method , manually designed and over verifies by using software economical column method and the dead load and live load was applied on the various structural components like slabs and beams

4.Design and analysis of multi-storeyed building by using STAAD PRO by Balaji and Selvarasan in International Journal of Technical Research and Applications, Volume 4 , Issue 4(July-Aug, 2016), PP.1-5 The design is made **using** software on structural analysis design . The vertical load consists of dead load of structural components such as beams, columns, slabs etc and live loads. The horizontal load consists of the wind forces thus building is designed for dead load, live load and wind load as per IS 875and the output obtained through the staad pro is more accurate and vivid in representation like beam output, column design output,etc,..

III. WORK PROGRESS

1.1 BASIC DATA

i. Type of building – Residential building.

ii. Type of structure –multi storeyed RCC framed structure

iii. No. of storey – (G+3)

iv. Concrete M20 grade and Fe 415

v. Characteristic strength of concrete is 20 N/mm^2

vi. Characteristic strength of steel is 415 N/mm^2

vii. Bearing capacity of soil – 200 KN/m^2

viii. Height of plinth – 0.6 m.

ix. Location of the building – Madurai district

x. Concrete is of mix 1:2:4

NOTE:-Others required data assume using NBC(national building code) for planning and IS:456-2000 for concrete design work.

1.2 PLAN OF APARTMENT BUILDING:

The plan of the proposed apartment building shown in the figure 1 below:

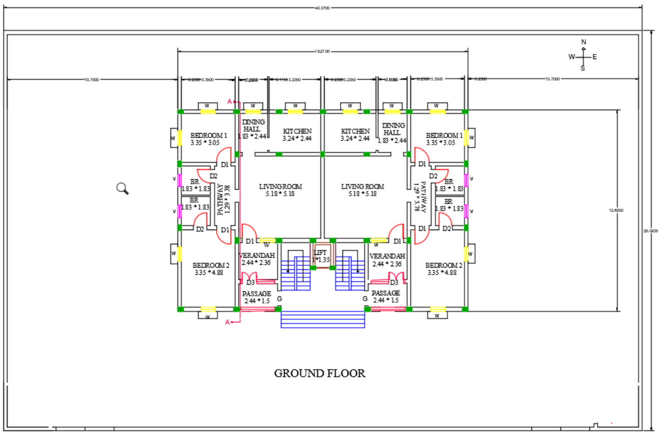

Fig1: Ground floor Plan of Residential Building.

2. DESIGN OF BUILDING COMPONENTS 2.1DESIGN OF TWOWAYSLAB

TABLE 1 DESIGN DATA FOR TWO WAY SLAB:

The basic design requirement for design of two way slab is given in the table below:

Room Dimension	3.35 x 3.05 m
Live Load	$3kN/m^2$
Floor Finish	$0.75kN/m^2$
Concrete Mix	M20
Grade of Steel	Fe 415
Dead load	6.25kN/m

SOLUTION:

Step 1: lx and ly ratio

Lx = 3.05m

Ly = 3.35m

Live load = $3kN/m^2$

$$Lx\ eff. = 3.05+\frac{0.23}{2}+\frac{0.23}{2}$$

=3.28m

$$Ly\ eff.=3.35+\frac{0.23}{2}+\frac{0.23}{2}$$

=3.58m

$$\frac{ly}{lx}=\frac{3.58}{3.28}=1.091<2$$

The given section is two way slab.

Step 2: Load calculation

$$\frac{lx}{d}=28$$

$\frac{3280}{d}$ =28

d =117.14~ 120mm

D=d+d'=120+20 =140mm.

Live load = $3kN/m^2$

Self-wt. of slab = $3.5kN/m^2$

(1x0.14x25)

Floor finish =$0.75kN/m^2$

Working load (w) = 7.25 kN/m^2

Factor load w_u = 1.5x7.25

= 10.875 KN

step 3: To find M_{ux}&M_{uy}.

Refer IS 456:2000 pg.:-91 Table 26.

α_x = 0.053

α_y = 0.035

$M_{ux} = \alpha_x w_u {l_{eff}}_x^{\ 2}$

= 0.053x10.875x3.28^2

= 6.2 kN-m <$M_{u\ (\max)}$

$M_{uy} = \alpha_y w_u {l_{eff}}_x^{\ 2}$

= 0.035x10.875x3.28^2

= 4.1 kN-m <$M_{u\ (\max)}$

$M_{u\ (\max)}$ = 0.138 f_{ck}bd^2

= 0.138x20x1000x120^2

= 39.744 kNm

M_{ux},M_{uy}<$M_{u\ (\max)}$

The section is Under Reinforced Section.

Step 4: To find Ast_x andAst_y.

M_{ux}= 0.87 $f_y Ast_x$ [d - 0.42 x_u]

6.2x10^6 = 0.87x415x Ast_x [120 – 0.42 ($\frac{0.87X415XAst_x}{0.36X20X1000}$)]

6.2x10^6 = 43326 Ast_x -7.604 ${Ast_x}^2$

Ast_x= 122.18 mm^2

M_{uy}= 4.1x10^6

Ast_y= 96.26mm^2

Step 5: To find $s_x s_y$.

$s_x = \frac{1000\text{xast}}{Ast_x}$

Assume 8mm ϕ

$s_x = \frac{1000\text{x}\frac{\pi}{4}\text{x}8^2}{122.18}$

= 411.41mm c/c > 300mm

~ 300 mm c/c

$s_y = \frac{1000\text{x}\frac{\pi}{4}\text{x}8^2}{96.26}$

= 522.18mm c/c > 300mm

~ 300mm c/c

Provide 8mm ϕ bar at 300mm c/c as main reinforcement along shorter direction (x direction)

Provide 8mm ϕ bar at 300mm c/c as main reinforcement along longer direction (y direction) as shown in figure 2 below.

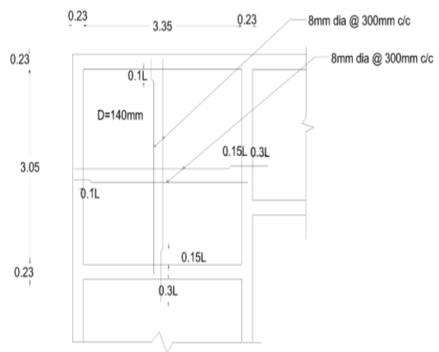

Fig 2: reinforcement detailing of slab

2.2 DESIGN OF BEAM

Structural concrete beam elements are designed to support a given system of external loads such as walls and slabs of roof and floor systems. The cross sectional dimensions are generally assumed based on serviceability requirements. The width is fixed based on thickness of walls and housing of reinforcements and the depth is selected to control deflections within safe permissible limits. There inforcements in beam are designed for flexure and shear forces along the length of the beam on structural analysis.

TABLE 2 DESIGN DATA OF A BEAM:

The basic design requirement for design of beams is given in the table below:

Type of beam	under Reinforced beam
Clear span	3.52m
Beam dimensions	230 x 350mm
Live load	3kN/m
Characteristic strength of concrete	$415N/mm^2$
Concrete mix (f_{ck})	M20
Dead load	6.25KN/m

SOLUTION:

b = 230mm

D = 350mm

f_{ck} = 20 N/mm^2

f_y = 415N/mm^2

L =3.52m

w_u = 32.21 KN

Step 1: To find M_u

$M_u = \frac{w_u l_{eff x}{}^2}{12}$

$= \frac{32.21X3.52^2}{12}$

= 33.26 kN-m

Step 2: To find $M_{u_{max}}$

$M_{u_{max}}$= 0.138$f_{ck}bd^2$

Assume d' = 35mm

d = D – d'

d= 350 – 35

d = 315

$M_{u_{max}}$ = 0.138x20x230x315^2

= 62.99 kNm

M_u<$M_{u_{max}}$

The section is Under Reinforced Section.

Step 3: To find A_{st}

M_u = 0.87x415x A_{st}[315-(0.42x$\frac{0.87X415XA_{st}}{0.36X20X230}$)]

33.26x10^6 = 113730.75A_{st} – 33.06$A_{st}{}^2$

A_{st}= 322.72 mm^2

~ 323 mm^2

Step 4: To find no of bars

Assume 16mm ϕ,

No of bar = $\frac{A_{st}}{ast}$

= $\frac{323}{\pi/_4 X16^2}$

= 1.61

~ 2nos

Step 5: To find p_t (or) % A_{st}

p_t= 100A_{st} /bd = $\frac{100X323}{230X315}$ = 0.46%

Step 6: To find τ_c

For M_{20} and p_t = 0.46%

From table 19 of IS456:2000 Pg. 73

τ_c = 0.46N/mm^2

Step 7: Design of shear reinforcement

$\tau_v = \frac{V_u}{bXd} = \frac{w_u l_{eff/2}}{bXd} = \frac{32.21X3.52/2}{230X315}$ =0.08N/mm^2

τ_v<τ_c<$\tau_{c_{max}}$

The given section is Designed shear reinforcement

Step 8: To find s_v

V_{us}= V_u - $\tau_c$bd = 33.27$X10^3$

$s_v = \frac{0.87\ f_y A_{sv\ d}}{V_{us}} = \frac{0.87X415X2X\ \pi/_4\ X\ 8^2X315}{33.27X10^3}$

= 343.66$mm\ c/c$> 300mm c/c

Provide 8mm stirrups @ 300$mm\ c/c$ spacing.

Provide 2 no's of 16mmϕ bars in tension side.

Provide 2 no's of 10mm ϕ bars in compression side.

Provide 8mm ϕ @ 300mm c/c as shear reinforcement as shown in figure3 below.

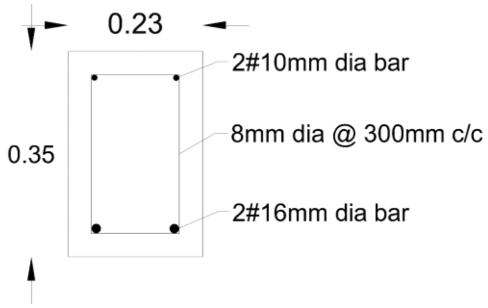

Fig: 3 reinforcement detailing of beam

2.3DESIGN OF COLUMNS:

A column is generally a compression member supporting beams and slabs in a structural system and having an effective length exceeding three times the least lateral dimension. A column may be considered to be short when its effective length doesn't exceed 12 times the least lateral dimension exceeds 12, the column is considered as long or slender for design purposes.

TABLE 3 DESIGN DATA OF COLUMNS:

The basic design requirement for design of columns is given in the table below

Type of column	Rectangular column
Size of column	230 x 350mm
Strength of reinforcement	415 N/mm²
Factored load (P_u)	1050.05KN (STAAD PRO load)
Moment	35.56KNm
Concrete mix	M20

Solution

The column to be designed is of size 230mm x 350 mm carrying a uniaxial load of 1050.05KN and carrying a moment of 35.56KNm.The arrangement of reinforcement is done on four sides. (Assume moment due to minimum eccentricity to be less than the actual moment).

Assuming 16mm dia bars with 40mm cover.

d' = 40 + 16/2 = 48 mm

d'/D =48/350 = 0.14 ~ 0.15

Charts of d'/D = 0.15 will be used

$\frac{Pu}{fckxbxD} = \frac{1050.05x10^3}{20x\ 230x\ 350}$= 0.65

$\frac{Mu}{fck\ xbx\ d^2} = \frac{35.56x10^6}{20x\ 230x\ 350^2}$= 0.063

From chart 45 pg no: 130 (ref. SP16)

$\frac{p}{fck}$= 0.12

P = 0.12 x 20 = 2.4%

Ast = 2.4x 230 x 350 / 100 = 1932 mm².

No of bars = $\frac{A_{sc}}{asc}$

= $\frac{1932}{\pi/_4 X16^2}$

= 9.6

~ 10nos

Design of lateral ties

ϕ_t< 8mm (or) $\frac{\phi_t}{4} = \frac{16}{4}$

ϕ_t = 8mm (or) 4mm

ϕ_t = 8mmϕ

Pitch of lateral ties

1. !< b = 230mm
2. !< 16ϕ_l = 16x16 = 256mm
3. !< 48ϕ_t = 48x8 = 384mm
4. !< 300mm

Pitch = 230 $mm\ c/c$

Provide 10 no's of 16mmϕ bars as longitudinal reinforcement. Provide 8mm ϕ lateral ties @ 230 $mm\ c/c$ pitch. As shown in figure4 below

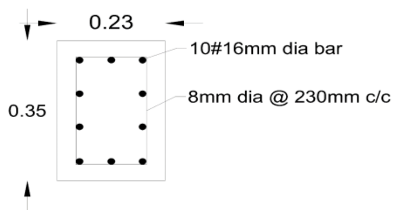

Fig: 4 reinforcement detailing of column

2.4DESIGN OF FOOTINGS

Reinforced concrete footing are designed to resist the design factored moments and shear forces due to the imposed loads. The area of footing should be such that the bearing pressure developed at the base of the footing doesn't exceed the safe bearing capacity of the soil. In plain concrete footings, the thickness at the edge should be at least 150mm for footings on soil and not less than 300mm above the tops of piles for footings on piles.

TABLE 4 DESIGN DATA OF FOOTING:

The basic design requirement for design of footings is given in the table below:

Type of footing	Sloped footing
Column size	230 x 350 mm
Reinforcement provided	10 no's of 16mm dia bars

Assumptions*:*

The basic assumptions of footings are given below:

SBC of soil	200KN/m^2
Unit weight of soil ( )	20KN/m^2
Angle of internal friction ( )	30
Concrete grade	M20 grade concrete
Steel grade	Fe415 grade steel
Ultimate load	1050.05

SOLUTION:

Size of Footing Calculation

Assume Self Weight of Footing & Weight

of Backfill 10% of load,P= $\frac{10}{100}$×1050.05

= 105.01KN.

Total Load = 1050.05+105.01

= 1155.06KN

Plan Area of Footing required,

A(req) = $\frac{Total\ Load}{SBC\ of\ Soil}$

= 5.77m^2

Consider length of footing = 1.25×Width of footing (L=1.25B)

A(req) = L×B

5.77 = 1.25B×B

B = 2.15m~2.35m

L = $\frac{Area}{B}$ = $\frac{5.77}{2.35}$ = 2.45m ~2.5m

Provide 2.5m×2.35m Size Footing

Area provided = 2.5×2.35 = 5.88m^2 > 5.77m^2

Net Upward Soil Pressure, p = $\frac{P}{A(prov)}$ = $\frac{1050.05}{5.88}$

p = 178.58KN/m^2

Depth of Footing & Area Of Steel Calculation:

i) Projection,x = $\frac{2.5-0.35}{2}$ **=** 1.075m.

Bending Moment at Y-Y axis,

$M_y = \frac{px^2}{2}$

$= \frac{178.58\times(1.075)^2}{2}$

M_y= 103.19 KN-m.

M_{uy}= 103.19×1.5 = 154.78KN-m.

Effective Depth,d(req) = $\sqrt{\frac{M_u}{0.138.fck.b}}$

$= \sqrt{\frac{154.78\times10^6}{0.138\times20\times1000}}$

d(req) = 236.81mm.

Provide 16mm $\emptyset$ *bar* & clear cover=50mm

Overall Depth,D(req) = d(req)+clear cover+$\frac{\emptyset}{2}$

= 236.81+50+$\frac{16}{2}$

D(req) = 294.81mm.

D(prov) = 2×D(req) (To avoid failure of footing due to punching shear).

D(prov) = 2× 294.81

= 589.62mm.

Provide Overall Depth,D = 590mm.

d=590−50− $\frac{16}{2}$

d=532mm.

$\frac{M_{uy}}{bd^2} = \frac{154.78\times10^6}{1000\times532^2}$

= 0.55 N/mm^2

From Table-2, SP 16

Pt= 0.158%

Area of steel, A (req) =Pt x b x d

$= \frac{0.158}{100} \times 1000 \times 532$

A (req) = 840.56mm^2

Spacing =$\frac{201.06}{840.56} \times 1000$

= 240.2mm.

Provide 16mm Ø *bar* @ 240mm c/c.

ii) Projection,Y= $\frac{2.35-0.23}{2}$= 1.06mm.

Bending Moment at X-X axis, Mx = $\frac{pY^2}{2}$

$= \frac{178.58\times1.06^2}{2}$

Mx = 100.33KN/m.

M_{ux}=100.33×1.5

M_{ux}= 150.5KN-m.

D=590mm; d= 590−50−16 − $\frac{16}{2}$

d= 516mm.

$\frac{M_{ux}}{bd^2} = \frac{150.5\times10^6}{1000\times516^2}$=0.565≈ 0.57N/$mm^2$

From Table 2, SP 16

Pt = 0.160 %

As = Pt x b x d

$= \frac{0.160}{100} \times 1000 \times 516$

As=825.6mm^2

Spacing = $\frac{201.06}{825.6} \times 1000$

= 243.53mm.

Provide 16mm Ø bar @ 240mm c/c.

Check for One Way Shear:

One way shear is critical at section'd' from face of the column.

V_{u1}=1.5(P×Shaded area/m width)

V_{u1}= 1.5(178.58×1 ×(1.075−0.532)

V_{u1}=145.45KN.

Pt(prov)=$\frac{100Asp}{bd}$

Asp= $\frac{Area\ of\ one\ bar}{Spacing\ between\ bars} \times 1000$

$= \frac{201.06}{230} \times 1000$

Asp = 874.17mm^2

Pt = $\frac{100\times874.17}{1000\times532}$

Pt = 0.164%

From Table 19, IS 456:2000

$\tau_{c\,=}$ 0.735N/mm^2 (For M20 Concrete)

Shear resisted by concrete, V_{uc}= $\tau_c$bd

V_{uc}= 0.735×1000× 532

V_{uc}= 391020N(391.02KN)

V_{uc}>V_{u1}

Hence Section is Safe in One Way Shear.

Check For Two Way Shear or Punching Shear

Two way shear is critical at section'd/2' from face of the column.

p= 178.58KN/m^2

p=$\frac{178.58\times10^3}{10^6}$

p = 0.179N/mm^2

V_{u2}= p×Shaded area

V_{u2}= 0.179[(2500 × 2350)– (882 × 762)]

V_{u2} = 931321.96N (931.32KN)

Actual Shear Stress,τ_v = $\frac{V_{u2}}{db_2}$

τ_v= $\frac{931.32\times10^3}{[(2\times882)+(2\times762)]\times532}$

τ_v *= 0.53N/*mm^2

Allowable Shear Stress =$K_s\tau_c$

τ_c=0.25$\sqrt{f_{ck}}$

= 0.25$\sqrt{20}$

τ_c=1.11N/mm^2>1 N/mm^2

τ_c~ 1N/mm^2

$K_s = \left(0.5 + \frac{Short\ side\ dimension\ of\ column}{long\ side\ dimension\ of\ column}\right)$

$= 0.5 + \frac{0.23}{0.35}$

$K_s = 1.157$

Allowable Shear Stress = $K_s\tau_c$ = 1.157×1

= 1.157N/mm^2

$\tau_v < K_s\tau_c$

Hence the section is safe in two way shear or punching shear.

Provide 16mmϕ @ 240mm c/c in both ways as shown in figure5 below

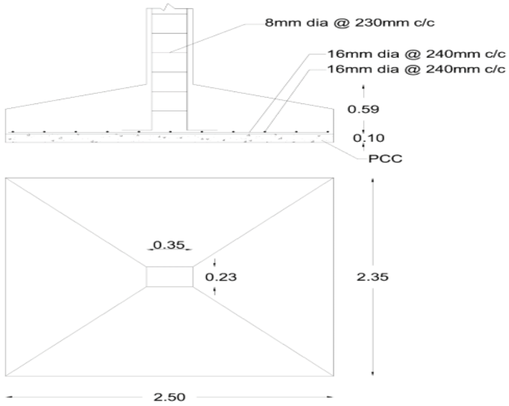

Fig:5 reinforcement detailing of footing

2.5DESIGN OF STAIRCASES:

Stair cases are generally provided connecting floors of a building and in small buildings they are the only means of access between the floors. The stair case comprises of flight of steps generally with one or more intermediate landings provided between the floor level. The structural components of a flight of stairs consist of: a tread which forms the horizontal portion of the step, Riser which is the vertical distance between the adjacent treads or the vertical projection of the step and going which forms the horizontal plan projection of an inclined flight of steps between the first and the last raiser. A flight of steps consist of two landings and one going with 10 to 12 steps. In this design project dog legged staircases are designed to access the upper floors of the apartment in addition to a lift.

DESIGN DATA OF STAIRCASE

SOLUTION

Assume the stairs to be supported on 230 mm i.e. Masonry walls at the outer edge of the landing parallel to the risers use $M_{20}$and Fe_{415} .

No. of steps = $\frac{3000}{150}$ = 20no's

$\frac{l}{d}$ = 20

$\frac{3000}{d}$ = 20

d= 150 mm

D =150 + 20 + $\frac{12}{2}$

D = 176 mm ≈ 180 mm

L = $\sqrt{R^2 + T^2}$

= $\sqrt{180^2 + 260^2}$

= 316.23 mm

Loading on going

Self-weight of slab

(25 X 0.2600 X 0.31623/0.260) = 7.91 kN/m^2

Self-weight of ∅ step

(25 X $^1/_2$ X 0.18) = 2.25 KN/m^2

Floor finish

(0.6 – 1 N/mm^2 = 1KN/m^2

L.L = 3 KN/m^2

Total 14.16KN/m^2

Factored load= 1.5x14.16 = 21.24 KN/m^2

Loading on landing

Self-weight of slab (25x0.2) = 5KN/m^2

Floor finish = 1 KN/m^2

L.L = 3KN/m^2

Total = 9KN/m^2

Factored load = 1.5x9 = 13.5KN/m^2

Taking moment about B,

$$\left[(R_A\ X\ 4.13) - \left(13.5\ X\ 0.91\ X\ \left(4.13 - \frac{0.91}{2}\right)\right] - \left[21.24\ X\ 2.08\ X\ \frac{4.13}{2}\right) - \left(13.5\ X\ 0.91\ X\ \frac{0.91}{2}\right)\right] = 0$$

$4.13R_A - 45.15 - 91.23 - 5.59 = 0$

$R_A = 34.37$ kN

$R_A = R_B = 34.37$ kN

$$M_{max} = \left(34.37\ X\ \frac{4.13}{2}\right) - 13.5\ X\ 0.91\ X\ \left(\frac{2.08\ X\ 0.91}{2}\right) - 21.24\left(\frac{2.08}{2}\right)\ X\ \left(\frac{2.08}{4}\right)$$

$= 70.97 - 11.63 - 11.49$

$M_{max} = 47.85$ kNm

To find A_{st}:

$$47.85\ X\ 10^6 = 0.87\ X\ 415\ X\ A_{st}\left[150 - 0.42\ \frac{0.87\ X\ 415A_{st}}{0.36\ X\ 1000\ X\ 20}\right]$$

$$47.85\ X\ 10^6 = 54157.5A_{st} - 7.6{A_{st}}^2$$

$A_{st} = 1033.5mm^2$

$$Spacing = \frac{1000\ X\ ast}{A_{st}}$$

$$= \frac{1000\ X\ {}^{\pi}/_4\ X\ 12^2}{1033.5}$$

$= 109.48$mm

$\sim 100mm\ c/c$

$$A_{st_{min}} = \frac{0.12}{100}\ X\ 1000\ X\ 180$$

$A_{st_{min}} = 216mm^2$

$$Spacing = \frac{1000\ X\ {}^{\pi}/_4\ X\ 10^2}{216}$$

$= 363.6$mm

$\sim 300\ mm\ c/c$

Provide 12mmϕ bars @ 100mm in plane area.

Provide 10mm ϕ bars @300mm in waist slab as shown in figure 6 below

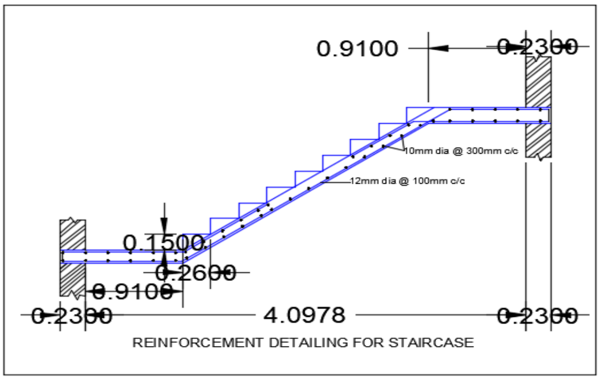

Fig 6: reinforcement detailing of staircase

IV. ANALYSIS OF STAAD-PRO OUTPUT:

In our project we considered a G+3 residential apartment building for planning design & analysis. The each floor contents 8 no's of 2BHK flat. Hear we analyses 1 flat area up to the top floor. So staad pro output is on the basis of 1 flat area.

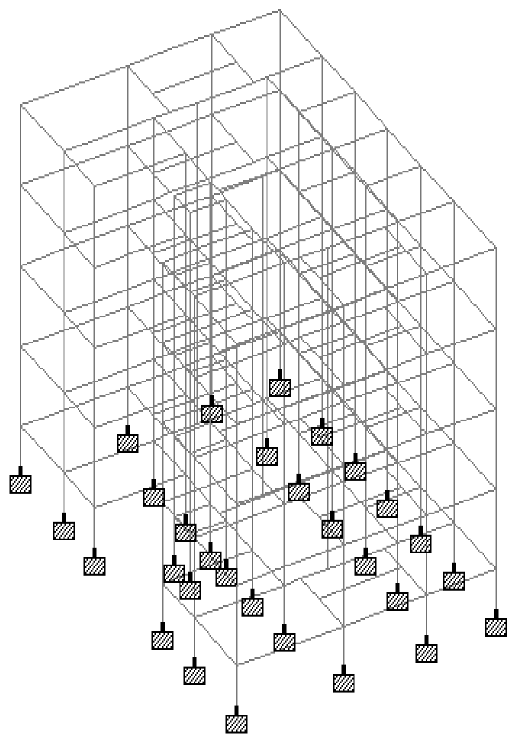

Fig7 : Isometric view

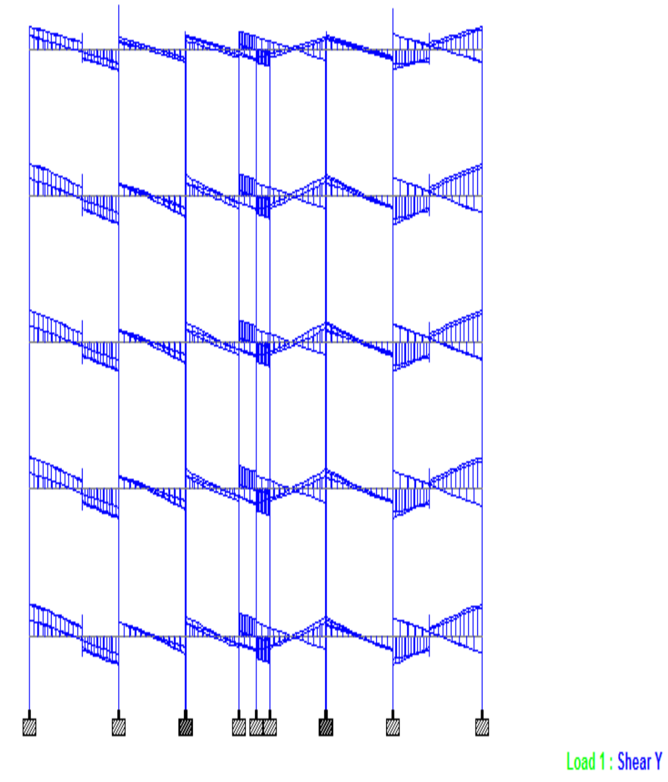

Fig 8 : shear force diagram in y-axis

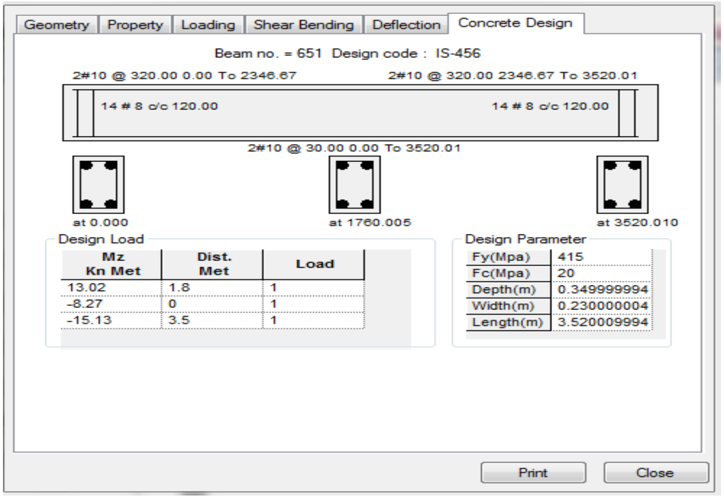

Fig 10: Beam result from staad pro

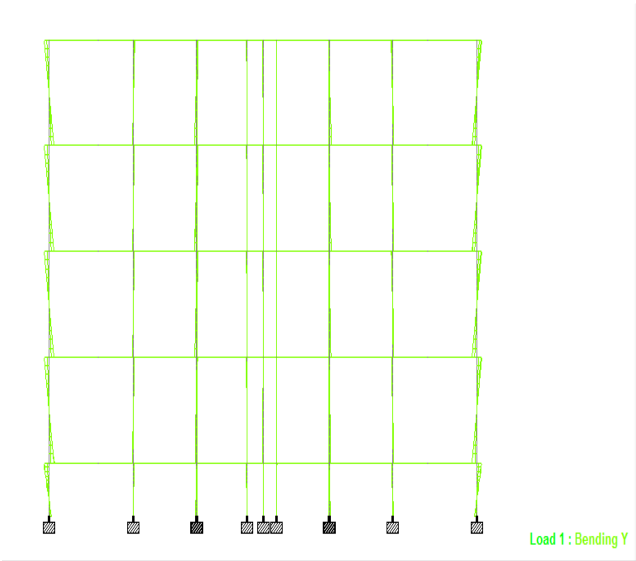

Fig 11 :Bending moment diagram in y-axis

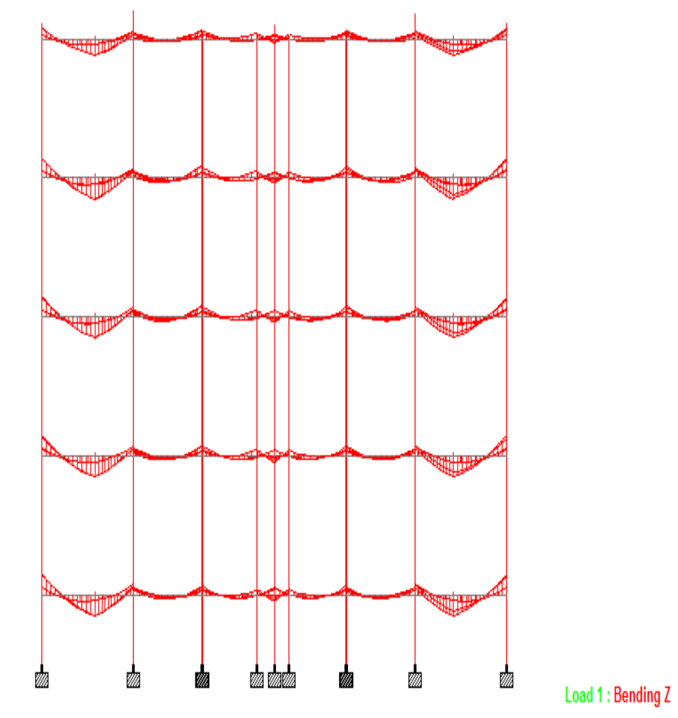

Fig 9:Bending moment diagram in z-axis

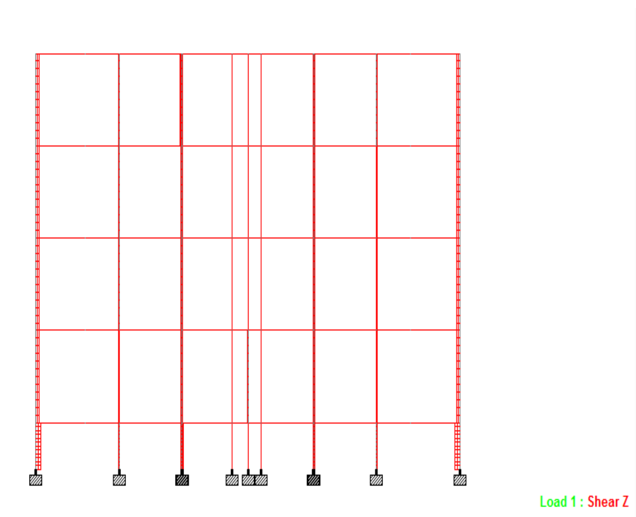

Fig 12 :shear force diagram in z-axis

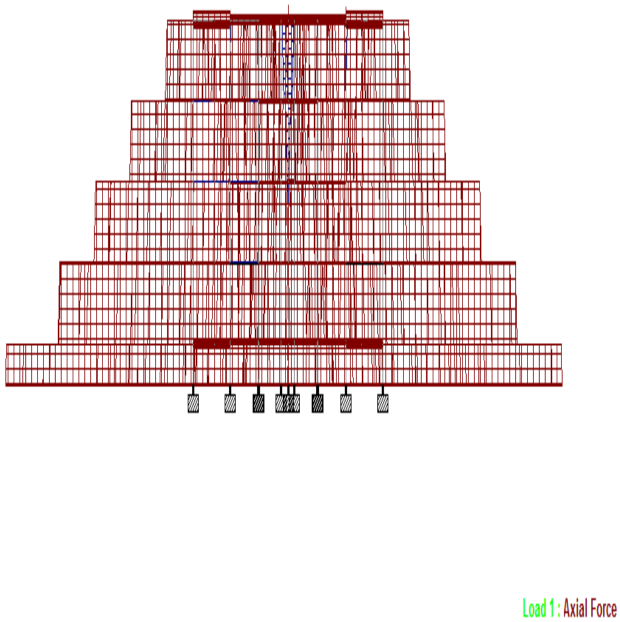

Fig13: axial force diagram

V. CONCLUSIONS

- The apartment is designed and constructed in such a way that it performs it functions for which it is designed for land scarcity.
- In the project the main concepts of analysis and design are covered. The basic principles of framed buildings are applied in the project work.
- Various design methodologies especially those going around the planning of apartments building were learnt by us.
- These concepts will improve our knowledge on analysis and design and guidest us in the future in taking up any design project.
- Our objective of designing a G+3 apartment building has been satisfied through this project.

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