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Manual analysis of VILLA and Comparison of result with STADD-PRO analysis

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ABSTRACT

Structural designing is the primary aspect of civil engineering. The foremost basic in Structural designing is the design of simple basic components and members of building like beams, columns and footings in order to design them it is important to first obtain the plan of a particular building .There by depending on the suitability plan layout of beams and columns are fixed.

Once the loads are obtained the component takes the load first is slab so first slab is designed. designing of slabs depends upon whether it is a one way or a two way slab the end conditions and loading .from the slab the load gets transferred to beam .The loads coming from the slabs onto the beam may be trapezoidal or triangular . Depending on this the beam may be designed. There after loads (mainly shear) from the beams are taken by the columns. For designing columns it is necessary to know the moments they are subjected to. For this purpose frame analysis is done by Kane's method. After this the designing of columns is taken up depending on end conditions moments, eccentricity. Finally footings are designed based on the loading from the column and also soil bearing capacity value for that particular area.

Keywords: *Analysis sequence, Structural Analysis, Numerical Computation, Design System.*

1. INTRODUCTION

In its modern form, a gated community is a form of residential community or housing estate containing strictly-controlled entrances for pedestrians, bicycles, and automobiles, and often characterized by a closed perimeter of walls and fences. Gated communities usually consist of small residential streets and include various shared amenities. For smaller communities this may be only a park or other common area. For larger communities, it may be possible for residents to stay within the community for most day-to-day activities. Gated communities are a type of common interest development, but are distinct from intentional communities.

In addition to a heightened sense of security, most gated communities provide a park or playground, community centre, swimming pool and private storage for homeowners. Larger, more prestigious communities may also include schools for young children, tennis courts, fitness centers, golf courses and marinas. Homeowner's association fees pay for the building and maintenance of common areas in a gated community.

2. SCOPE OF THE STUDY

At the end of the study we will have complete knowledge of designing of structural members according to IS 456-2000 which help us to design any structural member in future,

VILLA GROUND FLOOR PLAN

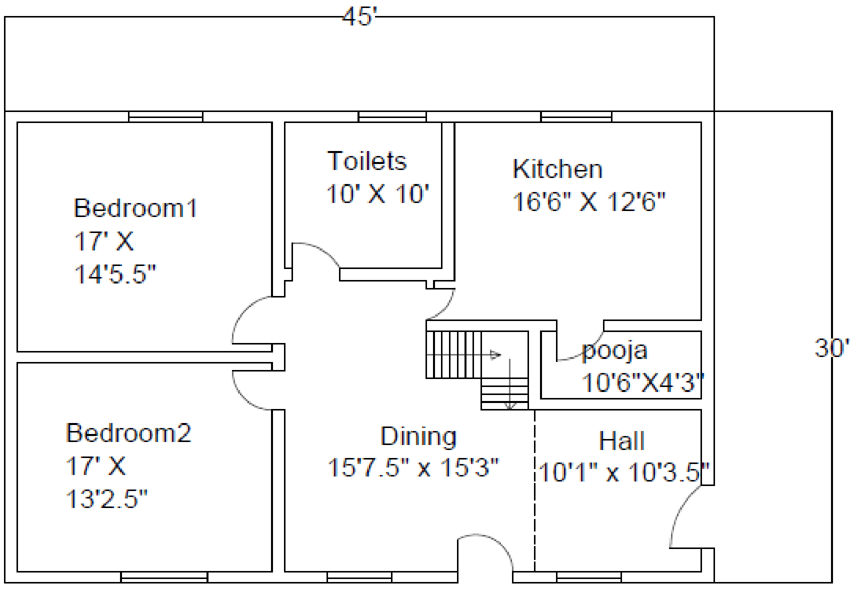


Fig 1

3. DESIGN OF SLAB

3.1 Two adjacent edges discontinuous

Data:

Dimension of slab	= 5.18m × 4.4 m	fck = 20 N/m2
Support width	= 230 mm	fy = 415 N/m2
Live load	= 3 KN/m2	
Floor finish	= 1.5 KN/m2	

Aspect ratio:

For values of $\frac{L_y}{L_x}$ & edge condition from table: 26 of IS: 456

$$\frac{L_y}{L_x} = \frac{5.14}{4.48} = 1.17 < 2$$

So it is a two way continuous slab

Effective stiffness depth required for:

$$Minimum\ depth = \frac{span}{26} (for\ continous\ slab)$$

$$depth\ d = \frac{4400}{26} = 170mm$$

Assume effective cover = 20 mm, Using 10 mm diameter bars

Effective depth = d = 170 mm

Overall depth = D = 170 + 20 + (10/2)

= 195 mm

d = 170 mm

D = 195 mm

Effective span:

As per IS 456:

Effective span = c/c of supports (or) clear span + effective depth (whichever is less)

- (Clear span + effective depth) = (4.4 + 0.17) = 4.57 m
- (Centre to centre of support) = (4.4+ 0.23) = 4.63 m

Hence L = 4.57m

Loading on the slab:

Self-weight of slab = (0.195 × 25) = 4.875 KN/m2

Floor finish = 1.5 KN/m2

Live load = 3 KN/m2

Total service load = w = 9.375 KN/m2

Ultimate load = wu = 1.5 × 9.375= 14.06 KN/m2

Wall load = 17 x 0.23 x 0.1= 0.391 KN/m2

Design load = 14.45 KN/m2

Bending moment coefficients:

Short span:

1. Negative moment at continuous edge (-αx) = 0.057

2. Positive moment at mid span (+αx) = 0.043

Long span:.

1. Negative moment at continuous edge (-αy) = 0.047

2. Positive moment at mid span (+αy) = 0.035

Bending moment:

• B.M along span (+ve) = 0.043 × 14.45 × 4.572

Mux = 12.97 KN.m

• B.M along span (-ve) = 0.057 × 14.45 × 4.572

Mux = 17.20 KN.m

• B.M along span (+ve) = 0.035× 14.45 × 4.572

Muy = 10.56 KN.m

• B.M along span (+ve) = 0.047× 14.45 × 4.572

Muy = 14.18 KN.m

Check for effective depth:

M_{max} = $0.138 f_{ck} b d^2$

$$d^2 = \frac{17.20x10^6}{0.138x20x10^3}$$

d = 78.94mm < 170mm

CALCULATION OF REINFORCEMENT

3.4.2For short span at mid span

$$M_u = 0.87 f_y A_{st} d(1 - \frac{f_y A_{st}}{bdf_{ck}})$$

A_{st} = 206.00 mm^2

Number of bars = 3

Assuming 10mm dia bars, spacing $= \left(\frac{\text{Ast of one bar}}{\text{total Ast}}\right) \times 1000$

= 333.33mm

Check for spacing:

For minimum reinforcement consideration,

$1.333.33mm$

$2.3d = 3 \times 170 = 510mm$

$3.300mm$

Therefore, provide 3-10mm diameter bars at 300mm c/c spacing

3.4.3 For short span at continuous edge

$$M_u = 0.87 f_y A_{st} d(1 - \frac{f_y A_{st}}{bdf_{ck}})$$

A_{st} = 275.65 mm^2

Number of bars = 4

Assuming 10mm dia bars, spacing $= \left(\frac{\text{Ast of one bar}}{\text{total Ast}}\right) \times 1000$

= 250mm

Check for spacing:

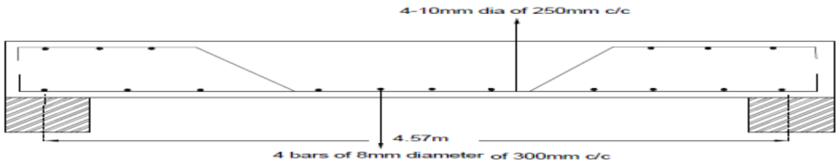
For minimum reinforcement consideration,

$1.250mm$

$2.3d = 3 \times 170 = 510mm$

$3.300mm$

Therefore, provide 4-10mm diameter bars at 250mm c/c spacing



C/S OF TWO WAY SLAB ALONG SHOTER SPAN

Fig 4

CALCULATION OF END MOMENTS IN FRAME "ABC"

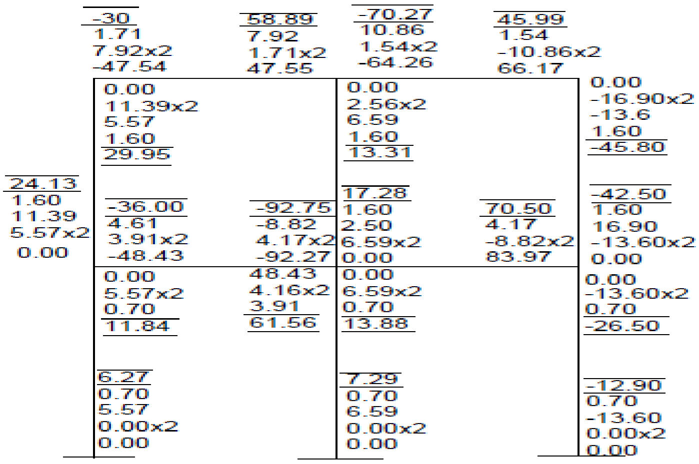


Fig 8

ANALYSIS OF FRAME "ABC"

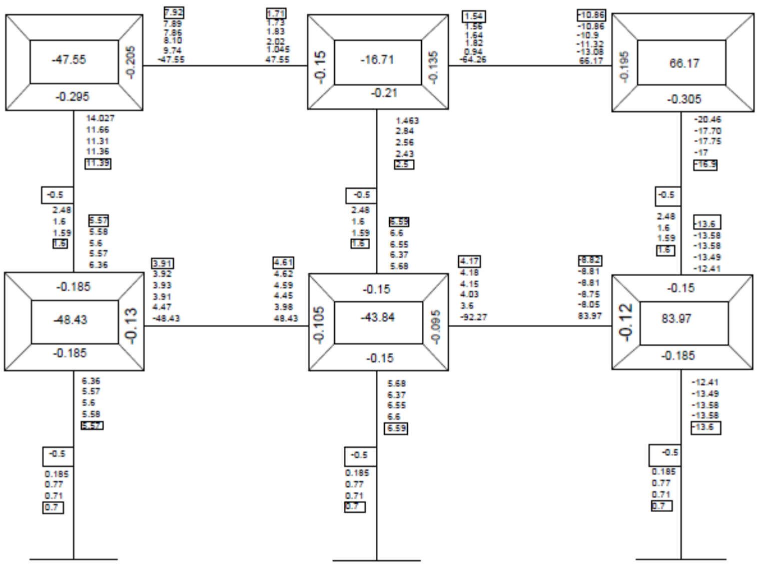


Fig 7

5.3 DESIGN OF BEAM

Dimension:

Shear force = 107 KN

Moment M_u = 92.75 KN.m

Beam size = 0.23 × 0.4m

Limiting moment of resistance

$M_{u\,limit}$ = $0.138\, f_{ck}\, bd^2$

$M_{u\,limit}$ = $[0.138\times20\times230\times400^2] \times 10^{-6}$

= 101.54 KN.m

Since M_u<$M_{u\,lim}$, section in under reinforced

Effective Span:

Centre to centre distance =4.63m

Clear span + d =4.57m

Therefore take L = 4.57 m

Calculation of loads:

Dead load on beam = 0.23x0.425x25KN/m

Imposed load on beam =60.92KN/m

Total load =63.36KN/m

Factored load =95.04KN/m

$$(Bending\ moment) = \frac{95.04x4.57^2}{8} = 248.11\ KN - m$$

Since B.M>M.R

We go for doubly reinforced beam

Moment of resistance of auxillary section:

$M_u =$ $M_{u\,limit}$ $+ M_{u2}$

$M_{u2} = 155.36$

Area of compression steel corresponding to M_{u2}

$M_{u2} = f_{sc} A_{sc} x(d - d')$

$A_{sc} = 1257.4$

Assume d'=50mm

$\frac{d'}{d} = 0.125$

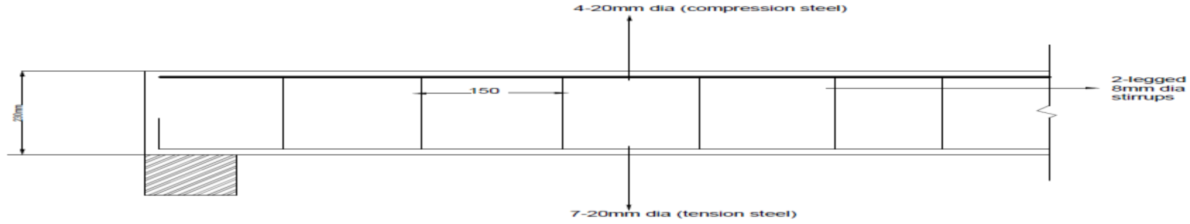
$f_{sc} = 353$

Assuming 20mm diameter, No of bars = 4

Therefore provide 4bars with area of 1256mm^2

The stress in compression steel (f_{sc}) can be calculated based on the grade of steel and ratio of

$\frac{d'}{d}\ as\ follows$



C/S OF DOUBLY REINFORCED BEAM

Fig 13

6.3 COLUMN DESIGN

Data:

Column size = 350mm × 400mm

Axial load = 250KN

Unsupported length = 4570mm

Concrete mix = M20

Characteristic strength of reinforcement = 415 N/mm^2

Slenderness ratio:

(L/D) = (0.65x4570/400) = 7.42 < 12(in x-direction)

(L/D) = (0.65x4570/350) = 8.48 < 12(in y-direction)

Therefore column is short column.

Minimum eccentricity:

IS 456-2000 clause 25.4

e_{min} = 22.47 > 20mm

Also 0.05 D = .05 × 400 = 20 < e_{min} (in x-direction)

e_{min} =20.8> 20mm

Also0.05 D = 0.05 × 400 = 20 < e_{min} (in y-direction)

Uniaxial short column should be designed

$$D = 400 + \frac{16}{2} + 40 = 448$$

$$\frac{d'}{D} = 0.1\ (in\ x - direction)$$

Factored ultimate load:

P_u = 375KN

Moments due to beams:

M_{UX} = 31.19KN.m

M_{UY} = 70.70KN.m

Reinforcement calculation:

- Reinforcement on two sides

Reinforcement is distributed equally on two sides.

Uni–axial moment's capacity about x – x axis:

d'/D = 4570/448 = 0.1

Chart for d'/D = 0.1 will be used.

$\frac{P_u}{f_{ck}bD}$ = 0.10

$\frac{M_u}{f_{ck}bD^2}$ = 0.18

Referring to chart 28

$\frac{P}{f_{ck}}$ = 0.11

p (% of steel) = 2.2%

$P_u = 0.4 f_{ck} A_c + 0.67 f_y A_{sc}$

Area of main reinforcement

A_{sc} = 3080 mm^2

Using 26mm dia,

Number of bars = 6

Design of Lateral ties:

Dia of tie should not be less than 1/4th dia of largest longitudinal steel or 6mm, whichever is greater.

26/4 = 6.5 0r 6mm

Use 8mm dia for lateral ties

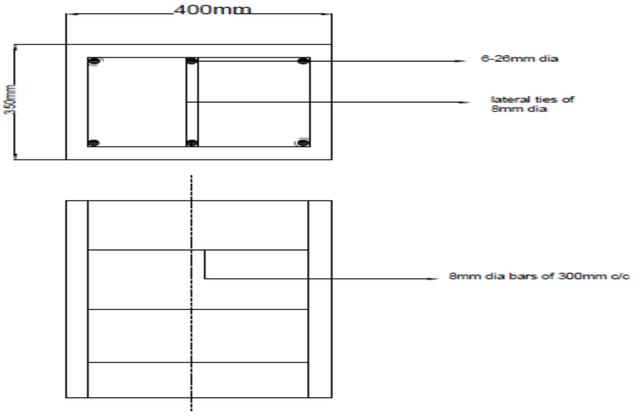
Spacing of lateral ties:

16x dia = 16x26 = 416mm

D = 448mm

300mm

Use minimum of all the above, i.e; 300mm c/c spacing.



C/S OF UNIAXIAL COLOUMN

Fig 14

7.3 DESIGN OF FOOTING

Proposed footing : " Square Isolated Footing"

Grade of materials:

f_{ck} = 20 N/mm^2 ; f_y = 415 N/mm^2

Data:]

Safe Bearing Capacity = 392.4 KN/m^2

Load calculations:

Self weight of wall =13.62x0.1x3x17 = 69.46 KN

Self weight of column =0.23x0.4x25x4.87=11.20KN

Design weight =121KN

Total weight = 375+121 = 496KN

Calculation of area:

Footing area = $\frac{load}{S.B.C} = \frac{496X10^3}{392400}$

$= 1.26 sq.m$

Therefore adopt square footing of size = 1.2mx1.2m

One way shear:

Load P = $\frac{495}{1.2x1.2} = 343.75KN$

Allowable shear stress τ_c = 0.35 N/mm^2

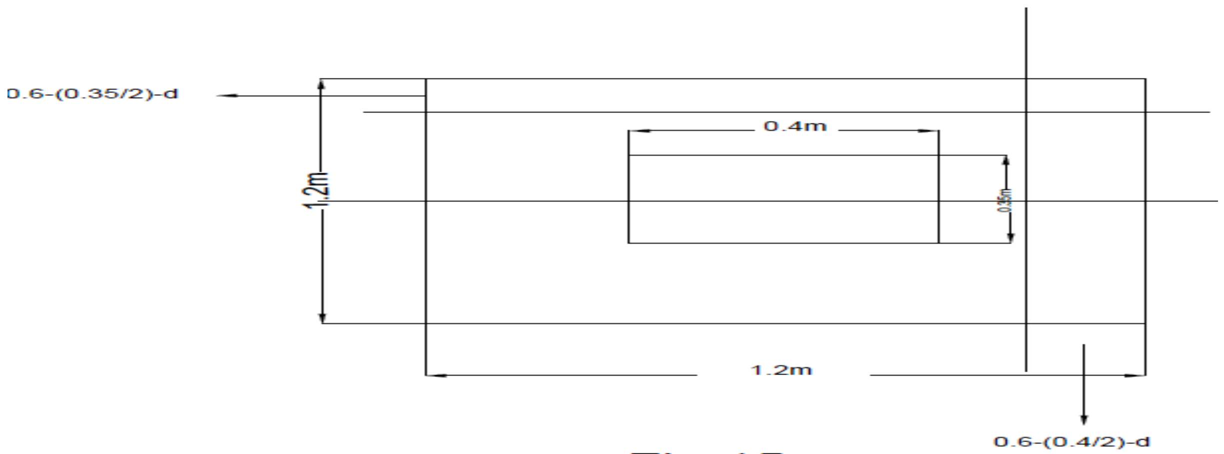


Fig 15

4. CONCLUSIONS

The aim of this project is to portray analysis of different members of a residential villa which is made of RCC .This was made using latest software's & manual analysis & building codes.

The 3D analytical models & Kanni's method is done in Auto-cad Software with manual analyised values which helped to develop a design with accurate values & optimized to arrive a cost efficient design.

5. REFERENCES

[1] Wakchaure M.R, Ped S. P on "Earthquake Analysis of High Rise Building with and Without Infill wall" International Journal of Engineering and Innovative Technology 2, August 2012, Volume 2, Issue 89, PP: 89-94.
[2] Hemant B. Kaushik, Durgesh C. Rai, and Sudhir K. Jain on "A Rational approach to analytical modeling of masonry infills in reinforced concrete frame buildings" The 14thWorld Conference on Earthquake Engineering,October 12-17, 2008, Beijing, China.
[3] P. Reza*, M.F. Wahid and D.M.N. Islam on "Comparative Study of Bare Frame and Infilled Frame Buildings Due To Seismic Load" in Proceedings of 11th Global Engineering, Science and Technology Conference, 18 - 19 December.
[4] Konuralp Girgin and Kutlu Darılmaz on "Seismic Response of Infilled Framed Buildings Using Pushover Analysis" volume 54, number 5, PP: 1-7
[5] Sayed Mahmoud,Magdy Genidy• Hesham Tahoon on "Time-History Analysis of Reinforced Concrete Frame Buildings with Soft Storeys" Research gate: Article • December 2016
[6] A. Mallika, " study on effect of storey height on the seismic performance of tall braced building" International Journal of research in engineering and technology, vol.5 , No:2,2016,PP: 37-41
[7] IS:456: 2000: Plain and Reinforced concrete -. code of practice.
[8] IS: 1893(part 1):2002 :Criteria for Earthquake Resistant Design of Structures.part 1: general provisions and buildings.
[9] IS: 875(part 2) : 1987: Code of practice for design loads (other than earthquake loads) for buildings and structure

