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A REVIEW OF SEISMIC ANALYSIS OF RC STRUCTURE USING DIFFERENT COUNTRIES CODES

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ABSTRACT

The earthquake resistant structures will survive during earthquake with small damage of structural components. To make earthquake resistant structure, there are requirement of an engineer who have sound knowledge of various seismic codes. Many academic and governmental researchers have worked and contributed their efforts for the evaluation of the various seismic codes. The analysis and design of various structures using the various codes was done by researchers. The evaluation of seismic performance was done by limiting the parameters according to the provision of various codes. This paper gives an overview of some paper published in international journals around the world and gives summary about the articles and papers found in the literature, about the comparison of various international and national codal provisions.

1. INTRODUCTION

The earthquake resistant structures will survive during earthquake with small damage of structural components. To make earthquake resistant structure, there are requirement of an engineer who have sound knowledge of various seismic codes. Many academic and governmental researchers have worked and contributed their efforts for the evaluation of the various seismic codes. The analysis and design of various structures using the various codes was done by researchers. The evaluation of seismic performance was done by limiting the parameters according to the provision of various codes. This paper gives an overview of some paper published in international journals around the world and gives summary about the articles and papers found in the literature, about the comparison of various international and national codal provisions.

2. LITERATURE REVIEW

P.R.Bose and R Dubey et al. (1992) compared the earthquake provisions for RC framed structure of different counties. The provisions compare are (BSLJ) 1981, Criteria for Seismic Resistant Design of Structures [IS: 1893-1984], 1985(NBC), (NZS) 4203:1984 and 1988(UBC). In general the provisions of five countries can be related to one another in terms of component. The study presents and compares the distribution of seismic shear along the height of building according to these five codes and the distribution pattern obtained by dynamic analysis.

F. Atique and Z.Wadud (2001) analysis of various provisions for earthquake and wind analysis codes of various countries. 1993 (BNBC- 93), Uniform Building Codes, 1983 (NBCIndia-83). The position of Bangladesh is lies in an active seismic zone. The constructed and tested building code has to update so as to ensure the safety of the structure and its occupants against the natural hazard. The developed countries have increased the factor of safety against earthquake by suggesting higher values of base shear. BNBC is the least conservative as compared to other codes and practices. Therefore BNBC has to improve over it for safety against in the country.

Dr. S.V. Itti and Abhishek Pathade (2002) comparison of the Indian Code (IS) and (IBC) with relative to the seismic design and analysis of OMRF, IMRF and SMRF. In both the codes the study explores differences in the results obtained using the two codes, particularly design base shear, lateral loads, drifts and area of steel for structural members for all RC buildings. Then compared and analyzed taking note of any significant differences by analytical results. The study will be confined to monolithically cast RC buildings. Specific provisions are presented in detail. Provisions of Indian and International Buildings Codes are identified. Target deflection of the building is achieved at a lower lateral force in SMRF IBC. The concept of lesser force and more deflection is followed. In OMRF, IMRF and SMRF of Indian Code the lateral force applied in higher as a result the deflection on the top of the building exceeds the target deflection. To make building stiffer and maintain deflection within the permissible limit then increase the column and beam sizes.

Yuji Ishiyama and Marjan Faizian (2004) it compares earthquake codes BSLJ, International Building Code

and Iran. Generally all seismic codes used to design to resist specified static lateral forces related to the structure and the seismicity of the region. The fundamental natural period of the structure is calculated by formulas are specified for the base shear and the distribution of lateral forces over height of the buildings. First as per introduction and background and design procedure given in three codes then for calculating the seismic load in each code the base shear coefficient, seismic zoning, spectral content, fundamental period, behavior coefficient, importance factor, effect of soil profile. The differences have been mentioned. After calculating the seismic force, the distribution methods over the height of the building and also the torsion and the base shear coefficients are compared. Then all considerations in these codes such as story drift and overturning moment reduction coefficients are discussed. At last, the dynamic analysis methods, which in all three codes are only necessary for irregular and unusual buildings, as described in the codes, are taken into consideration. Although these three codes differ in details, they have a lot of common features which can be compared. This comparison shows that the Iranian seismic code is very similar to the Americans but the Japanese code is considerably different from the other two codes.

Adem Dogangunand Ramazan Livaoglu (2006)in this design spectra through 4 worldwide codes are in comparison consisting ofeurocode8, uniform constructing code, international building code and Turkish code. The paper indicates that in earthquake codes the upgrades inside the representation of ground motions, structure and soils updated. Now an afternoon more regularly changes seen in latest years. The layout spectrum is 1 of the key changes achieved in seismic codes. The unique code shave been used in distinct web sites therefore to take a look at and look at exceptional reasons by using dynamic evaluation and seismic verification of constructing. The elastic or inelastic spectra described in short by the code by illustrated in fig and table. This parameter like base shears, lateral displacements, intervals and inner Storey drifts for analyzed business homes for defined soil type are relatively provided.

Vijay Namdev and Khose (2010) the ultimate objective of seismic or any design codes is to provide guidelines to designers and minimum design criteria with safety and economy. Latest and past earthquakes have demonstrated that buildings designed by seismic design codes are not always safe against earthquake because results are cleared after earthquake. Therefore, it is necessary that updating the codes time to time. Code updating is done considering current state of the art, its understanding by structural engineers and the construction practices in the country. Indian seismic design code IS 1893 (Part 1): 2002 and 13920: 1994 are traditional and obsolete in many concerns as compared to other country seismic design codes. This paper shows the limitations of the present IS design code and proposes some topics for updating according to the current condition and requirements.

Imashi and Massumi (2011) analyzed the earthquake forces calculated by using the linear static analysis technique in keeping with each (IBC 2003) and inside the Iranian Seismic Code (IS 2800-05). The layout base shear of a constructing with combined system (special moment metal frames + eccentric bracings) in 4 special soil types and vertical distribution of base shear at Storey stage changed into determined in step with both codes. The effects proved that there has been extensive difference between the 2 codes. Shear pressure values were extra in IS 2800-05 in comparison to the IBC 2003 for all form of soil profiles and seismically lively regions. Lateral force distribution within the constructing peak confirmed that distribution sample changed into distinctive most of the codes. In IS 2800-05, pressure distribution inside the peak turned into linear for all systems and all durations however a further force changed into carried out to the top floor of lengthy duration homes. In IBC 2003, there has been no extra force taken into consideration and vertical force distribution for all systems with length extra than 0.5s became parabolic. The IBC2003endorsed the Storey go with the flow issue in step with structural gadget type and importance thing cost. In IS 2800- 05, the Storey waft hindrance was structured handiest on fundamental period of the shape. So, there are want to check the IS 2800-05 and increase greater suitable relations onward searching financial and useful objective.

Landingin J and Rodrigues (2012) a comparison of seismic provisions. The Philippine code, Eurocode and the American code are compared. The common ordinary residential frames of standard occupancy. Reinforced concrete frames regular and irregular were analyzed and compared for four storey building types. The response spectrum and the seismic parameters of NSCP 2010 were considered. But the horizontal load actions with different load combinations are done. Response spectrum analysis and equivalent lateral force analysis were performed using SAP2000 software package. Five representative columns for each RC frame structure were

analyzed. Based on the results of column axial load EC8 was found to be conservative when compared to NSCP 2010 and 2009 IBC. The conclusion is that for the design and analysis of ordinary RC residential buildings with certain irregularity, EC8 provisions were considered to be safer.

S.H.C.Santos and Carmen Bucur et al. (2013) a comparative study European code and American seismic codes standards. This criterion for the analysis of conventional buildings described in paper. The study is generally focused on some critical points It defines all inputs for establishing period of recurrence, seismic zone, shape of design response spectra for given soil condition and seismic force resisting system modification coefficients. A model is made for a standard reinforced concrete building including residential and commercial has been developed to permit the comparison among codes. The building has been modeled with two different software SAP2000 and SOFISTIK. This model subjected to seismic input according to the several seismic codes.

BariandDas(2014)performed a evaluation among (BNBC), (NBC-India 2005) & (ASCE 7-05). This examines offers facts approximately protection required in opposition to earthquake. The numerous parameters were studied in BNBC 2010 and in comparison with that of (BNBC 1993), (NBC-India. 2005) and (ASCE. 7-05) from exploration, it turned into enumerated that BNBC 1993 had the least base shear among all of the codes. The bottom shear as according to (BNBC 2010) turned into observed to have improved considerably than that of BNBC. 1993 for low upward push homes. But BNBC 2010 had much less base shear price in comparison to (ASCE 7 05) for low storied homes and are fairly closer to NBC-India 2005. Therefore, the higher issue of protection in opposition to the earthquake given by BNBC 2010 code due to better values of base shear was considerable. But better reinforcement required in ground floor column of low storied buildings than BNBC 1993.

Pamela Jennifer J P and Jegidha K J (2015) study of seismic design behavior during earthquake. It deals with the yielding and inelastic behavior of structural element which is detailed to exhibit such behavior during earthquake. The structure is designed with moderate strength to behave elastically during earthquake. During earthquake ground motion is produces and to withstand that motion Seismic design of multistoried RC building is done. In order to design an earthquake resistant structure an Engineer must have a well knowledge about various seismic design codes for reduce to extra hazards had happens in earthquake. In this paper literatures of various researches were studied. Those papers give more information about the static and dynamic analysis done on various types of structures. The use of software in seismic analysis will reduce the time consumption and errors in analysis and design of the structure. The researchers used various countries codes to evaluate the seismic performance of the structure. There are parameters as displacement, base shear, storey drift, time period, axial and shear force bending moment were all studied in this paper. An interest arises to do seismic design of multistoried building using various codes to understand which codal provision gives very effective design to perform good during earthquake.

Dhanvijay and Telang et al. (2015) taken into consideration the standards of (Eurocode8), (IBC (American Society of civil Engineers) and (IS 1893:2002) for analyzing the bad performance of constructing at some stage in earthquake. The shape modeled in STAAD pro. V8i software turned into G+10specialRC moment-resting frame and Lateral seismic forces were calculated manually as in line with distinctive codes. A comparative evaluation become achieved in terms of (base shear), (displacement), (axial load), and (moments in Y and Z) path for columns and additionally for (displacement), shear Y, torsion and second Z of beams on every floor. conclusion became drawn that base shear in X direction turned into5.53%less and 38.52% extra in step with IBC and Eurocode8 respectively than Indian code and in Z direction, IBC confirmed 5.8 % much less base shear and Eurocode8 showed

30.45 % extra base shear than Indian code. The displacement, axial force and second in Y and Z direction for columns had been greater in Indian code compared to others code. Additionally, the displacement, second-Z, shear-Y and torsion for beams as according to IS code had been more as compared to other codes.

Karthiga and Titus et al. (2015) analyzed and designed a residential building (Ground+10) for seismic forces using 4 international building requirements- IS1893, Euro code 8, ASCE7-10 and the British Codes. The comparisons of the constructing became done using STAADProV8i. Then designed as per the required codes. The seismic overall performance of the constructing became investigated by way of pushover evaluation in SAP2000. The base shear as in keeping with Indian code was most excellent. As compared to Indian requirements, Euro requirement shad 3.05%, American requirements had 11.10% and British requirement shad

12.25%less base shear. The displacement came about as consistent with Indian standards became less than as in step with others code. This study can inferred that the Euro standards served to be the most most economical layout and the Indian standard shave been the least low-budget because constructing designed in keeping with the Indian standards was greater rigid and for this reason it attracted extra seismic forces.

Khan and Prasad (2016)compared the seismic behavior of multistory RC building using provisions made in Indian code i.e. IS 1893 2002, American i.e. IBC 2006 and Australian code i.e. AS 1170 2007 by considering residential building G+ 5 storey as reference. This study describes the different in the results obtain using three codes, mainly in design base slip, lateral loads, drifts and area of steel for structural members of Reinforcements buildings. The ordinary moment resisting frame was modeled and equivalent static method analysis was performed using STAAD Pro software. It inferred that design base shear as per IBC code was more than IS 1893 and AS 1170. Its value for IBC code was approximately double of IS 1893 and value for AS1170 was 70% of IS1893. The Column moments for IBC code were nearly 150% for below plinth and Ground Floor, 130% for second floor and110% for top floor than that of IS 1893 and for AS 1170 its values were nearly 80 - 85% of IS 1893. The axial loads on column for IBC code and AS1170 was less than IS 1893. The beam moments and beam shear forces for IBC code were approximately 120% of IS 1893 and for AS 1170 were approximately 80% of IS 1893. The lateral displacement and storey drift values was more in IBC code. It also depicted that building design using IBC code would be more conservative than IS 1893 and AS 1170codes because the area of steel required for the RCC members for IBC code would be more than IS1893 and AS 1170 codes.

Indumathi and Saravanan (2016) evaluated the performance of G+9 RC frame building subjected to seismic forces in severe condition. The RC structure was designed as per IS1893: 2002 and then analyzed for seismic lateral loading as per IS 1893:2002, ASCE 7-10, NZS 1170-2004 and EUROCODE 8-2004usingETABS2013.Maximumstoreydisplacement in 3D frame structure in descending order in Bare frame model, stiffen columned in soft first storey and Infill wall at corners of soft first storey respectively for Indian, American, New- Zealand and European Standards loading. Similarly in 2D frame max. Storey displacement and max.storey drift gave the same results. Hence use of infill walls at corners of soft first storey gives good resistant to lateral force. Further, on comparing ETABS results of Indian, American, New- Zealand and European Standards, Base Shear values were in descending order of European> New Zealand > American > Indian standards. Base shear value as per Eurocode8 was about 9 times greater than Indian Standard. Factors like earthquake zone factor, IP factor, Response reduction factor, Fundamental period and total mass of the structure varied from Standard to Standard. So, the base shear values were also different. Therefore, it also affected the deformation of building.

Kamaldeep Kaur and Jaspal Singh (2017) the analysis was carried out between the variant designs codes as reported by different researchers. The earthquake performance of building was analyzed by them and designed using various codes. The seismic forces by the different method such as RS method, pushover analysis, equivalent static analysis etc with various codes gave different results. This comparative study helps to check the code which serves as economical and reliable for seismic design and analysis of structure. A comparing analysis was performed by earlier researchers in terms of (base shear), (displacement), (axial load), and (moments) in Y and Z direction for columns and also for displacement, shearY1, torsion and moment Z of beams on each floor using the different code. The building designed by considering Euro code c was conservative than the buildings designed using other codes. Euro code used for designing was served to be the most economical as compared to others codes.

2. CONCLUSION

Review of literature suggests that number of studies have been done with various types of codes comparisons like OSC, 1997 UBC, 2006IBC, AS1170, IBC 2006, Eurocode8 and Indian code 1893:2002. But the differential analysis &modeling of three different size of RC frame structure with various standards i.e. IS1893-2002, ASCE-7- 2002 &, NZS1170.2004 using Etabs 2103 software have not be done. So it can be analyze and represent in the form of graph and table with the help of ETAB 2013. Few works are also remaining which is analyzed by time history method with combined loading of earthquake, wind and snow.

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