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

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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 behaviour and design, Auto-CAD, STAAD Pro, 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

***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 behaviour 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 earth quack.

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

He did the comparative study of multi-storeyed 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.

***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. Modern

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.

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

He considered a G+30 storied regular reinforced concrete framed building. Dynamic analysis of multi-storeyed 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.

***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 software's.

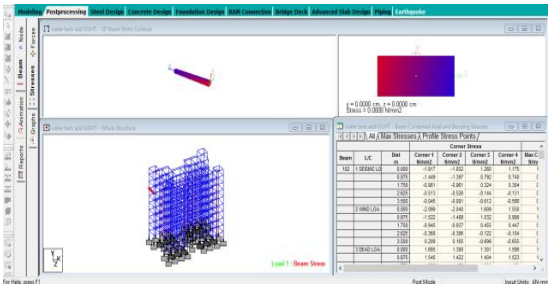


**FIG 1BEAM STRESSES**

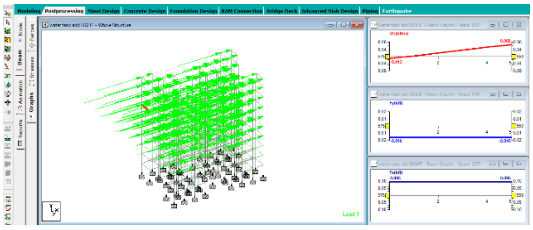


**Fig 2 SHEAR FORCE AND BENDING MOMENT**

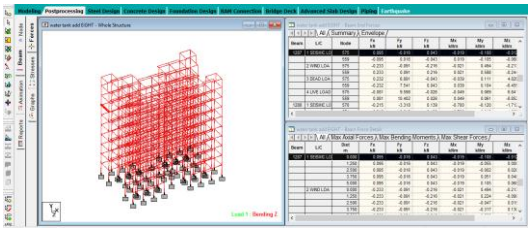


**FIG 3 FORCES ACTING ON MEMBER**

**Fig 4 3D MODEL**

**Fig-5**

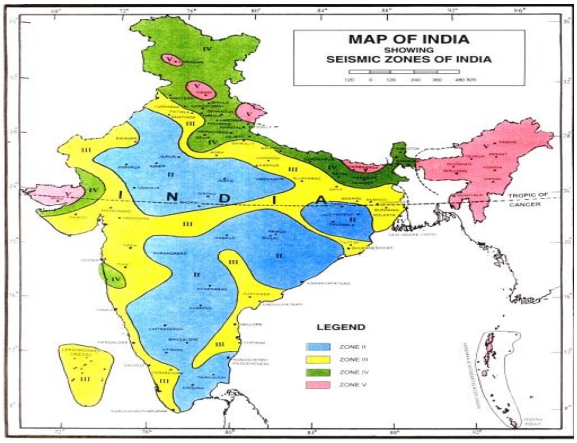



**Fig 6 Map of India Showing Seismic**

| Seismic Intensity | Low | Moderate | Severe | Very severe |
|---|---|---|---|---|
| Zone | II | III | IV | V |
| Zone Factor | 0.10 | 0.16 | 0.24 | 0.36 |
| No. of Towns In % | 26.41 | 46.26 | 17.90 | 9.60 |

**Table1 Seismic Zones of India Showing % Town Area**

## IV. ANAYLYSIS OF G + 7 STOREY BUILDING

***Material properties***: The analysis has been done considering the following material properties
Structural Steel: Tor steel
Reinforced concrete: Reinforced concrete of design mix with grade M 25
Steel reinforced: Fe 415
Stirrups and links: Fe 415
***Load calculation:*** Following assumption are made for load calculation
Density of concrete: 25kN/m3
Density of brick: 18kN/m3
Density of brickbat coba: 20kN/m3
Thickness of slab: 150mm
Thickness of wall: 230mm
Thickness of brickbat coba : 150mm
Floor finish load: 1kN/m
LL on floor slabs: 3kN/m2
***Evaluation of loads***
Dead load of slab=
0.150x1x25 = 3.750kN/m
LL on floors = 3X1 =3kN/m

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

**DESIGN AND ANALYSIS OF MULTI-STORIED BUILDINGS**
**CONTENTS 'INTRODUCTION 'CODES 'SOFTWARE'S 'STATEMENT OF PROJECT 'LOADS ON THE STRUCTURES 'OBJECTIVES OF STRUCTURAL DESIGN 'DESIGN AND ANALYSIS 'REFERENCES**

**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-456:200 :DESIGN CODE FOR RCC STRUCTURES ' SP-16 : DESIGN CODE FOR COLUMNS ' IS-875(PART 1) :CODE FOR DEAD LOADS ' IS-875(PART 2) :CODE FOR IMPOSED LOADS ' IS-875(PART 3) :CODE FOR WIND LOADS**

**SOFTWARES** ' This project is mainly based on software and it is essential to know the details about these software's ' Staad pro(v8i) ' Auto cad.

STAAD (Staad stands for structural analysis and design) ' staad is the powerful design software licensed by bentley . Staad stands for structural analysis and design ' To calculate S.F.D and B.M.D of complex loading beam it takes about an hour. ' So when it comes up to building with several members it will taken a week. ' 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. ' 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

Auto cad ' Auto cad is powerful software licensed by auto desk company and cad stand for computer aided design. ' It is used for drawing different layouts, elevations, details, sections different sections can be shown in auto cad. ' We used for drawing the plan of multi stored building. ' It is very useful for civil, mechanical, and also electrical engineer.

**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

Geometric details: ' Ground floor :3.5M ' Floor height :3.5M ' Height of plinth :2M from below foundation '' Depth of foundation :700MM
Material details: ' Concrete Grade : M25 ' All steel grade : Fe415 grade ' Type of steel bars : HYSD ' Bearing capacity of Soil : >180 KN/M2

**DIFFERENT TYPES OF LOADS ON THE STRUCTURES** 'Dead loads 'Imposed loads 'Wind loads

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

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)

**OBJECTIVES OF STRUCURAL DEIGN** ′ Structure designed should satisfy the criteration of ultimate strength. ′ Structures should satisfy the servicablity ′ 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** ′ The notation adopted through out the work is same as in IS 456-2000 ′ Using partial safety factors for loads in accordance with clause 36.4 of IS 456-2000 ′ Partial safety factor for material in accordance with clause 36.4.2 IS456-2000 is taken as 1.5 for concrete and 1.15 for steel ′ Using partial safety factors in accordance with clause 36.4 of IS 456-2000 combination of load ′ (D.L+L.L) 1.5 ′ (D.L +L.L+W.L) 1.2

Density of materials used MATERIAL Density 1.Plain concrete 24.0 kn /m3 2.Reinforced 25.0 k /m3 3.Flooring material(c.m) 20.0kn/m3 4.Brick masonry 19.0kn/m3 5.Fly ash 5.0kn/m3 LIVE LOADS: In accordance with IS 875-86 1.Live load on slab =3.0kn/m3 2.Live load on passage =3.0kn/m3 3.Live load on stair =3.0kn/m3

Structural design ′ For slab, depth is 150 mm provided. ′ For beams, after calculations are done . the dimensions of beam is 350x350mm factored load on beam iskn/m

Total unfactored weight of the structure = 21065.078 kn Total unfactored weight of the structure applied = 20636.455 kn total volume of concrete = 894.1 cu.meter.

Column no.2580 design results

length:3000.0mm cross section:450.0 mm x 450.0mm cover: 40.0 mm guiding load case:1

end joint: 1194 tension column design forces (kns-met) design axial force (pu) : -1.79 about z about y initial moments:3.46 0.0moments due to minimum ecc. : 0.04 0.04 slenderness ratios : - moments due to slenderness effect : - moment reduction factors : - addition moments (maz and may) : - total design moments : 3.46 0.04 reqd. Steel area : 1782.00 sq.mm. Reqd. Concrete area: 200718.00 sq.mm. Main reinforcement : provide 16 - 12 dia. (0.89%, 1809.56 sq.mm.) (equally distributed) tie reinforcement : provide 8 mm dia. Rectangular ties @ 190 mm c/c section capacity based on reinforcement required (kns-met) puz : muz1 : 9975.46 muy1 : 9975.46 nteraction ratio: 0.00 (as per cl. 39.6, is456:2000) section capacity based on reinforcement provided (kns-met) worst load case: 3 end joint: 1197 puz : ********* muz : 10063.36 muy : 10063.36 ir: 0.00

Shape of column is rectangular ′For columns, the dimension of column is 300*600mm ′Factored load on column 1090.10kn ′For footings, the bearing capacity of soil is 175kn/m2 ′To provide the dimensions of footing is 12.5m*2.7m

**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

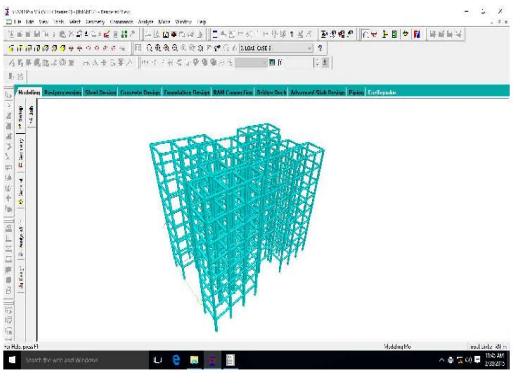


Fig 7 STAAD PRO Model

B E A M N O. 1363 D E S I G N R E S U L T S

M** Fe*** (Main) Fe*** (Sec.)

LENGTH: 3000.0 mm SIZE: 350.0 mm X 350.0 mm COVER: 30.0 mm

DESIGN LOAD SUMMARY (KN MET)

| SECTION (in mm) | FLEXURE P | (Maxm. Sagging/Hogging moments) MZ | MX | Load Case | SHEAR VY | MX | Load Case |
|---|---|---|---|---|---|---|---|
| 0.0 | 0.00 | 0.00 | 0.00 | 1 | 9.16 | -0.23 | 4 |
| | 0.00 | -14.08 | -0.02 | 1 | | | |
| 250.0 | 0.00 | 0.00 | 0.00 | 1 | 9.40 | -0.02 | 1 |
| | 0.00 | -11.73 | -0.02 | 1 | | | |
| 500.0 | 0.00 | 0.00 | 0.00 | 1 | 9.40 | -0.02 | 1 |
| | 0.00 | -9.38 | -0.02 | 1 | | | |
| 750.0 | 0.00 | 0.00 | 0.00 | 1 | 9.40 | -0.02 | 1 |
| | 0.00 | -7.04 | -0.02 | 1 | | | |
| 1000.0 | 0.00 | 0.00 | 0.00 | 1 | 9.40 | -0.02 | 1 |
| | 0.00 | -4.69 | -0.02 | 1 | | | |
| 1250.0 | 0.00 | 0.27 | -0.23 | 4 | 9.40 | -0.02 | 1 |
| | 0.00 | -2.34 | -0.02 | 1 | | | |
| 1500.0 | 0.00 | 1.18 | -0.23 | 4 | 9.40 | -0.02 | 1 |
| | 0.00 | -0.04 | -0.02 | 2 | | | |
| 1750.0 | 0.00 | 2.36 | -0.02 | 1 | 9.40 | -0.02 | 1 |
| | 0.00 | 0.00 | 0.00 | 1 | | | |
| 2000.0 | 0.00 | 4.71 | -0.02 | 1 | 9.40 | -0.02 | 1 |
| | 0.00 | 0.00 | 0.00 | 1 | | | |
| 2250.0 | 0.00 | 7.06 | -0.02 | 1 | 9.40 | -0.02 | 1 |
| | 0.00 | 0.00 | 0.00 | 1 | | | |
| 2500.0 | 0.00 | 9.41 | -0.02 | 1 | 9.40 | -0.02 | 1 |
| | 0.00 | 0.00 | 0.00 | 1 | | | |
| 2750.0 | 0.00 | 11.76 | -0.02 | 1 | 9.40 | -0.02 | 1 |
| | 0.00 | 0.00 | 0.00 | 1 | | | |
| 3000.0 | 0.00 | 14.11 | -0.02 | 1 | 9.40 | -0.02 | 1 |
| | 0.00 | 0.00 | 0.00 | 1 | | | |

SUMMARY OF REINF. AREA (Sq.mm)

| SECTION (in mm) | TOP Reqd./Provided reinf. | BOTTOM Reqd./Provided reinf. | STIRRUPS (2 legged) |
|---|---|---|---|
| 0.0 | 0.23/ 785.40(10-10i ) | 0.00/ 157.08( 2-10i ) | 8i @ 140 mm |
| 250.0 | 0.23/ 785.40(10-10i ) | 0.00/ 157.08( 2-10i ) | 8i @ 140 mm |
| 500.0 | 0.23/ 785.40(10-10i ) | 0.00/ 157.08( 2-10i ) | 8i @ 140 mm |
| 750.0 | 0.23/ 785.40(10-10i ) | 0.00/ 157.08( 2-10i ) | 8i @ 140 mm |
| 1000.0 | 0.23/ 785.40(10-10i ) | 0.00/ 157.08( 2-10i ) | 8i @ 140 mm |
| 1250.0 | 0.23/ 785.40(10-10i ) | 0.23/ 785.40(10-10i ) | 8i @ 140 mm |
| 1500.0 | 0.23/ 785.40(10-10i ) | 0.23/ 785.40(10-10i ) | 8i @ 140 mm |
| 1750.0 | 0.00/ 157.08( 2-10i ) | 0.23/ 785.40(10-10i ) | 8i @ 140 mm |
| 2000.0 | 0.00/ 157.08( 2-10i ) | 0.23/ 785.40(10-10i ) | 8i @ 140 mm |
| 2250.0 | 0.00/ 157.08( 2-10i ) | 0.23/ 785.40(10-10i ) | 8i @ 140 mm |
| 2500.0 | 0.00/ 157.08( 2-10i ) | 0.23/ 785.40(10-10i ) | 8i @ 140 mm |
| 2750.0 | 0.00/ 157.08( 2-10i ) | 0.23/ 785.40(10-10i ) | 8i @ 140 mm |
| 3000.0 | 0.00/ 157.08( 2-10i ) | 0.23/ 785.40(10-10i ) | 8i @ 140 mm |

**Table 2 Summary of beam reinforcement area**

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

shear design results at 535.0 mm away from start support vy = 9.40 mx = -0.02 ld=1 provide 2 legged 8í @ 140 mm c/c shear design results at 535.0 mm away from end supportvy = 9.40 mx = -0.02 ld=1 provide 2 legged 8í @ 140 mm c/c

CONCLUSIONS: ′ 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

REFERENCES ′ Structural analysis by S.RAMAMRUTHAM ′ For load calculation on structure by pankaj agrawal ′ IS456-2000 CODE used ′ SP16 CODE used ′ AUTO CAD & STAAD PRO packages ′ Design of RCC structures by B.C PUNMIA.

PRESENTED BY: ¬Udaysinh Redekar¬Imam Shekh¬Kartarsing Rathod¬Sagar Sable¬Sachin Ghatule Guided by:¬Pranay Khare¬Nagesh Shelke

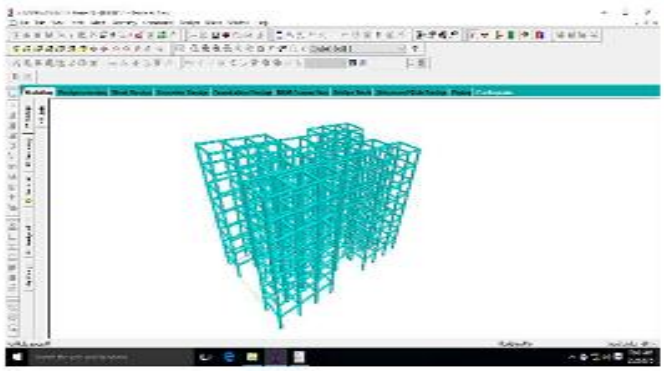
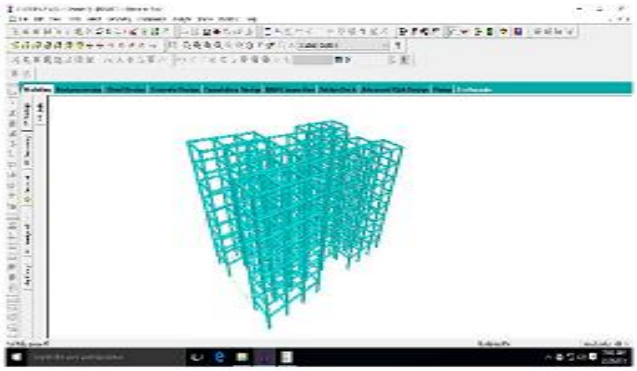


**Fig 8 STRESS DIAGRAM**



MOMENT DISTRIBUTION

**STAAD SPACE**
CONCRETE TAKE OFF
(FOR BEAMS, COLUMNS AND PLATES DESIGNED ABOVE)
NOTE: CONCRETE QUANTITY REPRESENTS VOLUME OF CONCRETE IN BEAMS, COLUMNS, AND PLATES DESIGNED ABOVE.
REINFORCING STEEL QUANTITY REPRESENTS REINFORCING STEEL IN BEAMS AND COLUMNS DESIGNED ABOVE.
REINFORCING STEEL IN PLATES IS NOT INCLUDED IN THE REPORTED QUANTITY.
TOTAL VOLUME OF CONCRETE = 894.1 CU.METER

BAR DIA WEIGHT
(in mm) (in New)
8 186154
10 389678
12 219886
16 7526
20 8272
25 683
TOTAL= 812575
TOTAL TRANSLATIONAL = 12
TOTAL ROTATIONAL= 12
TIME PERIOD FOR X 1893 LOADING = 0.50000 SEC
SA/G PER 1893= 2.000, LOAD FACTOR= 1.000
FACTOR V PER 1893 AT GL= 0.0320 X 21065.07
FACTOR V PER 1893 AT 30 M= 0.0160 X 21065.07
FACTOR V PER 1893= 0.0293 X 21065.07
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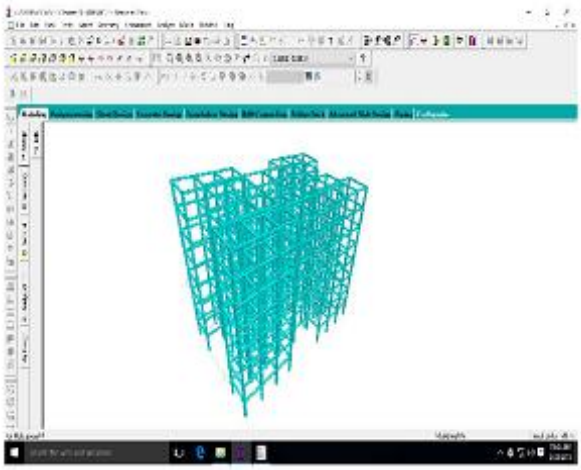

**Fig 9 3D Render View**

**Fig 10 load Diagram**

## VI. CONCLUSION

After analysing the G+7 storey building structure, concluded that structure is safe in loading like dead load, live load, wind load and seismic load.
Member dimensions (Beam, Column, Slab, Footing) are changed by calculating the load type and it's quantity applied on it.

Manual calculations gives min. diameter of bars, thickness of slab and same for column, footing
1. All the analysis can be repeated by changing plan dimensions and height of the structure.
2. A comparison of cost may be studied by changing different grade of steel and concrete.
3. Analysis and design of frames with dual systems.
4. Analysis and design of frames with dual systems (moment resisting frames with shear walls)
5. A comparison of cost may be studied by changing different grade of steel and concrete.

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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 minimize so the structure comes under healthy for environment and safe for human beings.

***SCOPE FOR FURTHER STUDIES***

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