DESIGN AND ANALYSIS OF RESIDENTIAL MULTISTORY BUILDING (G+5) BY USING ETABS

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ABSTRACT: The format method of structural making plans and layout calls for now not most effective imagination and conceptual thinking however moreover sound knowledge of technology of structural engineering except the statistics of Realistic", which incorporates brand new design codes bye legal tips sponsored up with the resource of sufficient enjoy, instinct and judgments.". The cause of standards is to make certain and decorate the protection, preserving cautious stability among economy and safety. In the present look at multistory residential constructing in good fortune now India is designed (slab, beam, column, floor, wall, footings) the use of AutoCAD, E-tab, software. Find the stress assessment in slab, shear pressure for beam, lateral load, axial load, longitudinal load, seismic or wind and vicinity reinforcement for the column and stair case, boost in those one-of-a-kind force are acting and evaluation and layout depending upon the reaction and height of the foundation degree rely upon the website online safe bearing capability of the soil "because of balance purpose designed the keeping wall in this task.. In order to layout them ,it's far important to first achieve the plan of the specific building that is , positioning of specific room (Drawing room, bed room, kitchen, wash room, balcony , stair case and raise and many others.) Such that they serve their respective motive and additionally suiting to the requirement and comfort of the inhabitant."Such that they serve their respective reason and moreover suiting to the requirement and comfort of the inhabitant.". There through depending at the suitability, plan format of beam and the placement of column are constant. Thereafter, the loads are calculated particularly the useless loads, which rely upon the unit weight of the substances used concrete and metal and brick and stay loads. Footings are design primarily based at the safe bearing capacity of soil. For designing of column and beam, It is important to recognize the moment they may be subjected to , one-manner, two- way slab the stop condition and the loading. From the slab, the hundreds are transferred to the them. Thereafter, the hundreds (specially shear) from the beam are taken through the columns. Finally, the phase has to be checked and analyze for the whole 4 aspect with regard to energy and provider capability.

Keyword: AutoCAD, STAAD Pro, E-tab, beam, column, wall, slabs, footing, structural designing.

INTRODUCTION

ETAB are commonly makes use of for analysis and layout for building machine. ETAB function are contain powerful graphical interface coupled with unequalled modeling, analytical, and layout procedures, all incorporated the use of a commonplace database. It is short and really smooth for shape. It can take care of the most important and complex constructing fashions. ETAB (Extended 3 dimensional evaluation of building system) is software which is included with all of the fundamental evaluation engines this is static, dynamic, linear and non-linear, etc. And specifically this software program is used to investigate and design the building .This program has been very well examined and utilized in the usage of this system. However, the complete person accepts and understands that no guarantee is expressed via the builders or the vendors at the accuracy or the reliability of the program. This software is a totally beneficial tool for the layout test of concrete systems. ETAB is the present time leading design software in the market. Many design company's use this software for their project design purpose. So, this paper deals with the mainly analysis of the results obtained from the analysis of a multistory building structure when analysis and design and using ETAB software.

Structural reaction to earthquake rely on dynamic symptoms of the structures and intensity, period and frequency are existing ground motion. "Structural evaluation method strength of mind of the overall shape and all of the precise dimensions of a specific form in order that it carry out the characteristic for which it's far creates and" will protection face up to the impacts in an effort to act on it during its beneficial lifestyles. The effective layout and creation of a earthquake resistant structures have extremely good important all around the global. This challenge gift evaluation and layout if multistory residential constructing as consistent with INDIAN CODES- IS 1893-part2:2002, IS 456:2000.And use national building codes. The analysis is done with the aid of thinking about seismic zones and conduct is classified with the aid of taking type-III Soil situation. In our mission we're thinking about a plan underneath quarter-III .Seismic depth is intense and zone issue is 0.Sixteen at Luck now. Can

layout of steel and urban frame, composite beam and column, steel joints, and concrete and masonry shear wall, complete and customizable reports are to be had for all evaluation and design output, and schematic production drawings of framing plans, schedules, details, and cross-section can be generated for concrete and steel structure ETAB. ETAB contain every element of the engineering design system. The introduction of fashions has in no way been clean – The AUTOCAD drawings may be transformed directly into ETAB model & can effortlessly evaluation and layout of constructing

Building bye laws:- These are the regulations prescribed by the authority with respect to building development for the safety and serviceability criteria of the inhabitants and also the environment criteria.

Building bye laws followed in the project:-

Floor Area Ratio (FAR) = Total covered area of the floor / Plot area
FAR = 2.3
Height of building = 18M less than 1.5(6+7.8)= 20.7M in (NBC)
Rear open space = 7.8M (Minimum 6M in NBC)
Slide open space = 8.5M (Minimum 6M in NBC for height of the building above 10M)
Plinth height = 750 (Minimum 450MM in NBC)
Habitable Room: Height = 3M   (Minimum 2.75M in NBC) Habitable Room: Size = 24.52M² (Minimum 9.5M² in NBC)
Kitchen Room: Height = 3M   (Minimum 2.75M in NBC) Kitchen Room: Size   = 13.42M² (Minimum 5M² in NBC)
Bath rooms and water-closets (combine): Height = 3M   (Minimum 2.1M in NBC) Size = 5.32M² (Minimum 2.8M2, Minimum width 1.2M in NBC)
Boundary wall = 1.5M   (Maximum 1.5M in NBC)
Parapet wall = (Minimum 1M and Maximum 1.2M)
Stair case : Width = 1M (Minimum 1M in NBC) Thread width = 300MM (Minimum 250MM in NBC) Riser height = 150MM (Maximum 190MM in NBC) Head room under the landing = 2.1M (Minimum 2.2 M in NBC)
Lift Provision = 18M (Between 15M height of the building and above in NBC)

PLAN SPECIFICATION OF BUILDING

Plan dimension:-

Area of Plot:	42000 x 40600 MM^2
Built up area:	25600 x 25450 MM^2
Size of bed room:	5000 x 4850 MM^2
Size of drawing room:	4850 x 3850 MM^2
Size of kitchen:	4850 x 2778 MM^2
Size of toilet:	2275 x 2350 MM^2
Size of balcony:	5000 x 974.6 MM^2
Size of passage:	4850 MM wide
Size of porch:	5075 x 3700 MM^2
Size of lift:	1795.2 x 1965.2 MM^2

Stair case configuration:-

Riser size:	150 MM
Tread size:	300 MM
Running width:	1000 MM
Landing size	2000 x 1000 MM^2

Window, Doors and Ventilation:-

Ventilation	600 X 600 MM^2
Window (W_1)	910 X 910 MM^2
Window (W_2)	1810 X 1210 MM^2
Window (W_3)	1200 X 1050 MM^2
Window (W_4)	910 X 910 MM^2
Window (W_5)	1360 X 1210 MM^2
Door (D_1)	900 X 2100 MM^2
Door (D_2)	750 X 2100 MM^2

Floor plan with center line:-
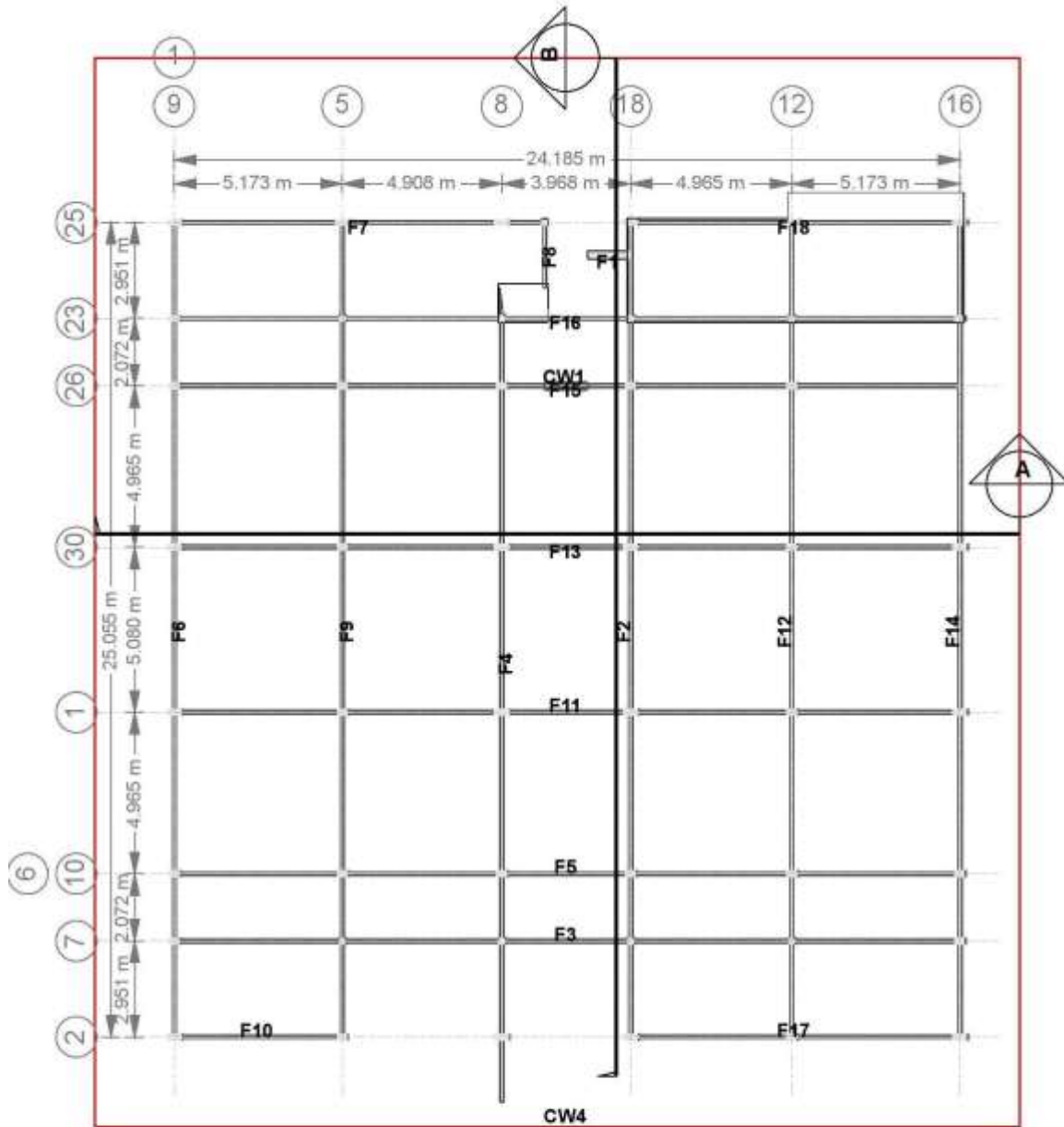
Floor Framing Plan - Base (EL. 0.000 m)
(Scale 1:200)

RESULT ANALYSIS

Load Patterns:

Name	Type	Self Weight Multiplier	Auto Load
Dead	Dead	1	
Live	Live	0	
wind	Wind	0	Indian IS 875:2015
seismic	Seismic	0	IS1893 2002

Dead loads:

I. Dead load is the self weight of the building components such as beams, columns, slabs, flooring, roofing, and brick masonry.
II. Dead load is calculated using the unit weight of the materials such as concrete, brick masonry, flooring etc multiplied by their volume.
III. In ETABS automatically taken care by the software i.e. Inbuilt.
IV. In this project analysis and design of dead load use IS: 875 (PART 1)-1987 code.

Live loads:

I. Live loads or Imposed loads is the load which is not static and thus varied throughout the service life of the building.
II. In this project analysis and design of live loads use IS: 875 (PART 2)-1987 code.
III. Residential buildings: some specific value use in this project for analysis and design.

S.No	Dwelling houses:	(UDL) KN/m²	(C.L) KN
1	All room and kitchen	2	1.8
2	Toilet and bath rooms	2	....
3	Corridors, passages, stair-cases including tire escapes and store rooms	3	4.5
4	Balconies	3	1.5 per meter

Wind load:

I. Buildings of height up to 10 meter are subjected to constant wind loads and above 10 meter subjected to varying wind loads.
II. In this project analysis and design of wind load use IS 875: 2015 code.

Parameters considered for determining the wind loads:

1. Basic wind speed (V_b): 47 m/s (Luck now Zone).
2. Building category-2.
3. Building class-B.
4. Risk coefficient (K_1): 1.0
5. Terrain coefficient (K_2): (1.02-1.05) for building between 15 to 20 meter height.
6. Topography coefficient (K_3) = 1.
7. Wind velocity (V_Z) = (V_b x K_1x K_2 x K_3) m/s .
8. Wind Intensity (P_Z) = ($.6V_Z^2$) N/m² .
9. Wind loads (F) = (Cpe – Cpi) APz (N).
10. Opening: (5-20%)/ wall.
11. External pressure coefficient (Cpe) = .7 for surface A of the roof.
12. Internal pressure coefficient (Cpi) = ± .5 for (5-20%) opening.

13. Formula for varying wind velocity: - $V_z/V_b=(Z/Z_o)\alpha$ (α =.9 and category 2).

Load combination:-

It should be remembered that for structures that have lateral force resisting elements in two orthogonal directions only the earthquake force or wind force is applied only along one direction X or Y at a time and the including in analyzed.

Various loads combinations are as follows:

1. 1.5 (DL + LL)
2. 1.5 (DL ± EQ In X- direction)
3. 1.5 (DL ± EQ In Y- direction)
4. 1.2 (DL + LL ± In X- direction)
5. 1.2 (DL + LL ± In Y- direction)

To check overturning:

1. .9 DL ± 1.5 EQ In X- direction)

2 .9 DL ± 1.5 EQ In Y- direction

Auto seismic loading:-

IS1893 2002 Auto Seismic Load Calculation

This calculation presents the automatically generated lateral seismic loads for load pattern seismic according to IS1893 2002, as calculated by ETABS.

Direction and Eccentricity

Direction = Multiple

Eccentricity Ratio = 5% for all diaphragms

Structural Period

Period Calculation Method = Program Calculated

Factors and Coefficients

Seismic Zone Factor, Z [IS Table 2] $Z = 0.16$

Response Reduction Factor, R [IS Table 7] $R = 3$

Importance Factor, I [IS Table 6] $I = 1$

Site Type [IS Table 1] = II

Seismic Response

Spectral Acceleration Coefficient, S_a/g [IS 6.4.5] $\frac{S_a}{g} = 1 + 15T$ $\frac{S_a}{g} = 1.108961$

Equivalent Lateral Forces

Seismic Coefficient, A_h [IS 6.4.2] $A_h = \dfrac{Z I \frac{S_a}{g}}{2 R}$

Calculated Base Shear

Direction	Period Used (sec)	W (tonf)	V_b (tonf)
X	0.007	2625.86183	210.06895
Y	0.007	2625.86183	210.06895
X + Ecc. Y	0.007	2625.86183	210.06895
Y + Ecc. X	0.007	2625.86183	210.06895
X - Ecc. Y	0.007	2625.86183	210.06895
Y - Ecc. X	0.007	2625.86183	210.06895

Properties of structure:

Materials:

Table - Material properties- Summary

Name	Type	E kgf/mm²	v	Unit Weight kgf/m³	Design Strengths
4000Psi	Concrete	2534.56	0.2	2402.77	Fc=2.81 kgf/mm²
A416Gr270	Tendon	20037.48	0	7849.05	Fy=172.32 kgf/mm², Fu=189.83 kgf/mm²
A615Gr60	Rebar	20389.02	0.3	7849.05	Fy=42.18 kgf/mm², Fu=63.28 kgf/mm²
A992Fy50	Steel	20389.02	0.3	7849.05	Fy=35.15 kgf/mm², Fu=45.7 kgf/mm²
HYSD500	Rebar	20394.32	0	7849.05	Fy=50.99 kgf/mm², Fu=55.57 kgf/mm²
M20	Concrete	2280.15	0.2	2548.54	Fc=2.04 kgf/mm²
Masonry	Masonry	367097.83	0.2	2162.49	

Frame Sections:

Table - Frame Section –Summary

Name	Material	Shape
beam 1	M20	Concrete Rectangular
beam 2	M20	Concrete Rectangular
Column (230 x230)	M20	Concrete Rectangular
column (355.6 x230)	M20	Concrete Rectangular
Column (500x230)	M20	Concrete Rectangular

Shell Section

Table - Shell Section- Summary

Name	Design Type	Element Type	Material	Total Thickness mm	Deck Material	Deck Depth mm
Deck1	Deck	Membrane	4000Psi	162.5	A992Fy50	75
slab	Slab	Shell-Thick	M20	120		
wall 115	Wall	Shell-Thick	Masonry	115		

Reinforcement bar:

Table - Reinforcing Bar Sizes

Name	Diameter mm	Area mm²
10	10	79
18	18	255
20	20	314

Conclusions:-

1. In this task are used constructing through legal guidelines, according to NATIONAL BUILDING CODE 2005.
2. This evaluation and layout is supplying ok electricity, serviceability and durability except financial system.

3. In structure are acting lateral force in x and y direction in all story of building within permissible limit. And story drift, dead load ,live load (induced shear force, bending moment) and axial force variation are in picture diagram also within permissible limit.
4. After analysis and design are check different section of beam and column, base reaction, story forces, max. / avg. drifts and model period and frequencies and also check beam & column overwrites , slab punching shear design, finite element based in concrete slab design come within permissible limit and safe structure and giving on warning & no error messaging completion of analysis and design.
5. So overall above conclusion our building structure are come in economical condition and safe in all way imp

REFERENCE:-

1. Design and analysis of multistoried building under static and dynamic loading conditions by using ETAB by **Balaji and Selvarasan.** In International journal of technical research and application, Vol. 4,Issue 4 Aug (2016).
2. .IS 1893:2002 "standards for earthquake resistant design of structure- widespread provision for constructing, "Bureau of Indian fashionable new Delhi".
3. IS code (875: 1987) Indian Standard Code of practice for Design loads (Other than earthquake) for building and strictures, Bureau of Indian standards, new Delhi.

    I.   IS code 875 (PART-1) For Dead load
    II.   IS code 875 (PART-2) For Live load
    III. IS code 875 (PART-3) For Wind load

4. National Building Code of India 2005.
5.   Limit state theory by **Ashok Kumar Jain** and IS Code follow.
6. IS 456: 2000, Indian Standard Plain and reinforced concrete- code of practice, Bureau of Indian Standard, New Delhi.
7. Theory of Structures- **S Ramamrutham**.
     Abhay Guleria, "Structural evaluation of a multi-storied building the usage of ETABS for distinctive plan configurations", International magazine of engineering research