Investigation on different Codes to Analyze Effect of Loads in Building by using Finite Element Method

Harshita Lokhande[1], Jyoti Yadav[2], Dr. Pankaj Singh[3]
M.Tech Scholar[1], Assistant Professor [2], HOD[3]
[1, 2, 3](Civil Engineering Department, SRK University, Bhopal, India)

Abstract

Reinforced concrete (RC) is a versatile composite and one of the most widely used materials in modern construction. Concrete is a relatively brittle material that is strong under compression but less so in tension. Plain, unreinforced concrete is unsuitable for many structures as it is relatively poor at withstanding stresses induced by vibrations, wind loading, and so on. To increase its overall strength, steel rods, wires, mesh or cables can be embedded in concrete before it sets. This reinforcement, often known as rebar, resists tensile forces. Test model was built, with specified specification. Vibration sensor was developed to measure the vibration amplitude. CAD model was created with all specification of test model to match the desired condition. Simulated environment was developed with all the boundary condition. Compared the result of both simulation and experiment. Data analysis is evaluated. It was observed that in building with column has more time period as compared to building columns, in building with column has less base shear as compared to building column, The displacement column building is more as compared to column building, on shifting of column from 1st storey towards top storey of the building results in increasing storey drift, From dynamic analysis it was observed that column at different location results into variation in dynamic response, It was also observed that shifting of column from 1st storey towards top storey of the building results in increasing base shear.

.

I INTRODUCTION

A severe earthquake is one of the most destructive phenomena of nature. It is quite impossible to precisely predict and prevent an earthquake but the damage to a structure can be reduced by its proper design. Hence it is Prudent to do the seismic analysis and design to save you systems in opposition to any disaster. The severity of the harm depends at the aggregate of several elements inclusive of- earthquake magnitude, proximity to epicenter, and the neighborhood geological situations, which affect the seismic wave propagation. The lateral forces because of earthquake purpose the most problem for structures. Earthquake resistant design is thereby mainly concerned with proscribing the seismic chance associated with guy-made structures to socio-economically appropriate tiers. It ambitions to foresee the capacity results of an earthquake on civil infrastructure and to make certain the design & production of homes complies with design codes in an effort to preserve an inexpensive degree of overall performance with a few common place level of damage during an earthquake exposure .The ductility of a structure acts like a shock absorber and helps in dissipating a certain amount of seismic energy. India is prone to strong earthquake shaking, and hence earthquake resistant design is essential. The Engineers do not attempt to make Earthquake proof buildings with the intention to no longer get damaged even in the course of the rare however robust earthquake. Such homes may be too sturdy and also too luxurious. Design of homes in which there is no harm in the course of the strong but uncommon earthquake is known as earthquake proof design. The engineers do not attempt to make earthquake evidence homes in order to no longer get damaged even at some stage in the rare but robust earthquake. Such buildings may be too sturdy and additionally too highly-priced. The purposes of the earthquake resistant design is to have structures with a view to behave elastically and continue to exist without disintegrate under primary earthquakes that might

arise at some point of the life of the structure. To keep away from collapse during a major earthquake, structural members must be ductile enough to absorb and dissipate energy by post elastic deformation.

II SEISMIC ANALYSIS

Earthquake analysis is a subset of structural analysis and is the calculation of the reaction of a structure to earthquakes. For the determination of seismic responses there's vital to carry out seismic analysis of shape. The evaluation may be achieved on the idea of exterior action, the performance of shape or structural materials, and the sort of structural replica model selected.

Structural analysis methods can be divided into the following categories-

- Equivalent Static Analysis
- Response Spectrum Analysis
- Linear Dynamic Analysis
- Nonlinear Static Analysis
- Nonlinear Dynamic Analysis

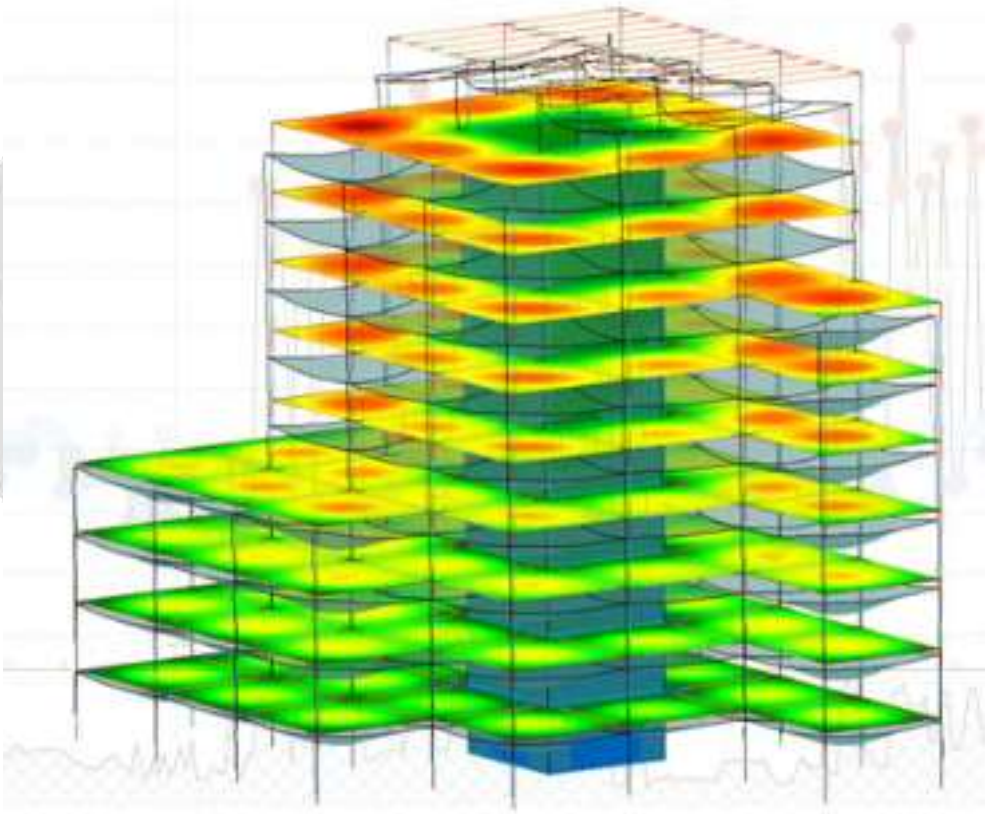


Figure - Structural analyses

III REVIEW OF LITERATURE:

Mayur R. Rethaliya et. al.[1] studied the revisions in various clauses of new IS 1893 (Part 1): 2016 with respect to old IS 1893 (Part 1): 2002 And their effect in particular, Separate reaction spectra for Equivalent static technique and Response spectrum approach. Old IS-1893- 2002 has given one response spectra for Equivalent Static Method and Response Spectrum method for four.Zero s durations. Expressions are given for calculating layout acceleration coefficient (Sa/g), for Rocky/hard soils, medium soils and tender soils. New IS 1893- 2016 has given response spectra for Equivalent Static Method and Response Spectrum approach one by one for 6.0 s periods. Expressions are given for calculating design acceleration coefficient (Sa/g), for Equivalent Static Method and Response

Spectrum technique separately for Rocky/difficult soils, medium soils and tender soils. It will trade the Sa/g values. **Choudhary and bokare et.al. [2]** illustrated that Frequency of earthquake incidence has expanded inflicting severe harm to human existence and property. Consequently want of precise seismic examination of structures emerges. There are diverse static and dynamic strategies for seismic research out of which seismic co-green approach and reaction spectrum technique are used in this studies. In this paper those techniques are related for seismic investigation of G+10 multistoried building. Response spectrum evaluation of constructing is executed the usage of superior model of software program STAAD-PRO-V8i while seismic coefficient analysis is completed using hand calculation from Codal components. Comparative have a look at those earthquake techniques are accomplished and offered and explained right here. **Gireesh babu et.al. [3]** Studied that Structural designing requires structural evaluation and earthquake or seismic evaluation of any shape previous to construction. Earthquake or seismic analysis is the calculation of the response of a shape subjected to earthquake excitation. Various seismic statistics are vital to perform the seismic analysis of the structures in this have a look at the seismic reaction of the systems is investigated below earthquake excitation expressed in the form of member forces, joint displacement, help response and story glide. In order so that it will save you or to minimize the incidence of cracks, it's far necessary to understand primary reasons of cracking and to have know-how about positive homes of building materials, the specification for mortar and urban, the Architectural design of building, structural layout, basis design, production practices & techniques and environments. **Akhil and Awasthi et.al.[4]** Illustrated that the seismic response of various vertical irregularity structures. The task is completed with the aid of Response spectrum evaluation (RSA) of vertically abnormal RC constructing. This take a look at consists of the modelling of regular and H-form plan abnormal constructing having place of 25X25m and peak of 3.5 m from every G+10 storey .The performance of this framed constructing during take a look at earthquake motions depends at the distribution of stiffness, electricity, and mass in both the horizontal and vertical planes of the constructing. The predominant intention of this work is comparative observe of the stiffness of the structure by using considering the 3 models in Regular Structure and three models in Plan irregular structure with one of a kind Vertical irregular structure. The seismic overall performance of multistory regular building is determined with the aid of Response Spectrum analysis in STAAD Pro software. **A sravan et. al.[5]** studied that the evaluation method followed for the evaluation of symmetric excessive upward push multi-storey constructing (G+15) beneath the effect of Earthquake(EQ) forces. Earthquake befell in multistoried constructing indicates that if the structures are not properly designed and built with and ok energy it results in the whole disintegrate of the systems. To make certain safety towards seismic forces of multistoried constructing hence, there may be want to study of seismic analysis to design earthquake resistance structures. The general structure becomes analyzed by means of computer with using STAAD.PRO software program. We observed the response discount of instances ordinary moment resisting frame and unique second resisting frame values with deflection diagrams in static and dynamic analysis. The unique second of resisting body structured is ideal in resisting the seismic loads. **Dnyaneshkumar et. al.[6]** analyzed a Seven fashions of G+10 storey building with one ordinary plan and ultimate irregular plan (C, E, H, L, T, PLUS shapes) have been taken. The plan region for each structure is equal only there's differ in geometry. Elevation is identical for all fashions. The static and dynamic analysis has carried out on laptop with the assist of STAAD-Pro software the use of the parameters for the layout as consistent with the IS-1893- 2002-Part-1. Seismic performance of various shape of systems positioned in extreme earthquake region and minor earthquake zones are evaluated and evaluate design lateral shear, time period, joint displacement and many others. Response spectrum evaluation is used for evaluation. **Raad Dheyab Khalaf et.al.[7]** studied presence of irregularities like plan irregularities or vertical irregularities is taken into consideration as a chief deficiency within the seismic conduct of structures. Shear walls are one of the very powerful solutions to preserve those lateral forces and that they provide required stiffness and energy and good drift manage and are easy to construct. In this present work attempt is made to observe and check out the plan irregularities with the aid of various vicinity of shear wall on exceptional asymmetry fashions. The parameters considered are displacement, inter storey

flow, and storey stiffness. Dynamic Analysis is accomplished the usage of FEM software ETAB v 15 by means of reaction spectrum technique. **S. Natarajan et.al.[8]** studied the seismic response of the homes and analysis became done by using the use of reaction spectrum approach using Finite element based totally software program-ETABS. A residential building of G+15 irregular structure is considered for the analysis. The homes of these seismic shear walls dominate the reaction of the homes, and consequently, it is essential to evaluate the seismic response of the walls correctly. A study on an irregular highrise constructing with shear wall and with out shearwall became studied to apprehend the lateral masses, tale drifts and torsion effects. When partitions are situated in positive positions in a building, they may be very green in resisting lateral masses originating from wind or earthquakes. **Harshita Tripathi et. al.[9]** Deteremined the impact of dynamic evaluation on tall systems of different storey G+24, G+36 and G+ forty eight, with identical dimesions in length and width guidelines as 36 m x 36 m. And paintings is executed on csi Etab, an analyzing and designing tool with thinking about lateral forces both seismic as in line with 1893 element-1 and wind forces as according to 875 component-three and conluded that storey displacement and storey drift values are in the permissible restrict and stiffness to the diagrid structural gadget which reflects the less pinnacle storey displacement. **Chithambar Ganesh.A et.al.[10]** studied to decide the answer for the shear wall vicinity in multi-tale building in Etabs nonlinear for a strengthened concrete constructing. There are many software applications which can be available to find and design the shear wall in a shape which includes ETABS, SAP, STAAD PRO, etc. **Varsha R. Harne et.al.[11]** studied to decide the solution for shear wall area in multistory building. A RCC building of six storey placed in NAGPUR subjected to earthquake loading in zone-II is considered. An earthquake load is calculated by using seismic coefficient technique the use of IS 1893 (PART–I):2002. **Aslam et.al.[12]** studied (G+5) storey Hospital building in Agartala one the initiatives undertaken through L&T. The seismic analysis of the proposed building changed into executed inside the software program ETABS, model- 9.7, which is one of the maximum advanced software within the structural design discipline. **Misam Abidi, Mangulkar Madhuri. N et.al. [13]** Studied an assessment to understand the behavior of Reinforced Concrete framed structures with the aid of pushover evaluation and the Comparative look at was executed for one of kind models in parameters of base shear, displacement, performance factor. The inelastic behavior of the instance structures are examined by using sporting out displacement controlled pushover analysis. **Bozdogan K.B.,Deierlein et.al. [14]** Contemplated in points of hobby of the displaying problems, nonlinear behavior and exam of the RCC define with shear divider fundamental framework. Utilizing rough method programming Etabs which relies upon at the continuum technique and one dimensional constrained element method, for sidelong static and dynamic investigations of multi-story constructing. In this research to appears on the usage full parameter like horizontal relocation, and powers.

IV FINITE ELEMENT METHOD

Sometimes, it becomes difficult to contemplate the behavior of a system when it is studied as a whole. On the other hand, it becomes relatively easier to study such system, by dividing it into its individual components and subcomponents. The behavior of every small issue can be easily understood and incorporated to explain the behavior of entire gadget. This is the primary concept in the back of finite detail approach (FEM).

V PROCEDURE FOR FINITE ELEMENT ANALYSIS

Consider the example of an automobile piston. A piston in the course of the operation of I.C Engine is subjected to numerous varieties of loads like impact load, friction pressure and reaction from cylinder wall due to thermal expansion of piston and so on. Due to these hundreds, a non-uniform pressure distribution may additionally take within the piston body. This nature of strain distribution may be determined the usage of finite detail evaluation method, in which the whole body of the piston is split into smaller factors known as finite factors. These elements can be square, cuboidal, tetrahedral, prism or hexahedral factors.

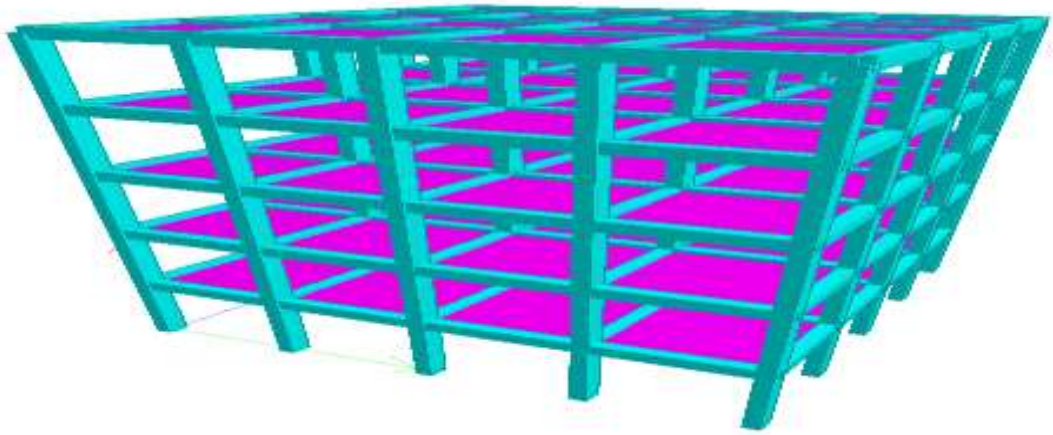


Fig 3.1: building frame

VI RESULTS & DISCUSSION:

In this work 2 Building (G+5) are taken into consideration with 5 flooring. One is ordinary building and the alternative is with column. Mainly this work will focus on the building with columns. Under the static loading situation both the building are safe. In dynamic load; with column structure is discovered dangerous. i.e. In earthquake this building observed risky. The discern beneath display the normal building without columns bending second, shear pressure and axial force while the constructing is beneath any kind to loading condition.

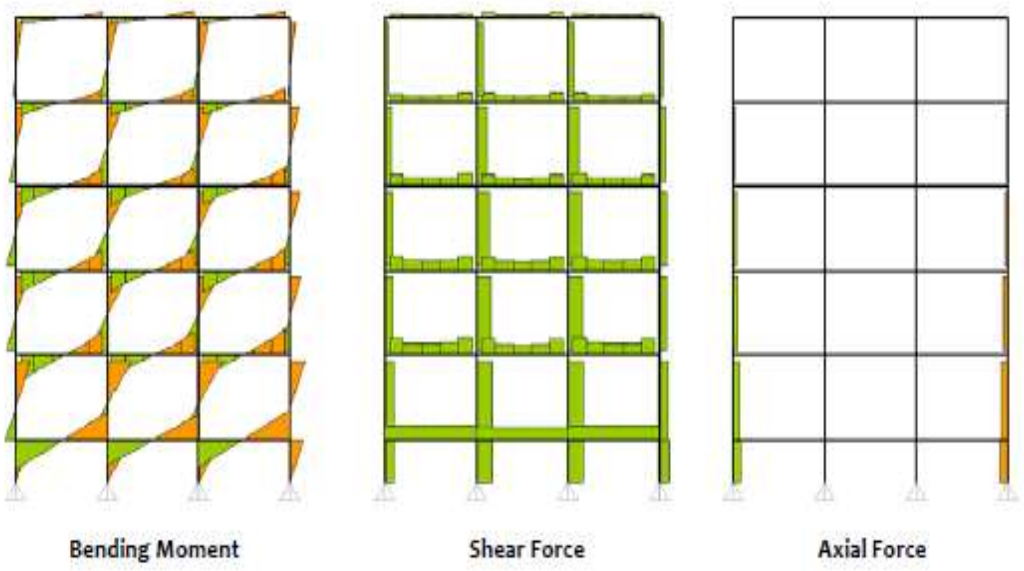
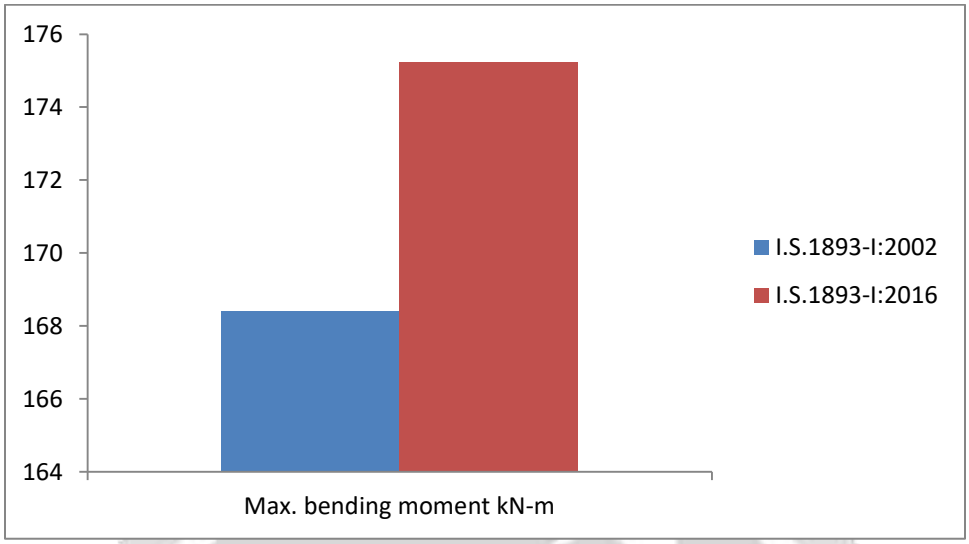
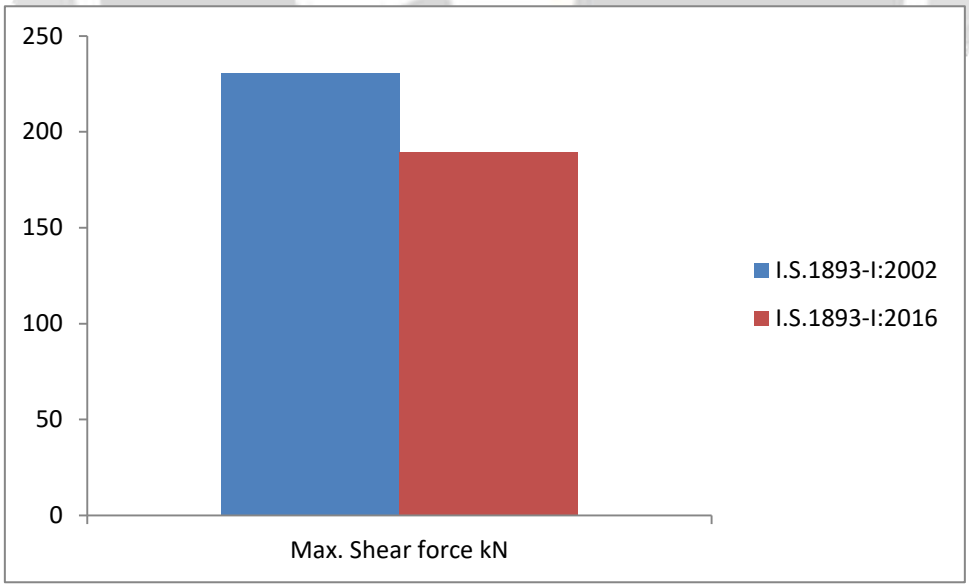


Figure - Behaviour of moment frames: Bending moment, shear force and axial force diagrams in the benchmark building having moment frames.

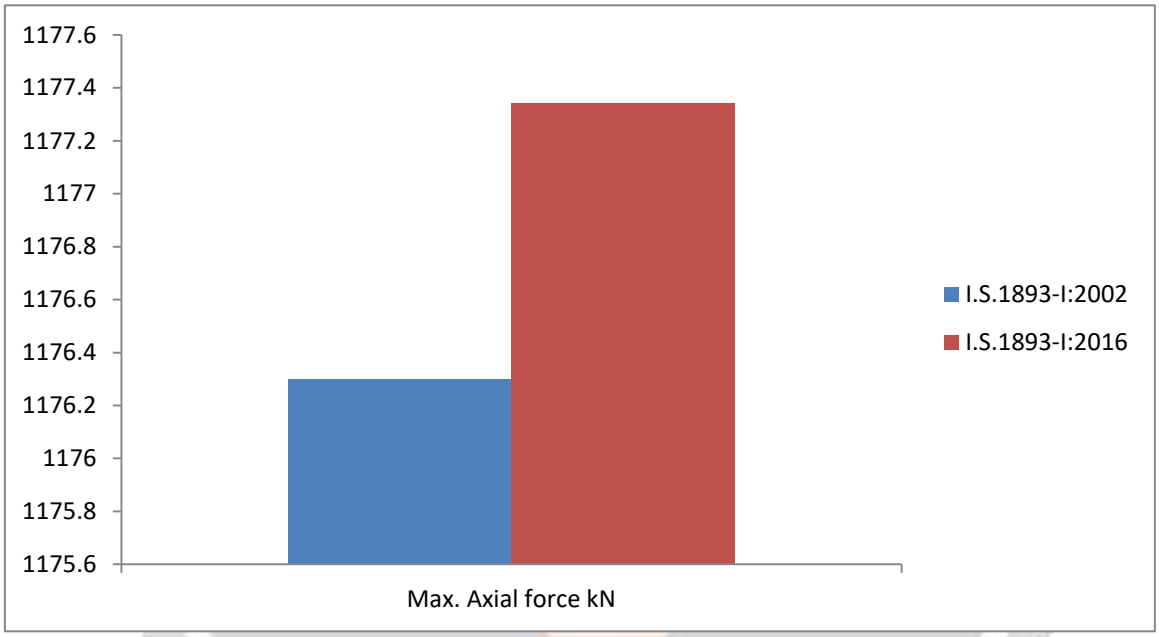
Max. bending moment kN-m	
I.S.1893-I:2002	I.S.1893-I:2016
168.4	175.23



Max. Shear force kN	
I.S.1893-I:2002	I.S.1893-I:2016
230.43	189.3



Max. Axial force kN	
I.S.1893-I:2002	I.S.1893-I:2016
1176.3	1177.34



Storey displacement in 0 degree		
Storeys	**I.S.1893-I:2002**	**I.S.1893-I:2016**
base	0	0
GF	9.224	6.149
1st storey	24.785	16.524
2nd storey	41.653	27.769
3rd storey	58.682	39.122
4th storey	75.39	50.26

S.No.	Qty cum (concrete)	Qty kN (reinforcement)	S.O.R Rate of concrete	S.O.R Rate of Rebar
I.S. 1893-I:2002	3245.87	213	4500	440
I.S. 1893-I:2016	3398.02	240	4500	440

VIII CONCLUSION

In this study we are comparing I.S. 1893-I: 2002 with its updated version I.S. 1893-I:2016 at two different regions i.e. East and West region for same Zone II and IV.

Considering all the changes done in new provisions which are based on present criteria of the country, which results in more stable and suitable to resist load.

Following outcomes are as follows:

1. In terms of max. bending moment, it can be said that design with new structure is Comparatively costly due to high resistive structure which need more reinforcement. Also in eastern regions due to terrain area sloping structure will cost more in comparison.
2. In terms of shear force the 2016 provision proved to be more resistive in minimizing Unbalance forces.
3. Axial force is approximately same in both conditions whereas deflection is comparatively more in previous structure provision.

The study presented in the paper compares the difference between I.S.1893-I: 2002 and an I.S.1893-I: 2016. The following conclusions were drawn based on the investigation

1) By the software of lateral loads in X and Y course at each floor, the lateral displacements of column constructing in X and Y instructions are more compared to that of an ordinary constructing. So the column building is risky for construction whilst in comparison to a regular building.

2) By the calculation of storey drift at each floor for the homes its miles discovered that column constructing will go through severe storey flow than ordinary constructing. The storey go with the flow is most at 5th ranges in both the instances.

REFERENCES:

[1]. IS: 1893(Part 1): 2002, "Criteria for Earthquake Resistant Design of Structures." Part-1, Bureau of Indian Standards, New Delhi, 2002.
[2]. IS: 1893(Part 1): 2016, "Criteria for Earthquake Resistant Design of Structures." Part-1, Bureau of Indian Standards, New Delhi, 2016.
[3]. Najif Ismail "Comparative studies of IMRF and SMRF in moderate seismic zones"
[4]. Chippa Ambika, Nampalli Prerana, " Analysis and Design of R.C. Moment Resisting Frames with and without, IJISET - International Journal of Innovative Science, Engineering & Technology, Vol. 1 Issue 6, August 2014. Shear Wall for Different Seismic Parameters.
[5]. IS 456: 2000 Plain and Reinforced Concrete- Code of Practice
[6]. IS 13920:1993- Ductile Detailing of Reinforced Concrete Structure subject to Seismic Force-Code of practice.
[7]. Mario Paz "Dynamics of Structures book"
[8]. Aggarwal & Shrikhande" Earthquake Resistant Design book"
[9]. Xiao-hua Wang, "MATLAB guide to Finite Element", Springer, Berlin & New York.
[10]. Niroomandi, "Analysis of building frames" Journal of Structural Engineering, Vol. 119, No. 2, Page no:468-483, 1993.
[11]. Garcia Reyes, HajirasoulihaIman, PilakoutasKypros, (2010),"Seismic behaviour of deficient RC frames strengthened with CFRP composites". Engineering Structures 32 (2010) 3075-3085.
[12]. Williams, Gardoni (2006), "Direct Stiffness Method For 2D Frames-Theory of structure".
[13]. Daryl L. Logan (2007), "A First Course in the Finite Element Method", Thomson, USAChopra, Anil k. (1995), "Dynamics of structures", Prentice Hall.
[14]. Brodericka B.M., Elghazouli A.Y. and Goggins J, "Earthquake testing and response analysis of concentrically-braced sub-frames", Journal of Constructional Steel Research ,Volume 64, Issue 9, Page no: 997-1007,2008.
[15]. Bardakis V.G., Dritsos S.E. (2007), "Evaluating assumptions for seismic assessment of existing buildings ".Soil Dynamics and Earthquake Engineering 27 (2007) 223–233.