RESEARCH ARTICLE OPEN ACCESS

Layout Planning, Design and Estimation of Residential G+2 Building

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ABSTRACT
The layout planning is a part of urban development it includes planning of residential houses, commercial complexes, service roads, primary health centres, school...& other amenities sewerage system for whole layout (includes treatment, sewer line, storm water drains), water distribution system. This project includes design& estimation of residential building in plot of layout planned.Designing involves identifying the loads which act upon a structure and the forces and stresses which arise within that structure due to those loads, perform analysis to get moments and shear forces on different elements of the structure and then design the structure for ultimate loads and moments. The loads can be self-weight of the structures, other dead loads, live loads, moving (wheel) loads, wind load, earthquake load, load from temperature change etc. Estimation includes finding the quantities of materials required for the construction of the structure and requirements of labour etc., finally determining the overall cost of the structure Before execution of work

Keywords :— CAD,STAADPRO.

I. INTRODUCTION

The layout planning is a part of urban development it includes planning of residential houses, commercial complexes, service roads, primary health centers, school..& other amenities sewerage system for whole layout (includes treatment, sewer line, storm water drains), water distribution system. This project includes planning of plots and roads in the layout in that plot design of residential building (G+2).and its estimation.

1.1 NECESSITY

Now a day's the urban development plays an important role in development of country. the population of Indian towns and cities is growing rapidly .so there is a great demand for the basic needs for people .in that housing is one of the basic need .these requirement leads to growth of real estate because of the growth of real estate number of townships, layouts, avenues are developing in developing towns and cities, For creating infrastructure to the people.

1.2 OBJECTIVE

•To create infrastructure to the people..
•To meet the requirements of people like water supply, roads.etc.
•To gain income for the government. Leads to country's development compresses

1.3 LAYOUT DETAILS

1.31 Soil profile at the site

As per local enquiry and test pits the profile of soil is
Up to 2m there is silty sand(SM) from 2 to 6 there is well Graded gravel (GW) is very hard soil &below that there is Laterite soil & SDR (soft disintegrated soil)..the soil at theB ite is good and the bearing capacity of soil ranges between 25t/sq.m to 35t/sq.m.so the isolated footing is more than Enough for a G+2 building.

1.32 Ground water table details

The Ground water may available at a depth of 25 ft at the location in rainy season so there is no problem of rise of G.W.T at the structure.

1.33 Area of Layout

The area of layout measured between the boundaries is 14.403 acre

1.34 Existing condition of layout

The layout there is almost a levelled surface and the layout features are as shown in the photographs..

1.35 Level of the layout: +16.956 above mean sea level

1.4 PLANNING OF LAYOUT

The layout is planned as in total area of land is 14.403 acres in that the land reserved for public purposes and for water works is 14% that is 2.016 acre's proposed roads area is 31.11% that is 4.408 acres. The main service connecting road is 40ft road and remaining all other service roads are 33ft.the remaining site area is divided into plots of size 40ft x 60ft plots the total number of plots are 143 no's

The plot no's 100,101,102,103,119,120,121,122,137 are proposed for park. And remaining plots are proposed for G+2 residential buildings..

1.41 Plot planning

Plots of size 40ftx60ft is planned for a G+2 unit

The total plot area is=2400sq.ft (223sq.m).

The abutting road width is 33 ftAccording to G.OM.MS.NO 67 for Minor GramaPanchayats

1.42Permissible height and setback requirements

The minimum open spaces /setbacks (open to sky) and height restrictions shall be as follows for considering the building permissions in Minor Gram Panchayats.

i. Height Permissible: 9 meters or G+2 floors in Gram Khantam and 13 meters or G+3 floors height in revenue survey number areas

ii. Setbacks:

In Gram Khantam:

Front setback or building line: 1.50 meters

Rear setback: 1.00 meters

Side set back=1.5m…AS PER G.O.MS 67

Deducting setback area

Net Plot area=1562.28sq.ft(145.14sq.m) in that net plot area we have to plan a G+2 building and have to design it.

1.43 Planning of built up area

All the Rooms in the Plan Plotted Are As Per Norms of National Building Code

(N.B.C-2005)

1.5 NATIONAL BUILDING CODE PROVISIONS (NBC)

1.51 **Classification of building**

•Occupancy classification

•Group-A: Residential

•Group –B: Educational

•Group -E: Business…etc.,

1.52 Room size requirements

•The area of habitable room shall not be less than 9.5m2, minimum width of 2.4 m

•The area of a kitchen where separate dining area is Provided, shall be not less than 5.0 m2 with a min width of 1.8 m.

•The area of a bathroom shall not be less than 1.8 m with a minimum width of 1.2 m.

In this project all the rooms in the building are planned as per N.B.C 2005

1.53 Open space

The open spaces inside and around a building is essential to cater for the lighting and ventilation requirements of the rooms.

In the case of building abutting streets in the front rear (or) sides, the open spaces provided shall be sufficient for the future widening of such streets.

1.54 Provision of lifts

It shall be made for building more than 15m height.

1.55 Fire zones

It shall be designed as follows

- Fire zone 1
- Fire zone 2
- Fire zone 3

1.56Exit requirements

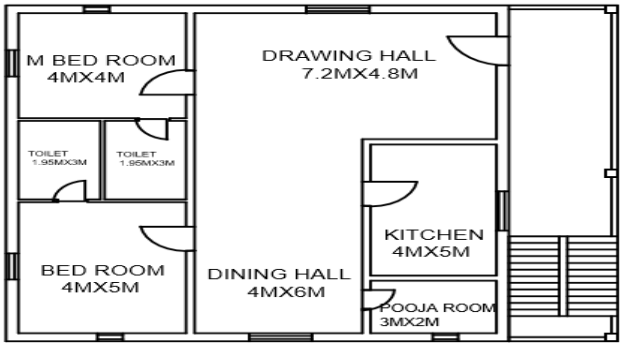
- All exits shall be free of obstruction.
- Firefighting equipment shall be suiting located and clearly marked.

1.57 Ventilation

- Proper ventilation widows should have minimum area 1/8 of the floor area of a room.
- Aggregate area of the doors & windows should not be 1/4 of the floor area of the room.
- Widows should be provided 60to90 cm above floor level.
- Area of each ventilator should not be less than 3sq.m.
- 1.58 Fire detecting & exiting system
- Manually operated fire alarms.
- Sound audible to all departs.
- Easily operated from the telephone switch board.

Structural analysis and design

The structural analysis and design is carried out manually and by using staad.pro software In manual analysis structural analysis is carried out by substitute frame method and design of structure is according to the codal provisions IS456-2000,sp-16,sp-34,is 875 part-1,2,3 estimation of cost is as per latest rates of SSR(standard schedule of rates)-2014-2018



II. THE ANALYSIS OF FRAMED STRUCTURE

2.1 MANUAL METHODS

There are many methods available to analyze a structure. Some of these are

1.Slope Deflection Method
2.Moment Distribution Method
3.Kani's Method
4.Matrix Method
a. Flexibility Method
b. Stiffness method

2.11 Need for analysis

In all structure each and every element like beams, columns should be analysed for maximum bending moment and shear force and with this moments elements as to be designed. The analysis has to be done to get a structure, which is structurally safe as well as, economical.

2.12 Moment distribution method (hardy cross method)

The structural system is first reduced to its cinematically determinate from in this method. This is accomplished by assuming all the joints to be fully restrained. The end moments of all the members are computed for this condition of the structure. The joints are allowed to deflect one after the other by releasing there successively. Hardy cross method provides an elegant and quick procedure to analyse continuous beam. The method can also be applied to frames with a few additional computations.

2.13 Substitute frame method

The method of analysis for this framed structure is by substitute frame method. By taking little portion of the frame called substituting frame, the moments can be calculated. The moments carried from floor to floor through columns are very small compared with beam moments; therefore, the moments in one floor have a negligible effect on the moments of the floor above and below. Therefore the analysis of these multi storeyed frames is carried out by taking one floor at a time. Each floor is taken with columns above and below fixed at the far ends and moments and shears are calculated in beams and it gives approximate results as only two cycles distribution are carried out.

2.14 Criteria for Analysis for Structural Members

The analysis for this building was performed by Substitute Frame Method since the most commonly used method for the analysis of vertical load is the Substitute frame method. In substitute frame method, the results can be obtained quite satisfactorily from the design point of view, which is also recommended for all practical purposes as per code IS 456 – 2000.

A substitute frame method consist of a small portion of a multi-storey, multi bay frame generally comprising of the floor beams, with the columns above and below the floor assumed to be fixed In moment Distribution method, the analysis is lengthy and difficult

III. SPEIFICATIONS

3.11DESIGN SPECIFICATIONS

Structural design is carried as per the following
R.C.C elements: As per IS456-2000 & SP16-1978
Reinforcement and Bar Bending Scheduling: As Per Sp-34
Detailing of building services: as per SP-24

3.12 OTHER SPECIFICATIONS

Clear cover to reinforcement bar
Beams-25mm to 30mm
Columns -40mm
Slabs-20mm
Foundations-50mm

Curing: Curing shall be done for 28 days

Compaction: Thorough compaction shall be done to avoid honeycombing

W/C ratio: For 1:2:4mix- 0.45
For 1:1.5:3mix-0.40

Admixtures: Addition of "super plasticizers" to concrete while preparing is recommended

Development length: Anchorage /lap length: 55xds where ds is the diameter of the bar

Curtailment of bars: Development length shall be maintained for all curtailed bars from point of theoretical curtailment

Lapping of columns bars shall be staggered lapping shall be done at the mid length of the column

For Lateral ties (of beam or column) 1350 hook should be given

Removal of formwork: For slabs and beams formwork shall not be removed before 21 days of laying concrete

Beam-column joints: All the beam bars must pass in between column bars at joints

In the joint C type rings if closed stirrups are not provided. Proper compaction of joints shall be ensured in the joints

Bars left out: the column bars that are left out for future extension must be given anti-corrosive coating and then should be filled with concrete.Istallation process

3.2DESIGN OF BEAMS

3.22Types of Beams On The Basis Of Their Reinforcements

Singly reinforced beams

Doubly reinforced beams

Flanged beams

3.24 Design Procedure

Ultimate moment on the beam=Mu

Breadth of the beam=b

Depth of the beam=D

Effective depth of the beam=d

Find Mu/bd2

Find area of tension steel & also compression steel if required from SP16 tables 1-4 & 45 -56

Ultimate shear force acting=VU

Find the Shear Capacity of the beam from SP16 (Tables 61-63)

Note: check for deflection must be done

In overall we have to design 2 similar beams of different spans let the beams are B1 and B2

3.25DESIGN OF BEAM –B1

In case of framed beams the section at mid span is tube designed as beam and at support it has to be designed as singly or doubly reinforced beams

Characteristic strength of concrete,

FCK=20n/mm2

Grade of steel FY=415 N/mm2(HYSD bars**)**

Beams	Reinforcement at supports		Reinforcement at midspan		Shear reinforcement (vertical stirrups) Asv		Deflection control
	Tension steel(Ast)	Compression steel (Asc)	Tension steel (Ast)	Compression steel (Asc)	At supports	At mid span	
B1 =400 X230	4-bars of 16# in 2 layers	Nil	4-bars of 16# at bottom	Nil	2-legged 8mm stirrups at 225mmc/c	2-legged 8mm stirrups at 225mmc/c	safe
B2 =300 X230	6-bars of 16# in at top	4-bars of 8# in at bottom	6-bars of 16# at bottom	Nil	2-legged 6mm stirrups at 110mmc/c	2-legged 6mm stirrups at 200mmc/c	safe

3.3 DESIGN OF COLUMNS

3.32 DESIGN PROCEDURE

Columns Subjected To Bi-Axial Bending

Ultimate Load on Column =Pu

Ultimate Moments in X & Y Direction= Mux &Muy

Assume Percentage of Steel Is =P%

From (Charts 63 & 64 of Sp-16) Find Uni-Axial Moment Capacity Of Column In Both X & Y Direction = Mux1 & Muy1

Find Capacity of Column in Pure Axial Compression=Puz

Obtain α Value Also

Check For (Mux/ Mux1) α + (Muy/ Muy1) α< 1.0

Then Provide lateral ties As per Is456-2000

S. No	Position	Pu (load) KN	Mux (KNm)	Muy (KNm)	Section mm x mm	P %	Ast mm^2	Dia of tie	Pitch mm
1.	Columns	963	31.483	10.237	300x300	1.8	8-18#	18 ϕ	200

3.4 DEISIGN OF FOOTINGS:

3.41 Footing:

Footing / Foundation is the bottom most component of a structure which lies well below the ground level. The foundation provided for a R.C.C Column is called a Footing

Types of Footings

1.Isolated column footing

2.Combined footing for columns

3.Strap - footing for columns

4.Raft footing (mat)

5.Spread footing for walls

When separate footings are provided for each column they are called isolated footings

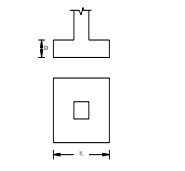
They are mainly classified on the shape of footing

a) Square footing

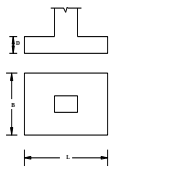
b) Rectangular footing

c) Circular footing

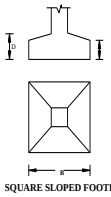
Isolated footings may be of uniform thickness (or) Stepped (or) Varying thickness



SQUARE FOOTING (UNIFORM THICKNESS)



RECTANGULAR FOOTING(UNIFORM THICKNESS)



SQUARE SLOPED FOOTING

In our design as the good soil is found at shallow depth by analysing the soil profile the isolated footing is more than enough at that location

3.42 Design procedure of isolated footing:

Safe bearing capacity of soil: SBC

Working load on footing=P

Area of the footing required =1.1xP/SBC

Size of the footing Af=AxB

Determine upward soil pressure=qu

Find the bending moment in both directions= Mx& My

Find the Depth Required From Max B.M Consideration

Calculate Reinforcement Required In both the Directions as per IS 456-2000

Check for one way shear & two way shear and punching shear stress

Check for development length is also be done as per IS 456

In this project the footings are accommodated in a trench of 2.2m x2.2m x1.5m for inner columns and 1.7m x1.7m x 1.5m

3.43 DESIGN OF FOOTINGS

Data:

Load on column=805.74kN

Size of column=300mm x300mm

Safe bearing capacity of soil=200kN/m2

Grade of concrete(fck)=20 N/mm2

Grade of steel fy=415N/mm2

For rectangular column economical design of footing is obtained if the projection of footing from the face of the column in the both directions is same .the design is similar to that of square footing for square column same reinforcement is provided in the both directions

Size of the footing

Load from the column=805.74kN

Self weight of the footing =10% of the weight of the column=805.74/10=80.574 kN

Total load on the column=805.74+80.574=886.314kN

Area of the footing required=1.1×workingload/SBCofthesoil =1.1×886.314/200=4.87m2

Area of the square footing(A)=4.87m²

Area of the footing provided(A)=B× =2.2×2.2=4.84m²

Provid 12mm dia bars of 15 numbers with 150mm c/c spacing

Therefore V> c hence unsafe in one way shear

τ_U N/mm2<τ_V N/mm2hence footing is safe againstpunching shear stress, two way shear

3.5 SLABS

Slabs are structural members having small thickness when compared to its other two dimensions

(i.e., length & width)

Slabs carry the loads by bending action in one or more directions and transfer to the supports

Based on the ratio between longer span to shorter span, slabs are classified .

Classification of slabs

3.51 One Way Slabs

Bending takes place along the shorter span direction and deflects in one direction onlyMain reinforcement will be provided in shorter span direction only Distribution reinforcement will be provided in longer direction to take into effect of temperature stresses

3.52 Two Way Slabs

Bending takes place along both the directions and deflects in two directions (like saucer) Main reinforcement will be provided in both the directions

Lx = shorter span Ly = longer span Ly / Lx> 2 one way slab Ly / Lx< 2 two way slab

In case of framed structures the slab panels behave as a two way restrained slabs and restrained one way slabs

3.53 DESIGN PROCEDURES

3.54 Design of two way slab:

Look at the edge condition of the slab.

Let lx&ly be the spans in x, y directions

Total working loads on the slab=W

Find Ly / Lx ratio

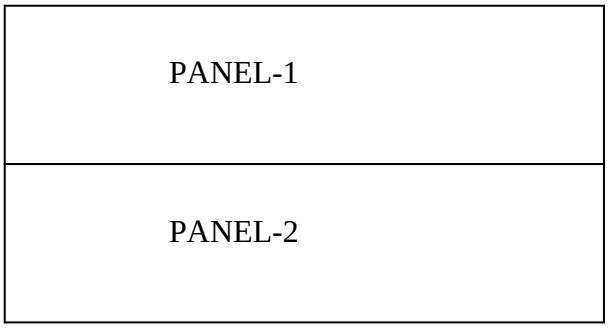
Obtain moment coefficientsax &ay from IS456

Find ultimate moments in both x & y directions at supports as well as mid span using the formula M=a w l2

Find area of steel as per IS456

Check for deflection may also done

In this project the slabs panels are given below



3.55 Design of one way slab:

Moment on the slab=M

Depth of Slab=D

Effective depth of slab=d

Find M/bd2 where b=1000mm

From IS 456 find area of main steel and distribution steel

slab	Type	Main Ast along x-direction	Main Ast along y-direction	Distribution steel	Ast in edge strip	Torsion steel	Deflection control
S1	1-way	12mm bars@ 150mm c/c	Nil	12mm bars@ 300mm c/c	no	no	safe
S2	1-way	12mm bars@ 150mm c/c	Nil	12mm bars@ 300mm c/c	no	no	safe

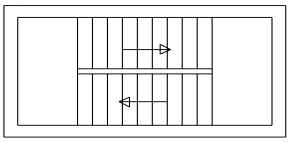
3.6 DESIGN OF DOG-LEGGED STAIR CASE

Design load w_u =1.5×9.5=14.25kN/m^2

provide overall 170mm with effective depth 150mm

Using 8mm bars area of each bar =50mm^2

No.of bars in the width of 1.2m of stair = (273.46/50)×1.2=6.56~7 bars



dogleggedstaircase

Provide 8mm bars@90mm c/c

Distribution Reinforcement: Provide 8mm bars@ 145mm c/c

3.8 DESIGN OF PLINTH BEAMS

Plinth beams are provided below walls i.e. at above foundation (at the floor level)They are to be designed as singly (or) doubly reinforced beams it is subjected to wall loads above it

3.8.1DESIGN OF PLINTH BEAM-P1

Depth of the beam is restricted to D=500mm

Effective depth=d=470mm

Width of the beam b=230mm

Effective span=7.2+0.23+0.23=7.67m

1. Loads:

Factored load=1.5*14.458=21.683 kN/m

Tension reinforecemet :

Provide 4-bars of 20# in at bottom A_{st} provided =1256.64 mm^2

Compression reinforcement:

Provide 2-bars of 12# at top is provided =226.2 mm^2

Design of shear reinforcement:

Provide 2-legged 6mm stirrups at 215mmc/c throughout span

IV. ANALYSIS AND DESIGN OF G+2 RESIDENTIAL BUILDING USINGSTAAD–PRO V8I

4.1 INTRODUCTON

STAAD-v8i is comprehensive structural software that addresses all aspects of structural engineering model development, analysis, design, verification and visualization. It is based on the principles of "Concurrent Engineering". We can build the model, verify it graphically,

Perform analysis/design, review the results, sort/search the data to create a report all with in the same graph based environment. Main options available are

STAADv8i- analysis and design

STAADv8i- graphical input generator

STAAD-POST- graphical post processing

STAAD-INTDES- interactive design of structural component

In addition we have on line manual access and file management

4.1.1 Input generator

The STAAD-v8i input file can be created through a text editor or STAAD-PRE input generator facility. Any text editor can be used to create data file. The input generation facility creates the input file through an interactive menu driven graphics oriented procedure. The following types of structures

SPACE

FLOOR

4.1.2 Unit system

The user is allowed to give input data to almost all commonly used engineering unit systems including MKS, SI and FPS systems. In the input file the user may change units as many times as required. In the output rotations are given in radians.

4.1.3 For Concrete

STAADv8i has the capabilities of performing concrete design. It will calculate reinforcement needed for any concrete section. All concrete design calculated are based on Limit State Design method of IS 456-2000. The following types of section for concrete beams can be designed.

For Beams-Prismatic (Rectangular, square, L shape)

For columns-Prismatic (Rectangular, square, and circular)

4.1.4Material properties

The material constant are young's modulus of elasticity(E), Density(DEN), poisson's Ratio(POISS), Coefficient of Thermal expansion (ALPHA) and beta angle (BETA) or coordinates of any reference point(REF).

4.15Supports

STAAD-v8i allows specification of support that is parallel as well as inclined to global axes. Support are specified as pinned, fixed,

4.16loads

1. Joint Load
2. Member Load
3. Area load
4. Priestess member load
5. Temperature/ strain load
6. Support displacement

STAAD-v8i is equipped with built in algorithm to generate moving loads, lateral seismic load wind load.

V. CONCLUSION

Finally we conclude that by planning thelayouts, we can preserve the open spacesWe can provide infrastructural facilities to people. It makes wealth to government in the form of taxesit leads to urban development

GENERAL

A general methodology for analysing a building by both

1.Manual methods,

2.STAAD Pro was presented.

Using the above results we can choose better method for analysis and to design any type of structure.

COMPARETIVE STUDY

From the previous study we are finally concluded and can go for STAAD Pro analysis for high raised building For residential and low raised buildings we can go for manual methods taking maximum loaded intermediate frame.

SCOPE FOR FURTHER STUDY

In this thesis, the study was concentrated only job analysis output of STAAD Pro and manual method. In future we can extend this project by comparing the design procedures or by comparing the output results of some other software.

The project done by our team is as per standard codes. The drawings and the estimate have been prepared according to the cement schedule of rates and P.W.D specifications.

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