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Analysis, Design of G +7 Storey Building Structure with U Boot Beton Slab by using IS Code Method and Software

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Abstract: Analysis, Design and Estimation of G +7 Storey Building Structure by using IS Code Methods and by Software's

Keyword: SMRF, Seismic behavior and design, Auto-CAD, STAAD Pro, ETABS Revit, Estimation and costing, IS code -Limit State methods

I. INTRODUCTION

Severe damage of buildings in the most distressing consequence of most natural hazards especially earthquake and due to ++. In the past limiting damage was not a prime objective of seismic design codes which concentrated only on providing an adequate level of life safety. Seismic load, wind load, dead load and live load is calculated and applied on structure. From these load combination maximum factor of safety is consider so the structure will not fail during natural hazards or due to overloading. Reinforced concrete special moment frames are used as part of seismic force-resisting systems in buildings that are designed to resist earthquakes. Beams, columns, and beam-column joints in moment frames are proportioned and detailed to resist flexural, axial, and shearing actions that result as a building sways through multiple displacement cycles during strong earthquake ground shaking. STAAD. Pro features a state-of-the-art user interface, visualization tools, powerful analysis and design engines with advanced finite element and dynamic analysis capabilities. From model generation, analysis and design to visualization and result verification. IS codes are used for manual calculations. For manual calculations of G+7 storey building construction limit state method is used. Therefore, it is need of time to analyze & design such hazard resisting structures so as to save human life and avoid property damage.

II. LITERATURE REVIEW

A. Prakash Sangamnerkar et al. (2015). *Static and dynamic behaviour of reinforced concrete framed regular building.*

He has done the comparative study on the static and dynamic behavior of reinforced concrete framed regular building. Comparison of static and vibrant behaviour of a six storey's structure is considered in this paper and it is analysed by using computerized solution available in all four seismic zones i.e. II, III, IV and V. This is important for building design and resistant from earthquake.

B. M. S. Aainawala et al. (2014). *Comparative study of multi-storey R.C.C. Buildings with and without Shear Walls.*

He did the comparative study of multi-storey R.C.C. Buildings with and without Shear Walls. They applied the earthquake load to a building for G+12, G+25, G+38 located in zone II, zone III, zone IV and zone V for different cases of shear wall position. 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. As per analysis, it was concluded that displacement at different level in multi-storeyed building with shear wall is comparatively lesser as compared to R.C.C. building without shear wall. Which is important for building design and use of shear walls.

C. P. Rajaram, A. Murugesan, G.S. Thirugnanam (2010). *Experimental study and research on behavior of interior RC beam column joint subjected to cyclic loading.*

He discuss about Experimental study and research on behavior of interior RC beam column joint subjected to cyclic loading is carried. Beam column joint is an important component of reinforced concrete moment resisting frames and should be designed and detailed properly, especially when the frame is subjected to earthquake loading. Failure of beam column joints during earthquake is governed by bond and shear failure mechanism which are brittle in nature. Therefore, a current international code gives high importance to provide adequate anchorage to longitudinal bars and confinement of core concrete in resisting shear.codes provide for reduction of seismic forces thorough provisions of special ductility requirements. Details for achieving ductility in reinforced concrete structure are given in IS 13920:-1993. This paper covers the analysis and design of two bay five stories R.C.C moment

resisting frames for general building using ETABS as per IS 1893-2002 code procedures and detailed as IS 13920-1993 recommendations.

D. Mohit Sharma et. al. (2015). To study the dynamic analysis of multi-storey Building.

He considered a G+30 storied regular reinforced concrete framed building. Dynamic analysis of multi-storey Building was carried out. These buildings have the plan area of 25m x 45m with a storey height 3.6m each and depth of foundation is 2.4 m. & total height of chosen building including depth of foundation is 114 m. The static and dynamic analysis has done on computer with the help of STAAD-Pro software using the parameters for the design as per the IS-1893- 2002-Part-1 for the zones- 2 and 3. It was concluded that not much difference in the values of Axial Forces as obtained by static and dynamic analysis.

E. Anwaruddin M. et. al. Carried out the study on non-linear Static Pushover Analysis of G plus 3 medium rise reinforced cement concrete structure with and without vertical irregularity.

It was seen that irregularity in height of the building reduces the performance point of structure. There was reduction in displacement or deformation of the RCC building also.

III. METHODOLOGY

Process of designing G+7 building structure by using softwares.



FIG 1 Autocad Plan

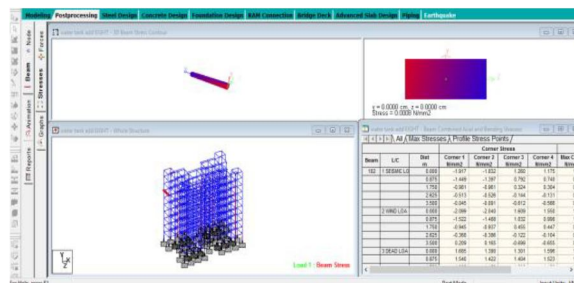


Fig 2 Shear Force And Bending Moment

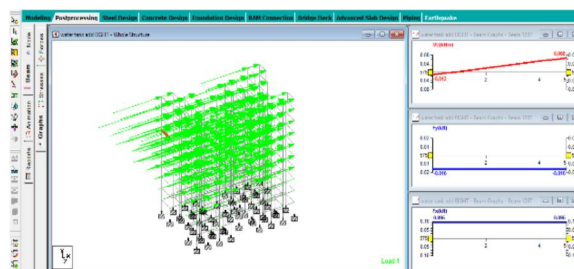


FIG 3 Beam STRESSES

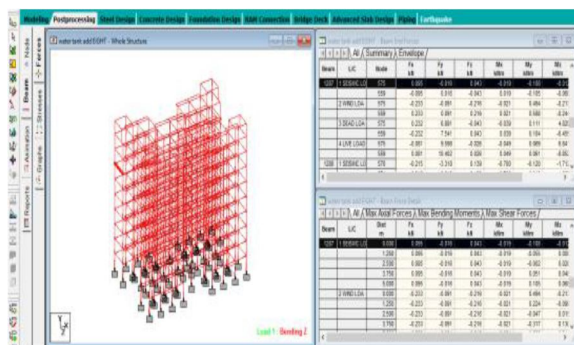


FIG 4 Forces Acting on Member



FIG NO 5- 3D Plan in Revit

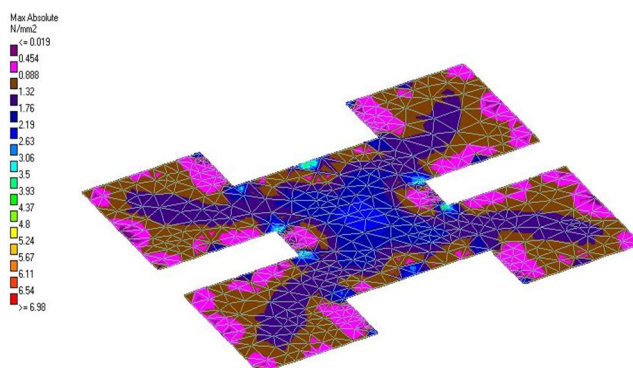


FIG 6 Plate Loading

IV. ANALYSIS OF G + 7 STOREY BUILDING

- 1) *Material Properties:* The analysis has been done considering the following material properties
 - a) *Structural Steel:* Tor steel
 - b) *Reinforced Concrete:* Reinforced concrete of design mix with grade M 20
 - c) *Steel Reinforced:* Fe 415
 - d) *Stirrups and Links:* Fe 415
- 2) *Load Calculation:* Following assumption are made for load calculation
 - a) Density of concrete: 20kN/m³
 - b) Density of brick: 18kN/m³
 - c) Density of brickbat coba: 20kN/m³
 - d) Thickness of slab: 200 mm

- e) Thickness of wall: 230mm
- f) Thickness of brickbat coba : 150mm
- g) Floor finish load: 1kN/m
- h) LL on floor slabs: 3kN/m²
- 3) *Evaluation of Loads*
- a) Dead load of slab=
- b) $0.20 \times 1 \times 25 = 5 \text{ kN/m}$
- c) LL on floors = $3 \times 1 = 3 \text{ kN/m}$

V. DESIGN AND ANALYSIS OF G+7 STOREY BUILDING USING STAAD PRO

A. Introduction

Our project is based on the design and analysis of the multi-storied buildings. Analysis is done through using the STAAD- PRO. Notation adopted through out the project is same as in IS-456-2000.

CODES IS-456:2000 :DESIGN CODE FOR RCC STRUCTURES SP-16 : DESIGN CODE FOR COLUMNS IS-875(PART 1) :CODE FOR DEAD

Zone	II	III	IV	V
	0.10	0.16		
No. of Towns In			17.90	9.60
%	26.41	46.26		

Table 1 Seismic Zones of India Showing % Town Area LOADS IS-875(PART 2) :CODE FOR IMPOSED LOADS IS-875(PART 3) :CODE FOR WIND LOADS

B. Softwares

This project is mainly based on software and it is essential to know the details about these software's

- 1) Staad pro(v8i)
- 2) AUTOCAD
- 3) ETABS
- 4) ESTIMATION AND COSTING

C. Staad

(Staad stands for structural analysis and design)

- 1) Staad is the powerful design software licensed by bentley . Staad stands for structural analysis and design
- 2) To calculate S.F.D and B.M.D of complex loading beam it takes about an hour.
- 3) So when it comes up to building with several members it will taken a week.
- 4) Staad pro is a very powerful tool which it does this job in just an hours staad is a best alternative for high rise buildings.
- 5) Now a days most of the high rise buildings are designed by staad which makes a compulsion for a civil engineer to know about this software.

D. Auto Cad

Auto cad is powerful software licensed by auto desk company and cad stand for computer aided design.

- 1) It is used for drawing different layouts, elevations, details, sections different sections can be shown in auto cad.
- 2) We used for drawing the plan of multi stored building.
- 3) It is very useful for civil, mechanical, and also electrical engineer.

E. ETABS

Used for shear, bending moment reinforcement result check purpose

F. Statement of The Project

- 1) Utility of building: Residential building
- 2) No of storeys :G+7
- 3) No.of staircases: 8 no's
- 4) Shape of the building: Rectangular
- 5) Type of construction: R.C.C framed structure 5.Type of walls :brick wall
- a) Floor height :3.2M
- b) Height of plinth: 2M from below foundation
- c) Depth of foundation: 700MM
- d) Material details: Concrete Grade: M20
- e) All steel grade: Fe415 grade
- f) Type of steel bars: HYSB
- g) Bearing capacity of Soil : >180 KN/M2

G. Different Types Of Loads On The Structures

Dead loads Imposed loads Wind loads

Dead loads Involves self weight of RCC slab Beams & columns Plinth Wall

Imposed loads: Imposed also known live loads. Loads over the floor i.e. Load of persons it is calculated as 1 KN/m². This load is applied over the length of structure

Wind loads Wind is air in motion Wind loads are calculated according to IS:875(part 3) Intensity of wind and exposure are applied in the direction as required

Load combinations The structures should be analysed for combination of loads as in practice we have numbers of loads in various directions act Some of the combinations to be checked are 1.5(DL+LL) 1.5(DL+WL) 1.5(DL+LL+WL)

H. Objectives Of Structural Design

Structure designed should satisfy the criteria of ultimate strength. Structures should satisfy the serviceability. It should satisfy the stability against overturning, sliding, and buckling

The main objective of the design are Foundation design

Column design

Beam design

Slab design

DESIGN PRINCIPLE, ASSUMPTION AND NOTATION ASSUMED

Top cover 25

Aggregate size 40

Bottom cover 25

Concrete grade M20

Side cover 25

Beam segments 12

Main Bar Criteria

	Top Bar Criteria	Bottom Bar Criteria
Min. bar size	8	8
Max. bar size	40	40
Link hanger size	8	8
Min. layer gap	32	32
Side bars controlled by minimum size of	10	

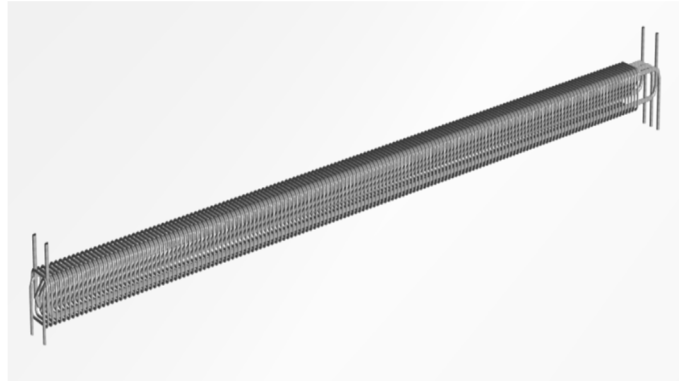


FIG 7 BEAM REINFORCEMENT

I. Analysis

Analysis is done using STAD PRO developed by BENTLEY Once the loads and load combinations are assigned to the structures, analysis is to be done Analysis is done for RCC structure

- 1) Assign the properties of structures
- 2) Assign loads on the slab
- 3) Load assign on the walls
- 4) Assign wind load on the structures (x+ve direction)
- 5) Assign wind load on the structures (x-ve direction)
- 6) Assign wind load on the structures (z +ve direction)
- 7) Assign wind load on the structures (z -ve direction)

RCC analysis Code is assigned as IS: 456-2000 The parameters are assigned to the structure Commands to be given are 1. Concrete design 2.define parameters 3. Command

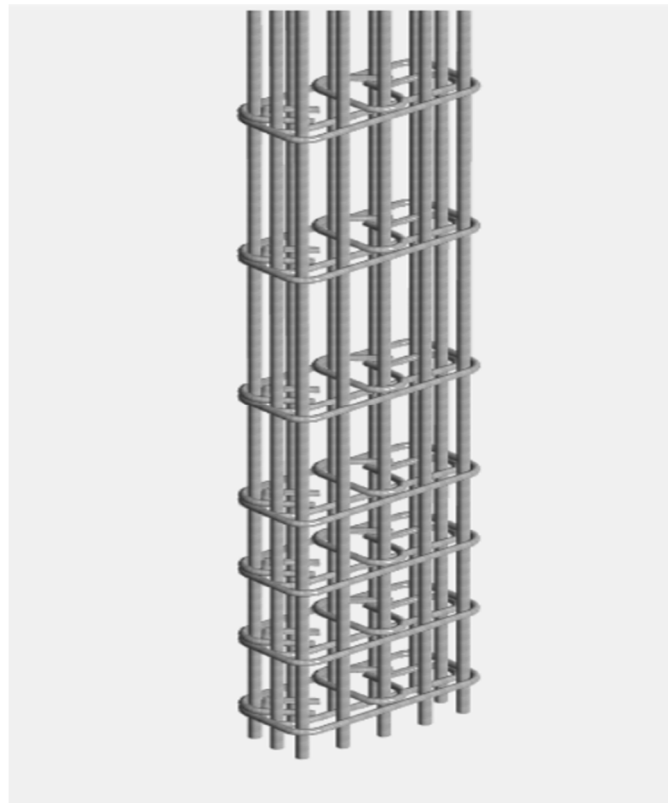


Fig 8 COLUMN REINFORCEMENT

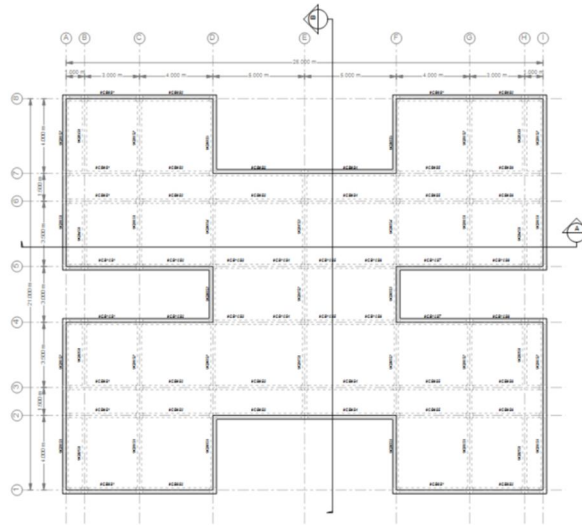


FIG 9 Column Layout

Shear design results at distance d (effective depth) from face of the support

shear design results at 535.0 mm away from start support $v_y = 9.40$ $m_x = -0.02$ $l_d=1$ provide 2 legged 8 ϕ @ 140 mm c/c shear design results at 535.0

mm away from end support $v_y = 9.40$ $m_x = -0.02$ $l_d=1$ provide 2 legged 8 ϕ @ 140 mm c/c

	Top Bar Criteria	Bottom Bar Criteria
Min. bar size	8	8
Max. bar size	40	40
Link hanger size	8	8
Min. layer gap	32	32

Side bars controlled by minimum size of 10

TABLE NO 2 COLUMN – BAR SCHEDULE

Shear bars: Fe250

Min. size	8	Min. spacing	40 mm
Min. number of legs	2	Link style	Closed

TABLE NO 3 SHEAR BAR CRITERIA

	Top Bar Criteria	Bottom Bar Criteria
Min. bar size	8	8
Max. bar size	40	40
Link hanger size	8	8
Min. layer gap	32	32

TABLE NO 4 BAR SIZE

Min. size	8	Min. spacing	40 mm
Min. number of legs	2	Link style	Closed

TABLE NO 5 LINK SIZE

VI. ONCLUSIONS

The design of slab, beam, column, rectangular footing and staircase are done in limit state method which is safe at control of deflection and in all aspects Using staad.pro software, the design consideration has been taken as per the is codes. The design is safe in all conditions On comparison with drawing, manual design and the geometrical model using staad.pro the area of AST required for the beam, column, footing and slab are comparatively similar to that of the requirement.

while software also gives required sizes of bar and members but with factor of safety.

Auto-cad plan gives detailed information of the structure members length, height, depth, count etc.

After running model in Revit software it gives more plan details and various design options. This software gives more decorative building structure.

STAAD PRO has the capability to calculate the reinforcement needed for any concrete section. The program contains a number of parameters which are designed as per IS: 456(2000). Beams are designed for flexure, shear and torsion.

From the STAAD PRO result required different types, size and number of bars are found.

And final evaluation and valuation is confirmed by estimation and costing software.

Due to manual and software calculations, the required amount and material will be minimized so the structure comes under healthy for environment and safe for human beings.

Region	Name	Direction	Des. Mom. (kNm/m)	Min. Steel	Bar Size	Min. Spacing (in)
Reg 1	Region 1	Top : X	24.072	Y	#7	9
		Top : Y	24.065	Y	#7	18
		Bottom : X	67.378	n	#7	9
		Bottom : Y	71.835	n	#7	12

Table NO 6 Slab Reinforcement

Bar	Size	Design Length		Anchorage (cm)
		Start (m)	End (m)	
1	8	0.001	7.999	37.6
2	8	0.001	7.999	37.6
3	8	0.001	7.999	37.6
4	8	0.001	7.999	37.6

Table NO 7 Beam- Main Bar Criteria

VII. SCOPE FOR FURTHER STUDIES

- A. All the analysis can be repeated by changing plan dimensions and height of the structure.
- B. A comparison of cost may be studied by changing different grade of steel and concrete.
- C. Analysis and design of frames with dual systems.
- D. Analysis and design of frames with dual systems (moment resisting frames with shear walls)
- E. A comparison of cost may be studied by changing different grade of steel and concrete.



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