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RESEARCH ARTICLE OPEN ACCESS

COMPARATIVE ANALYSIS OF ORDINARY MOMENT RESISTING RCC FRAMED STRUCTURE IN SEISMIC ZONE IV AND V BY USING IS 1893:2016

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Abstract:

This study is carried out to investigate the seismic behaviour of Ordinary Moment Resisting Frame (OMRF) RCC structural system in various Zone IV and V as per IS 1893:2016 with the help of Etabs softwar. A comparative study of Zone IV and V for OMRF frames Stucture will shed light on the best suited to be adopted for seismic loads in Indian scenario. For this purpose, modeled G+30 storey OMRF RCC structure. regular building are analysed for zone IV and V configurations in Seismic Zone VI & V according to Indian codes. Linear static Analysis or Equivalent static Analysis are carried out to evaluate their structural efficiencies in terms of Base Reaction, Base Share, storey drifts, average storey displacement. In OMRF structures the design and detailing of reinforcement are executed as per the guide lines of I.S:456-2000 which makes the structure less tough. The basic approach of earthquake resistant design should be based on lateral strength as well as deformability of structure . The Seismic evaluation will provide a general idea about the building performance during an earthquake. The criteria of evaluation of building will depend on materials and strength of structural components and detailing of reinforcement. In this report Ordinary Moment Resisting Frame are considering as structural frame and Comparison is made for seismic load in zone IV and V.

1. *Up to 30 floored building subjected OMRF structure in zone IV as per IS 1893:2016*
2. *Up to 30 floored building subjected OMRF structure in zone V as per IS 1893:2016*

***Key Words*:** Seismic analysis, OMRF RCC Structure, Zone IV and V, Response spectrum Method, Etabs, IS 1893:2016.

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I. INTRODUCTION

Design of structures for earthquakes is different from that for any other natural phenomenon. The displacement imposed at the base of the structure during an earthquake causes inertia forces to be generated in it, which are responsible for damage in the structure. As a consequence of this, the mass of the structure being designed assumes importance; the more the mass, the higher is the inertia force. After a whole gamut of earthquake experiences collected during the 20th century from across the world, today the earthquake engineering community believes that there are four virtues of an earthquake-resistant structure. Some of the largest earthquakes of the world have occurred in india 1897assam,1905kangra,1934bihar-nepal,1950assam-tribbet despite an early started, the seismic risk in the country has been increase rapidly in the recent year. Five moderate earthquacke in the last eleven year 1988 bihar-nepal,about 1004

Dead, 1991uttarkashi about 768 dead, 1993latur about 8000 dead, 1997jabalpur about 38 dead, and 1999 chamoli about 100 dead. The earthquake engineering developments in the country started rather early. The institutional development started in the late 1950's and earthquake engineering concepts have been applied to numerous major projects in high seismic regions in the country. Earthquake risk in the country has been increasing alarmingly. However with increase in the seismic risks, it becomes insufficient.

1.1 Model Design As Per These Codes

1. IS 875 Part 1 Dead Loads
2. IS 875 Part 2 Live Loads
3. IS 1893:2016 Part 1 Seismic Loads
4. IS 456:2000 RCC
5. IS 13920 Ductility

The building structure modeled with a dimension of 25m x 16m and having a column & beam with the slab panel of 5m x 4m the model is made by using Etabs software.

1.2 History And Seismic Zone In India

India has divided according to the earthquake zone as per the Indian standard code which is considering according to the geological survey to the different location in the country. Earthquake zone map has shown in the fig.
Earthquake map revised history in the year of 1962 1966 1970 2002

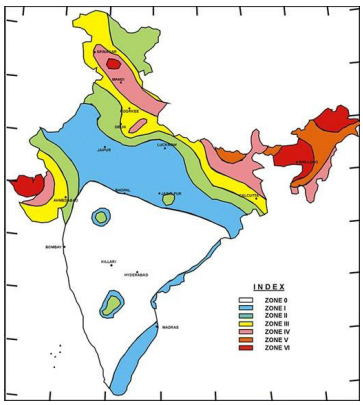


fig1. **Fig1. Seismic Zone Map of India 1962 IS 1893: 1962**

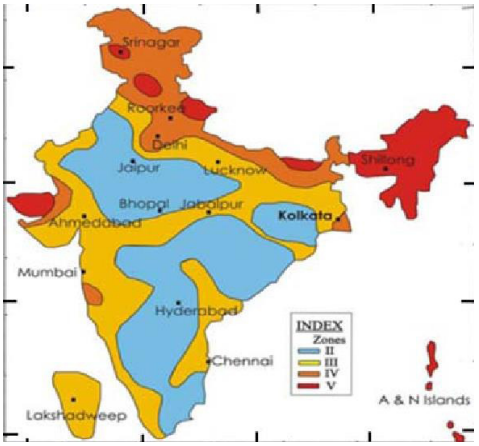


Fig.4 Seismic Zone Map of India IS 1893: 2002

Last map indicated for earthquake in india IS 1893:2002

1.3 The Main Goal Of The Study Are As Follows

1. Seismic analysis of OMRF RCC framed structure for seismic zone IV & V
2. Difference between base reaction, base shear, story drift, story displacement and seismic weight in zone IV & V OMRF framed structure
3. Check the structural stability for high intensity earthquake load

2.1 METHODOLOGY

Two different models were analyzed in software Etabs with the help of different load conditions. Seismic loads of different zones were represented in tabular form with its time acceleration graph. Different building structures separately were subjected
to more intensity & classic earthquakes of seismic force to India's different zones. It was observed that the zone IV and V buildings combinations with either OMRF configuration were modeled which was further applied with proper boundary conditions. It was observed that seismic analysis was performed considering that the foot of the building was firmly placed in ground therefore end connections of the buildings were fixed. Gravity loads also was found to play a very significant role in the seismic analysis of the building. Analysis of OMRF were done by considering Response spectrum Method as per IS 1893-2016. The special type of mode superposition is on the base of response spectrum method. The idea is to provide an input that gives a limit to how much an Eigen mode having a certain natural frequency and damping can be excited by an event of

this type. method of Response spectrum analysis to get the estimate of the structural behavior to less, non-deterministic and transient dynamic program. Examples of such program are earthquakes and shocks. Since the perfect time history of the load is not known, it is difficult to run a time-dependent analysis.

2.2 Discussion Of Model Making

The basic step considered to the model making

1. Considered the earthquake past history of seismic zone iv and v

2. Considered basic model and specification

3. Force design and analysis as per IS 1893:2016

4. Comparison zone IV and V OMRF RCC frame structure

The model Plan and elevation details of the G+30 story structure are shown in fig. The analysis of determined structure frame demand knowledge measurement of beam column to all floor.

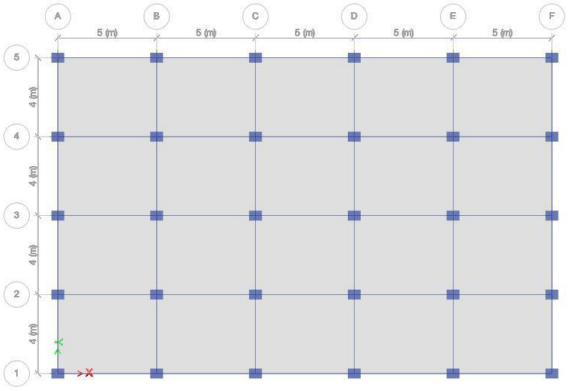


Fig. 3 Top view Plan

TABLE I Building Details

Particular	Zone IV	Zone V
NO OF STOREY	G+30	G+30
Total Height	94.5m	94.5m
Beam Size	300x300mm	300x300
Column Size	500x500mm	500x500mm
Slab/Deck	150mm	150mm

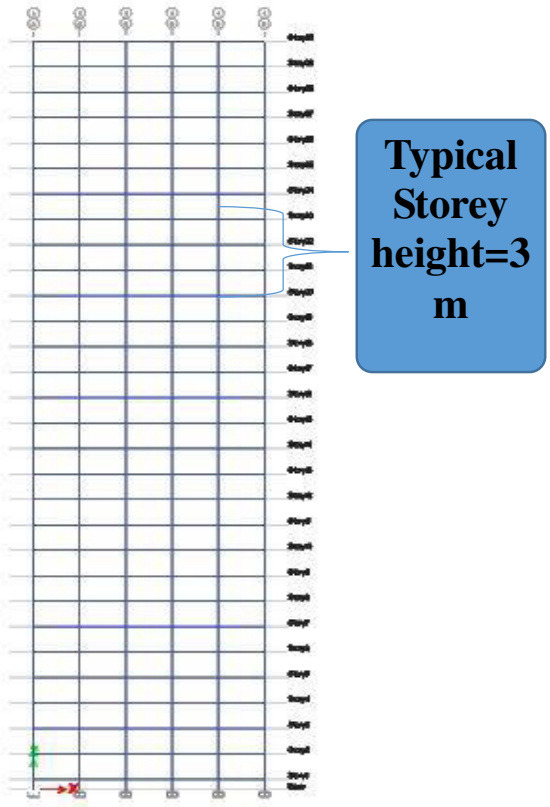


Fig. 4 Elevation for G+30 RCC Framed Structure

2.3 The following load combinations are considered during the analysis of the model:

1. **DL1.5+WL1.5**
2. **DL1.5+LL1.5+WL 1.5**
3. **DL1.2+LL1.2+WL1.2+EQX1.2**
4. **DL1.2+LL1.2+WL1.2+EQX-1.2**
5. **DL1.2+LL1.2+WL1.2+EQY1.2**
6. **DL1.2+LL1.2+WL1.2+EQY-1.2**
7. **DL1.5+WL1.5+EQX1.5**
8. **DL1.5+WL1.5+EQX-1.5**
9. **DL1.5+WL1.5+EQY1.5**
10. **DL1.5+WL1.5+EQY-1.5**
11. **DL0.9+WL0.9+EQX1.5**
12. **DL0.9+WL0.9+EQX-1.5**
13. **DL0.9+WL0.9+EQY1.5**
14. **DL0.9+WL0.9+EQY-1.5**
15. **DL1.2+LL1.2+WL1.2+RSx1.2**
16. **DL1.2+LL1.2+WL1.2+RSy1.2**
17. **DL1.5+WL1.5+RSx1.5**
18. **DL1.5+WL1.5+RSy1.5**
19. **DL0.9+WL0.9+RSx1.5**

20. **DL0.9+WL0.9+RSy1.5**

TABLE II
MODEL SPECIFICATION

PARTICULARS	Zone IV	Zone V
	G+30	G+30
Type of frame	OMRF	OMRF
Total height of building	94.5m	94.5m
Bottom Story Height	1.5m	1.5
Height of each storey	3m	3m
Plan of the building	25m × 16m	25m × 16m
Thickness of walls	230mm	230mm
Live load	3.0 kN/m^2	3.0 kN/m^2
Grade of Concrete	M-40	M-40
Rebar	HYSD500	HYSD500
Density of Concrete	40 kN/m^3	40 kN/m^3
Density of brick masonry	20 kN/m^3	20 kN/m^3
Zone	IV	V
Soil type	Type II medium soil	Type II medium soil
Importance factor	1.0	1.0
Response reduction	3.0	3.0
Seismic zone factor	0.24 For zone IV	0.36 For zone V

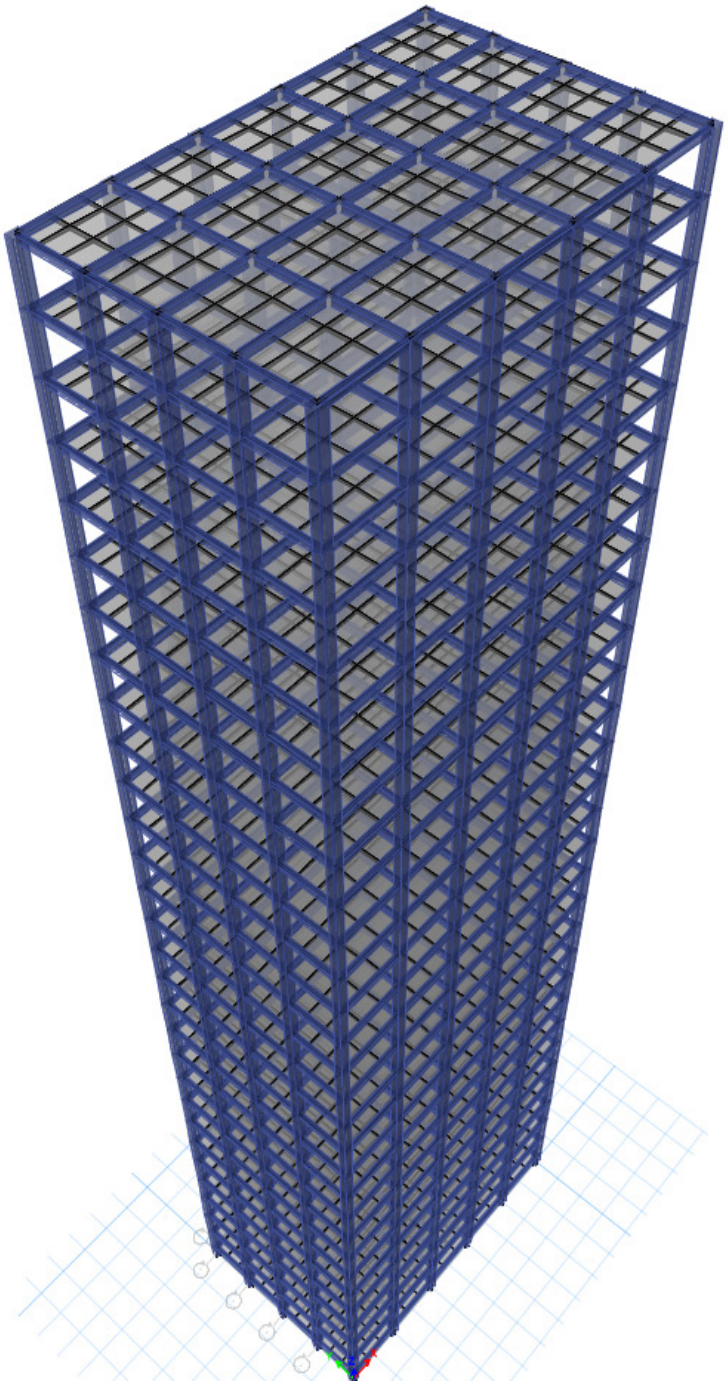


Fig 5. Details of Model & General Elevation

3.1 PERFORMANCE ANALYSIS

It was observed that buildings start to perform highly non-linearly on the application of highly dynamic seismic loads. Structural non-linearity occurs in the high rise buildings whatever may be the shape of building. Under seismic loads

of structure due to various zones of earthquake non-linearity behavior of the structure almost remains the same only the magnitude of the deformation varies. It was observed that for tall or high rise building seismic analysis has to be performed by dynamic modes then only accurate results were possible while for small building even static seismic analysis could give us better results. The behavior of all the three framing systems took as a basic study on the modeled structure. Against the clause 7:11:1 of IS-1893:2016 i.e. under transient seismic loads lateral drift/deflection ratio is checked. The following parameters were considered

3.2To Present A Comparison Between Zone IV and V for OMRF stucture

1. Base Reaction

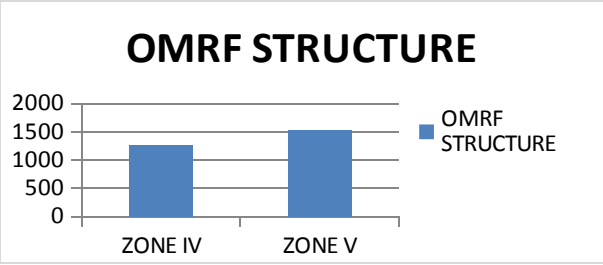
2. Base shear

3. Story Drift

4. Seismic Weight

Base Reaction Table III Base reaction of OMRF STRUCTURE in zone IV and V

OMRF Structure	
ZONE IV	ZONE V
1254.403KN	1532.31KN

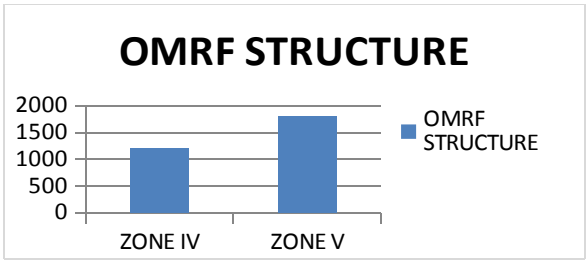


Base Shear

The value for base shear in OMRF structure in zone IV is 1201.42KN whereas for zone V is 1802.131KN. So percentage increase in base shear for Zone V structure.

TABLE IV BASE SHEAR FOR OMRF IN ZONE IV & V

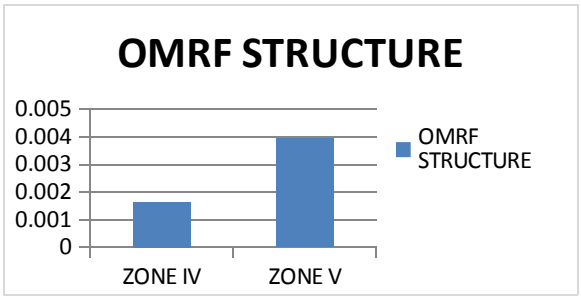
OMRF Structure	
ZONE IV	ZONE V
1201.42KN	1802.131KN



STORY DRIFT

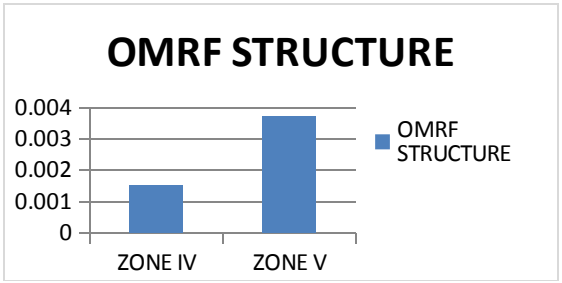
Max Story Drift in X direction

OMRF Structure	
ZONE IV	ZONE V
0.001641(RSx)	0.003945(RSx)



Max story drift in Y direction

OMRF Structure	
ZONE IV	ZONE V
0.001519(RSy)	0.003717(RSy)

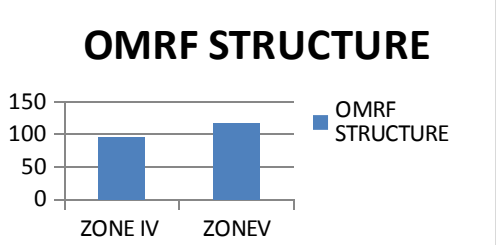


Story Displacement

Max story Displacement in X direction

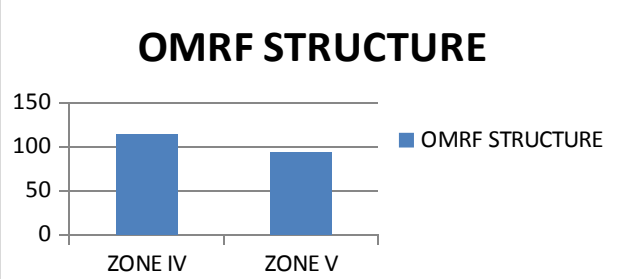
OMRF Structure

ZONE IV	ZONE V
95.728mm	116.91mm



Max story Displacement in Y direction

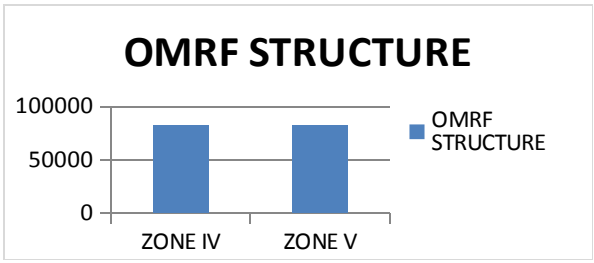
OMRF Structure	
ZONE IV	ZONE V
93.601mm	114.32mm



Seismic Weight

OMRF Structure	
ZONE IV	ZONE V
82451.70KN	82451.70KN

Following are the conclusions:



3.4 SUMMARY AND CONCLUSION

The study includes the development of a new method and analysis of framing systems and a new model that compares the safety and cost-effectiveness of a structure for lateral loading System. In this project the behavior of OMRF structure in Zone VI & V under seismic load was studied. Lateral load, dead load, live load is taken for the design of the structure as per IS standards for Zone IV&V. This study is based on past history of earthquake zones. A specific models was done for serviceability of OMRF systems will be valuable tool for decision makers. Engineers In particular, it will be able to choose eco-economic framing systems resulting in structure safety and cost-effective structures. These structures are more competitive structures and challenging structures in the construction sector. Area maps currently falling in seismic.zone I has been merged with Seismic Zone II. Also, the seismic zone map in the peninsular region is being revised. The National Seismic Zone Map is one of the seismic zone Offers a large-scale view of the region in the country. Local variations in soil types and geology cannot be represented at that scale. Therefore, important projects, such as major waterfall or nuclear power plant, the seismic hazard is assessed specifically for that site. In addition, for the purposes of urban planning, microzonation accounts for local variations in geology in metropolitan areas. analytical study done with 2 structures in 2 defferent zone using etabs software.

The conclusion driven with the help of response spectrum analysis by using IS 1893:2016 for G+30 RCC structure.

- ✓ The study gives a comparison of OMRF structure in ZONE IV&V under seismic loads. OMRF mostly design for normal areas and the designers can design the structure economically.
- ✓ Base reaction for G+30 OMRF Structure in zone V is 1532.31KN where as for zone IV is to be 1254.403KN.

- ✓ Base reaction for OMRF in zone V is increase by 22.15% as compare to zone iv.
- ✓ Base shear for G+30 OMRF in zone V is 1802.131KN where as for Zone IV is 1201.42KN.
- ✓ Base shear for OMRF in zone V is increase by 50% as compare to zone iv.
- ✓ Maximum story drift is bound more in zone V i.e 0.003945 as compared to zone IV i.e 0.001641 in X-direction.
- ✓ Maximum story drift is bound more in zone V is 0.003717 where as in Zone IV is 0.001519 for Y-direction.
- ✓ Story displacement for OMRF structure in zone V is 116.91mm where as in zone IV is 95.728mm in X direction.
- ✓ Story displacement for OMRF structure in zone V is 114.32mm where as in zone IV is 93.601mm in Y direction.
- ✓ So from above results interpretation we can conclude that for seismic zone IV and below zone, OMRF RCC structure should be designed.

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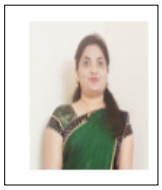

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