A STUDY ON ANALYSIS AND DESIGN OF G+15 HIGH RISE BUILDING BY USING STAAD PRO IN SEISMIC ZONE IV & ZONE V

Ms. A.Krishna priya[1], D.Durga Prasad[2], D.Naga Suman Teja [3] ,M.Rahul Kumar[4],P. Yashwanth[5]

Assistant Professor [1], Student [2][3][4][5]

SRK Institute of Technology, Department of Civil Engineering [1][2][3][4][5]

Vijayawada, India

Mail Id: mounianumolu@gmail.com [1] , durgaprasad.d234@gmail.com[2] , sumanteja31@gmail.com[3] , rahulkumarmeriga@gmail.com [4] , yashkumar42.p@gmail.com[5]

Abstract: In this project G+15 high-rise building modeling is completed to examine the outcome of special circumstances along with specific heights on seismic parameters like base shear, lateral displacements, and lateral drifts. The knowledge gained has been implemented for zones IV and V in soil type II (medium soils) as targeted in 1893–2002. This study focuses on the analysis and design of a G+15 high-rise building situated in seismic Zone IV and Zone V, employing STAAD Pro software. The seismic performance of structures is a critical aspect, particularly in regions characterized by high seismic activity. In this research, the seismic response of the building is evaluated, considering the dynamic effects of earthquakes. The analysis involves the determination of seismic loads, model analysis, and response spectrum analysis to understand the building's behavior under seismic forces. The software enables the assessment of various design parameters, including member sizing, reinforcement detailing, and load distribution, ensuring compliance with relevant building codes and standards. The findings of this research contribute to the advancement of seismic design practices for high-rise buildings in Zone IV and Zone V regions. The insights gained from the analysis facilitate the development of safer and more resilient structures, mitigating the risks associated with seismic events, and ensuring the protection of life and property.

Keywords: Zone IV & Zone V, Staad pro, Seismic zone.

I. INTRODUCTION

A soft storey known as weak storey is defined as a storey in a building that has substantially less resistance or stiffness or inadequate ductility (energy absorption capacity) to resist the earthquake induced building stresses. Soft storey buildings are characterized by having a storey which has a lot of open space for example, parking garages.

Earthquakes are the most destructive of natural hazards, Earthquake occurs due to sudden transient motion of the ground as a result of release of energy in a matter of few seconds. The impact of the event is most traumatic because it affects large area, occurs all of a sudden and un-predictable. Vibrations induced in the Earths crust due to Internal (or) External causes that virtually shake up a part of the crust and all the structures and living and non-living things existing on it they can cause large scale loss of life, Property and disrupts essential services such of water supply, sewerage systems, power and transport etc.

II. LITERATURE REVIEW

SOURABH RAJORIA (2016) In this study, we studied about the analysis of these kinds of buildings for seismic zones III and V of the India for same

load conditions. We have done comparative study of collapse conditions (i.e., Bending moment, Shear force, Lateral displacement and Support reactions), with the help of Staad.Pro V8i software.

GIREESH BABU (2017) In this case, we have taken earthquake zone 2, response factor 3 for Ordinary moment resisting frame and importance factor1. Then according to the specified criteria assigned it analyses the structure and designs the mem- bers with reinforcement details for G+7 residential building RCC frames

RAJAT SRIVASTAVA (2018) In this journal an investigation of structure for static and dynamic examination in standard minute opposing casing. We have thought about the private building, a G+9 storied structure for the seismic investigation, and it is situated in Zone II district in India.

AKSHAY SHAJI (2019) In this study, seismic behaviour of various mod- els of soft storey framed buildings enhanced with shear walls, bracings and stiffer columns are compared with that of a soft storey framed model. Soft- ware ETABS is used to perform response spectrum analysis and parameters such as base shear, stiffness, inter storey drift and storey displacement are studied.

PRASHANTH D. HIWASE (2019) In this Journal, a residential building with ground floor as partial parking located in seismic zone III has been con- sidered for static analysis and seismic analysis by using Staad pro software. Various load combinations as per IS 1893-2016 have been considered to obtain the worst condition.

III Types of software

The following software are used for the design of residential building in this project. 1.AUTOCAD Software 2.STAAD.Pro Software

AUTOCAD is a commercial computer-aided design (CAD) and drafting soft- ware application.Developed and marketed by AutoCAD was first released in December 1982 as a desktop app running on microcomputers with internal graphics controllers. Before AutoCAD was introduced, most commercial CAD programs ran on mainframe computers or minicomputers, with each CAD op- erator (user) working at a separate graphics terminal.

STAAD or (STAAD. Pro) is a structural analysis and design computer program originally developed by Research Engineers International at Yorba Linda, CA in 1997. In late 2005, Research Engineers International was bought by Bentley Systems. The commercial version, STAAD .PRO, is one of the most widely used structural analysis and design software products worldwide. It supports several steels, concrete and timber design codes. The design of considered Residential Building design is done with the help of STAADPRO software.

IV.PLANNING OF A BUILDING

Stages in Structural Planning:

Once the type of structure is finalized and planned, design of structure involves the corresponding stages in the planning. This is the main stage which decides the total.

1. Column positioning
2. Orientation of columns
3. Beam location
4. Spanning of slabs
5. Lay out and planning of stairs and
6. Type of footing

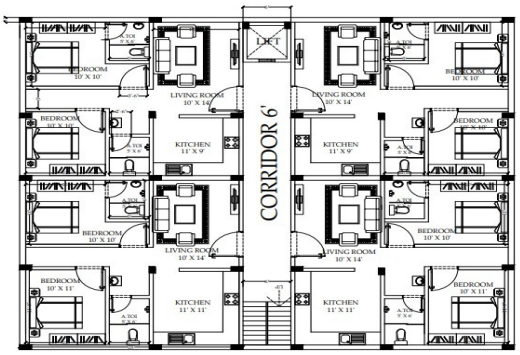

Figure 1 Plan of building

SEISMIC ZONES OF INDIA

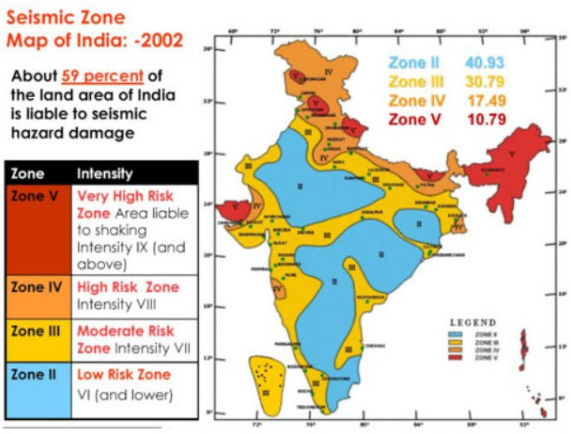

Figure 2:Seismic zone of India

V.MODELLING AND ANALYSIS OF A BUIDLING

Procedure for modelling the residential building using STAAD.Pro software

1.Double click on STAAD PRO software-select new project-select space-change file name and location-give the units i.e., metre and kilo newton-next-add beam- finish.

2. Click on the geometry tab-run structure wizard-select frame model-bay frame- give the length (17.3), height (3), width (14.6-) give number of bays along length (5), height (1), and width (4) of the frame and also the length of each bay.

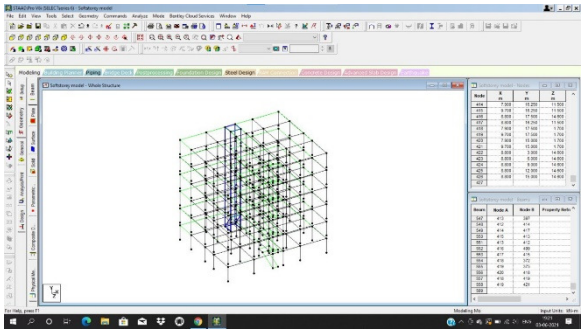

Figure 3: Model of Structure

Procedure for analysis of the residential building using staad pro

1.After modelling cut the section-select to view-cut the bottom storey of the structure-select the plate cursor- add plates to the entire structure-and transfer it to the all storeys of the structure.

2.Go to the general tab-define property-select rectangle(0.3mx0.3m) for beams-select rectangle (0.35x0.35) for columns-select thickness (0.125) for slab section.

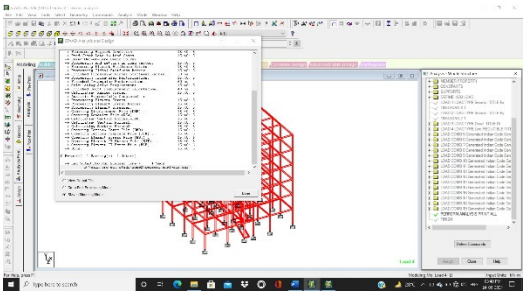

Figure 4: Analysis of Building

VI Results and Discussions

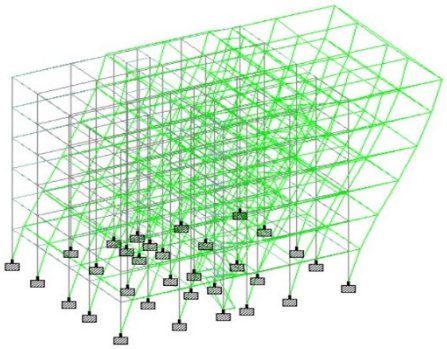

Figure 5:Earthquake analysis of structure in X-direction

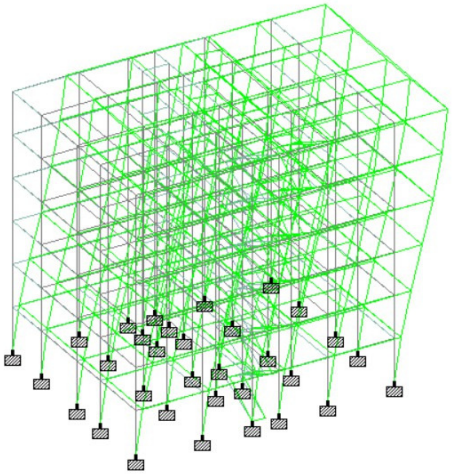

Figure 6:Earthquake analysis of structure in Z-direction

Table1: Base shear in zone IV

```
************************************************************
* UNITS - KN     METE                                      *
* TIME PERIOD FOR X 1893 LOADING =     1.36770 SEC         *
* SA/G PER 1893=     0.994, LOAD FACTOR= 1.000             *
* VB PER 1893=     0.0239 X    135540.75=     3234.65 KN   *
*                                                          *
************************************************************
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Table2: Base shear in zone V

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************************************************************
* UNITS - KN     METE                                      *
* TIME PERIOD FOR X 1893 LOADING =     1.36770 SEC         *
* SA/G PER 1893=     0.994, LOAD FACTOR= 1.000             *
* VB PER 1893=     0.0358 X    135540.75=     4851.98 KN   *
*                                                          *
************************************************************
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OUTPUT FILE (ZONE IV)

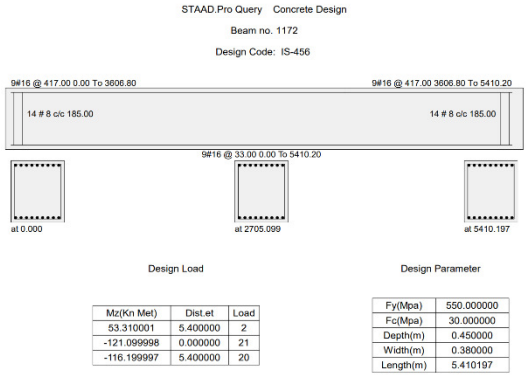
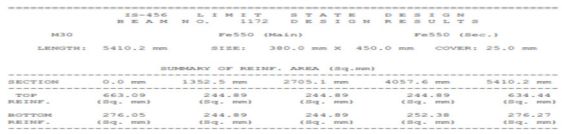
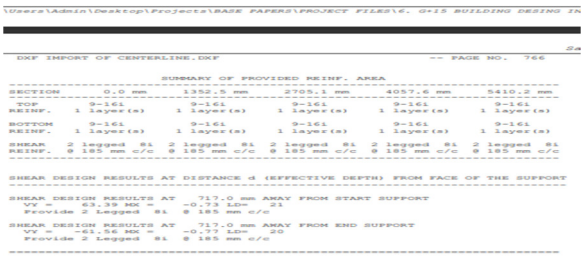
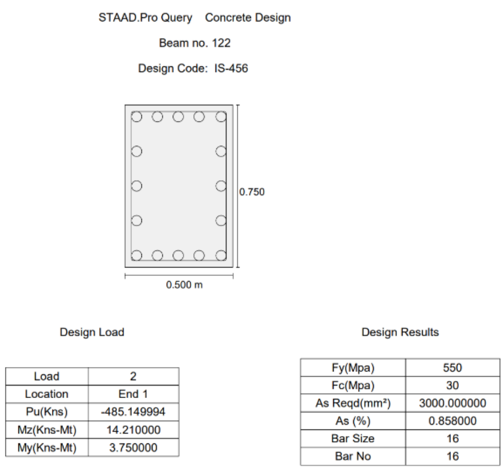


Figure 7: Beam



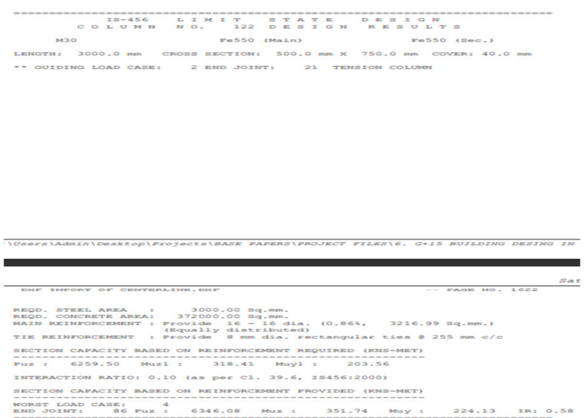




Load	2
Location	End 1
Pu(Kns)	-485.149994
Mz(Kns-Mt)	14.210000
My(Kns-Mt)	3.750000

Fy(Mpa)	550
Fc(Mpa)	30
As Reqd(mm²)	3000.000000
As (%)	0.858000
Bar Size	16
Bar No	16

Figure 8: Column



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IS-456   L I M I T   S T A T E   D E S I G N
C O L U M N   N O.   122  D E S I G N   R E S U L T S

M30                 Fe550 (Main)                Fe550 (Sec.)

LENGTH:  3000.0 mm   CROSS SECTION:  500.0 mm X  750.0 mm  COVER: 40.0 mm

** GUIDING LOAD CASE:    2 END JOINT:    21  TENSION COLUMN

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 DXF IMPORT OF CENTERLINE.DXF                                -- PAGE NO. 1622

REQD. STEEL AREA    :      3000.00 Sq.mm.
REQD. CONCRETE AREA:    372000.00 Sq.mm.
MAIN REINFORCEMENT : Provide  16 - 16 dia. (0.86%,   3216.99 Sq.mm.)
                     (Equally distributed)
TIE REINFORCEMENT  : Provide  8 mm dia. rectangular ties @ 255 mm c/c

SECTION CAPACITY BASED ON REINFORCEMENT REQUIRED (KNS-MET)
Puz :    6259.50   Muz1 :    318.41   Muy1 :    203.56

INTERACTION RATIO: 0.10 (as per Cl. 39.6, IS456:2000)

SECTION CAPACITY BASED ON REINFORCEMENT PROVIDED (KNS-MET)
WORST LOAD CASE:    4
END JOINT:     86 Puz :   6346.08   Muz :    351.74   Muy :    224.13   IR: 0.58
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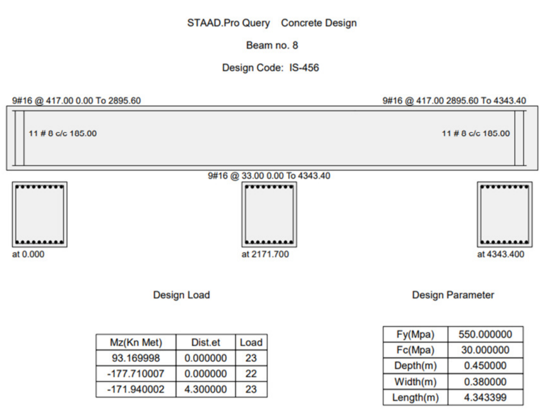
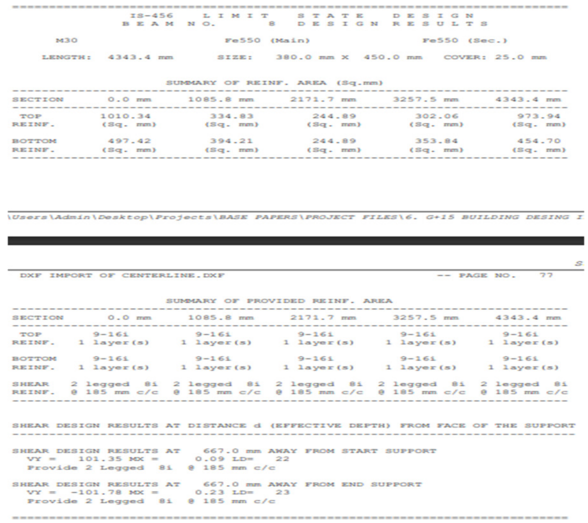
OUT FILE (Zone 5)



Mz(Kn Met)	Dist.et	Load
93.169998	0.000000	23
-177.710007	0.000000	22
-171.940002	4.300000	23

Fy(Mpa)	550.000000
Fc(Mpa)	30.000000
Depth(m)	0.450000
Width(m)	0.380000
Length(m)	4.343399

Figure 9: Beam



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IS-456   L I M I T   S T A T E   D E S I G N
B E A M  N O.     8  D E S I G N   R E S U L T S

M30                 Fe550 (Main)                Fe550 (Sec.)

LENGTH:  4343.4 mm      SIZE:   380.0 mm X  450.0 mm   COVER: 25.0 mm

                 SUMMARY OF REINF. AREA (Sq.mm)
SECTION      0.0 mm     1085.8 mm    2171.7 mm    3257.5 mm    4343.4 mm
 TOP        1010.34      334.83       244.89       302.06       973.94
REINF.     (Sq. mm)    (Sq. mm)     (Sq. mm)     (Sq. mm)     (Sq. mm)

BOTTOM      497.42       394.21       244.89       353.84       454.70
REINF.     (Sq. mm)    (Sq. mm)     (Sq. mm)     (Sq. mm)     (Sq. mm)

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 DXF IMPORT OF CENTERLINE.DXF                                -- PAGE NO.   77

                 SUMMARY OF PROVIDED REINF. AREA
SECTION      0.0 mm     1085.8 mm    2171.7 mm    3257.5 mm    4343.4 mm
 TOP        9-16i        9-16i        9-16i        9-16i        9-16i
REINF.   1 layer(s)   1 layer(s)   1 layer(s)   1 layer(s)   1 layer(s)

BOTTOM      9-16i        9-16i        9-16i        9-16i        9-16i
REINF.   1 layer(s)   1 layer(s)   1 layer(s)   1 layer(s)   1 layer(s)

SHEAR   2 legged  8i  2 legged  8i  2 legged  8i  2 legged  8i  2 legged  8i
REINF.  @ 185 mm c/c  @ 185 mm c/c  @ 185 mm c/c  @ 185 mm c/c  @ 185 mm c/c

SHEAR DESIGN RESULTS AT DISTANCE d (EFFECTIVE DEPTH) FROM FACE OF THE SUPPORT

SHEAR DESIGN RESULTS AT   667.0 mm AWAY FROM START SUPPORT
  VY =   101.35 MX =     0.09 LD=   22
  Provide 2 Legged  8i  @ 185 mm c/c

SHEAR DESIGN RESULTS AT   667.0 mm AWAY FROM END SUPPORT
  VY =  -101.78 MX =     0.23 LD=   23
  Provide 2 Legged  8i  @ 185 mm c/c
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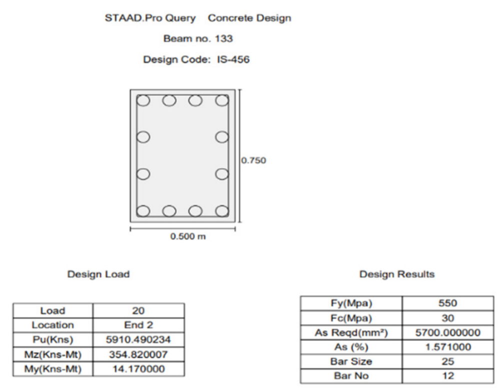
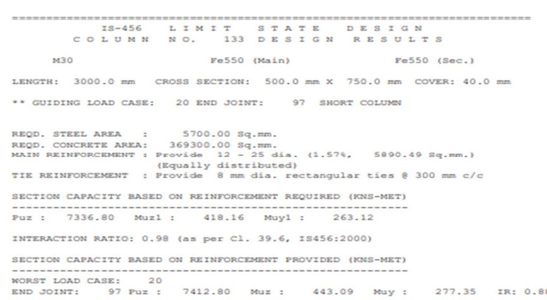


Load	20
Location	End 2
Pu(Kns)	5910.490234
Mz(Kns-Mt)	354.820007
My(Kns-Mt)	14.170000

Fy(Mpa)	550
Fc(Mpa)	30
As Reqd(mm²)	5700.000000
As (%)	1.571000
Bar Size	25
Bar No	12

Figure 10:Column



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IS-456   L I M I T   S T A T E   D E S I G N
C O L U M N   N O.   133  D E S I G N   R E S U L T S

M30                 Fe550 (Main)                Fe550 (Sec.)

LENGTH:  3000.0 mm   CROSS SECTION:  500.0 mm X  750.0 mm  COVER: 40.0 mm

** GUIDING LOAD CASE:   20 END JOINT:    97  SHORT COLUMN

REQD. STEEL AREA    :      5700.00 Sq.mm.
REQD. CONCRETE AREA:    369300.00 Sq.mm.
MAIN REINFORCEMENT : Provide  12 - 25 dia. (1.57%,   5890.49 Sq.mm.)
                     (Equally distributed)
TIE REINFORCEMENT  : Provide  8 mm dia. rectangular ties @ 300 mm c/c

SECTION CAPACITY BASED ON REINFORCEMENT REQUIRED (KNS-MET)
Puz :   7336.80   Muz1 :    418.16   Muy1 :    263.12

INTERACTION RATIO: 0.98 (as per Cl. 39.6, IS456:2000)

SECTION CAPACITY BASED ON REINFORCEMENT PROVIDED (KNS-MET)
WORST LOAD CASE:    20
END JOINT:     97 Puz :   7412.80   Muz :    443.09   Muy :    277.35   IR: 0.88
```

VII CONCLUSIONS

From the above results and discussion, we can conclude that,

1. Zone-V is a very high-risk zone for the structure.

2.Zone-IV is a high-risk zone.

3. G+6 Building can be constructed in Zone IV & Zone V

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