Stabilization of Structures in Seismic Areas Subjected to Different Ground Motions

Ramachander Damera , Ilango Thaniaras

Abstract: ***Structures with seismic damage with various ground motions are playing a vital role in some areas of research due to the increase in metropolitan culture which is getting developed in the world. In our present paper we are enhancing and focusing on the structural damage with some structural damages that are occurring due earth quakes which can develop with ground motion intensity, structural performance and optimal intensity which can be used for best conclusions. The research is needed for civilization which can overcome the conditions of seismic affecting risks in seismic zones of Indian Context. An investigation like the methods of structural stability after an earth quake in developing the earthquake monitoring system vibration control ability of the structures is focused in this paper.***

Index terms : Seismic analysis, analysis of structure.

I.INTRODUCTION:

The Seismic waves are described as the waves of energy which can travel through the layer of earth and also result in tremor, blast, or a fountain of liquid magma that bestows low-recurrence acoustic vitality. The waves with proliferation speed rely upon thickness and medium with versatility. The refraction or impression in geophysics for seismic waves is utilized for examination concerning Earth's inner structure, and man-made vibrations which can consistently create the shallow research and subsurface structures.

Revised Manuscript Received on December 22, 2018.

RAMACHANDER DAMERA
Geethanjali College of Engineering and Technology
Civil Engineering Department, Hyderabad, India.
Email Id: ramachander66@gmail.com, ilango.se@velsuniv.ac.in
ILANGO THANIARAS *Vels University, Civil Engineering DepartmentPallavaram, Chennai, India.Email Id: ramachander66@gmail.com, ilango.se@velsuniv.ac.in*

With some upgrading parameters the seismic plan of structures has been made in light of spring like heading which are concentrated with earth shake powers with the distinction in structures which can avoid resonation. Due to the disconnection effect of shake powers with the sliding forces which can get transmitted with some structure with some pounding. [1]Due to the ground effects that are molded at the development length with can demonstrate an apex housetop with buoy and zenith that can be surveyed. As per the data which can be loaded down with basic term and the gathered with the imperativeness of stimulate grams that are made edge expanding speed limits. [2]An investigation has been done in different methods, for instance, seismic coefficient methodology and response go procedure with non straight static system. Due to these descriptive conditions the inclination ground story which can section the structure that passes on more burden diverged from the long length portion. Growing the plot for settled height the fragment forces and solidness of the structure reduces with augmentation in the point however for settled width structures it was extending. [3, 4] Analysis is led furthermore, has found the assortments for various hurt parts which can cause strong seismic tremor having little effect reliant on the last fold with technique for structure under free vibrations. Due to this we can redesign the mistake of the sections which can be mistreated with different ground developments which are same in all stages. The direct symphonious period with some ground development can be around reenact with dissatisfaction earth shiver. [5]

The parameters of concrete and reinforcement [5]

Material	Strength	E (GPa)	ρ(t·mm-3)	Poisson's ratio γ	σtu(MPa)	σcu(MPa)
Concrete	C30	30	2.4E-9	0.2	2.5	30
Longitudinal rebar	HRB400	200	7.8E-9	0.3	540	540
Stirrup	HPB300	200	7.8E-9	0.3	420	420

An investigation is improved the circumstance finding the vertical ground development of the structures that can be strengthened with most logical conditions. A part of the components updated [6, 7]

• Analytical Investigation

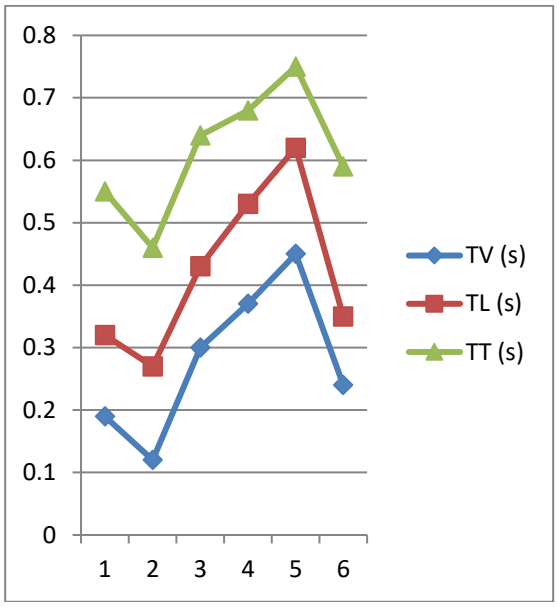
• Evaluate the seismic execution of Reinforced Concrete structures with complement on the effect of vertical ground development.

• Assess the effect of various zenith vertical-to expanding speed (V/H) extents Reinforced Concrete structures.

• Study the effect of time breaks between the vertical and level zenith accelerating on Reinforced Concrete Buildings

• Investigating accelerating and Drift at Cantilever Projections considering distinctive zones of Earthquake

The impacts of vertical ground developments on the seismic response of customary expressway ranges are examined. Results demonstrate that vertical effects brief basic assortments in center point oblige demand in fragments which can result in instabilities in moment demands at the embodiment of the bowed best, upgrade of moment demands at the prop mid-length, and changes to moment and shear farthest point of the segment [8].Super Structure Analysis has been done by taking distinctive burden blends to check the basic elements of disappointment [9].



The superstructure was displayed both as versatile components in the underlying period of the examination and later as inelastic components to look at the impacts of inelasticity on support yielding [10]. The flexible furthest reaches of various burden blends are broke down and the ideal variable occasions are spoken to above.

Characteristics of selected near-fault records

Earthquake	Year	Station	Distance (km)	PGA-H_{MAX} (g)	PGA-H_{MIN} (g)	PGA-Vert (g)
Gazli (USSR) [11]	1976	Karakyr	5.46	0.718	0.618	1.264
Imperial Valley[12]	1979	Bonds Corner	2.68	0.755	0.588	0.425
Morgan Hill[13]	1984	Coyote Lake Dam	0.30	1.298	0.711	0.388
Erzican (Turkey) [14]	1992	Erzincan	4.38	0.515	0.496	0.248
Landers [15]	1992	Lucerne	2.19	0.785	0.721	0.818
Northridge[16]	1994	Rinaldi Rec Stn	6.50	0.838	0.472	0.852
Kobe (Japan) [17]	1995	KJMA	0.96	0.821	0.599	0.343

A bridge structure harmed amid the Northridge Earthquake what's more, a Federal Highway thought interface design are assessed. The effects of a suite of seismic tremor ground development records with different vertical-to-try and peak expanding speed extents on the two expansions are presented and the results are differentiated and the case of level just excitation. [18]

A.Reviews on methods of stabilization of structures in seismic zones

In 2005 Durgesh [19] made guidelines for the seismic structures in Gujarat zone and this book dynamic for fortifying of strong structures. As contacted the congruity readings in ground developments on the hanging square side are progressively significant on account of the free-surface effect, and in light of the way that a greater piece of the accuse surface is nearer to the stations for the accuse that dives under the narrative stations [20]. At any rate the vertical development basically reduced as far as possible in vertical parts [21]. According to the Indian standard for for plan affirmation of new structures. In light of the 9-story symmetric and digressed structures, the effect that the edge of turn of the ground development has on a couple of structure demand parameters (EDPs) has been seen in nonlinear-inelastic space [24].

Pinnacle responses of structure demand parameters (EDPs) were gained for transformation focuses reaching out from 0° through 180° for discovering the FN/FP headings. It is watched that turning ground developments to FN/FP orientation (1) does not commonly incite the most outrageous responses over all focuses, (2) does not by and large envelope the extent of possible responses, and (3) does not give most noteworthy responses to all EDPs rapidly paying little heed to whether it gives a biggest response to a specific EDP [25]. Spring-like restriction bearing concentrated tremor controls by changing the real day and age of the structure to keep up a vital separation from resonation. Sliding-type separation introduction filter through the shake controls by methods for sporadic sliding interfaces and forces were blocked from getting transmitted to the superstructure in light of the contact. The arrangement of the base isolation system included finding the base shear, bearing removing, etc according to site-specific conditions [26].

B.Types of methods

Power strategy is generally called closeness procedure or the system for solid migrations. In this strategy, the likeness and power movement necessities for the particular structure are first portrayed with the ultimate objective to choose the abundance powers. At the point when these forces are settled, the remaining responsive powers on the given structure are found by satisfying the equalization essentials [27]. In the uprooting system, as an issue of first significance stack dislodging relations for the people from the structure are settled and a while later the equalization essentials for the equal are satisfied. The inquiries in the conditions are movements. Darken migrations are formed the extent that the stores or powers by using the load dislodging relations and after that these conditions are fathomed to find the expulsions. The crucial doubt of this framework is to consider the distortions caused just by turning minutes. It is accepted that the effects of shear drive or center point urge distortions are insignificant in dubious columns or edges. [28] The basic inclination evasion condition communicates the moment around the completion of a section as the superposition of the end minutes caused due to the external loads on the part, with the terminations being normal as controlled, and the end minutes brought about by the movements and genuine end turns. Inclination redirection conditions are associated with every person from the structure [29]. Minute course procedure is an iterative system. At first all of the joints are by chance controlled against rotate and settled end minutes for all of the part are made down.

Earthquake safe arrangement (IS: 1893), the seismic power or develop shear rest in light of the zone factor (Z) and the typical response accelerating coefficient (Sa/g) of the soil sorts at thirty meter significance with sensible modification depending on the significance of foundation [22].

A normal estimation of the most extraordinary impact power would support us to control the level of damages in different structures. It is outstanding that solid ground development in the nearby field an area has different traits from far-field ones. In this paper, beating power response spectra for adaptable structures presented to close field and far-field ground developments are showed up. Both of the neighboring structures were exhibited fundamentally as Single Degree Of Freedom (SDF) systems and beating sway has been reproduced by applying the nonlinear visco flexible model [23].

It is assumed that three-dimensional nonlinear response history examinations approach will incite two game plans of responses that spread the extent of possible responses over all non-dull unrest edges. As such, it is seen as a moderate procedure appropriate

Published By:
Blue Eyes Intelligence Engineering &

Each joint is then released one by one in movement and the unbalanced moment is passed on to the completions of the people in the extent of their scattering factors. These dispersed minutes are then reached out to the most removed terminations of the joints. Again the joint is unexpectedly controlled before taking off to the accompanying joint. Same plan of exercises are done at each joint till all of the joints are done and the results achieved are up to needed precision. The procedure does exclude fathoming different synchronous conditions, which may get very tangled while overseeing far reaching structures, and is along these lines supported over the inclination redirection technique [30]. Kani's system offers an iterative arrangement for applying incline redirection method for helper examination. Despite the fact that the moment dissemination system diminishes the amount of straight synchronous conditions and such conditions required are comparable to the amount of translator migrations, the amount of conditions required is zero if there ought to be an event of the Kani's procedure [31].

C.Analysis of structures

In time history examination the essential response is figured at different coming about time minutes. In like manner extend examination the time progression of response can't be figured. Simply the most outrageous response is foreseen. No data is open moreover about when the most outrageous response occurs [32].

II.INDIAN CONTEXT

Zone factors based on Intensity of shaking (IS-1893, 2002)[33]

Zone	Intensity
II	0.10g
III	0.16g
IV	0.24g
V	0.36g

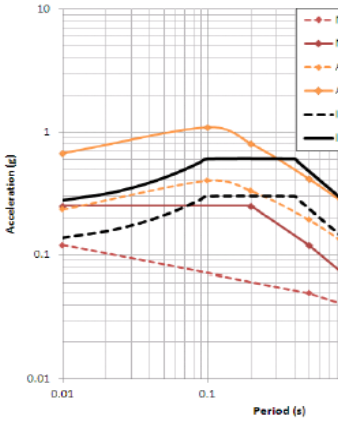
The MCE (Maximum Credible Earthquake) is the most genuine seismic tremor impacts considered by this standard. The DBE (Design Basic Earthquake) is the seismic tremor impacts which can reasonably be required to occur in any occasion once in the midst of the arrangement life of the structure. The arrangement approach grasped in this standard is to ensure that structures contradict the DBE without significant assistant mischief anyway some non-fundamental damage may occur, and focuses those structures withstand a vital tremor (MCE) without fall. The DBE is taken as half of the MCE regards.

As indicated by Indian Standard code, 1893:2002, 60% of India's landmass is helpless to seismic tremors of moderate to high power. What's more, complete Indian land mass is separated into four zones viz., II, III, IV and V, where V being exceptionally extreme. At present, development of RCC structures isn't just restricted to urban communities yet has additionally observed development in towns and towns. In this examination, four comparative five story structures are intended to withstand sidelong powers created in four Indian seismic zones. What's more, the seismic reactions of these structures are tried with different tremor ground movements recorded at various areas of the globe. Time history investigation is done, and examinations of the considerable number of results are talked about to sum things up. All the three-dimensional numerical models are created utilizing ETABS. [34]

III.TECTONIC MAP

Two tectonic maps isolated from the NDMA report (2011) were used as reference in the Arup work. The essential basic guide joins the Neo basic faults inside the India area and the second one doesn't especially consider the Neo auxiliary activity of the issues anyway covers a greater region. The best tremor degrees relied upon the most outrageous significance proposed by NDMA (2011) report by including an extra size of 0.5 to give nourishment to the best pondered shudder.

With everything taken into account as far as possible zones have a most extraordinary moment measure between sizes 8.0 and 9.0, while the intra plate part changes among regions and has most noteworthy sizes of 6.5 to 7.0. The best degree for each source zone has been checked against the watched seismicity to ensure they are not lower than the watched seismicity. The Indo-Norwegian Program of Institutional Cooperation on Earthquake Risk Reduction adventure which is a joint Norwegian and Indian endeavor has starting late driven research on 'Seismic Risk Reduction in the Himalayas'.[35] and have also been diverged from the results in this examination. As can be found in Figure 6, the examination at Dehradun for the 10% and 2% in the accompanying 50 years response spectra agree extraordinary, especially now and again of 1 and 2 seconds.



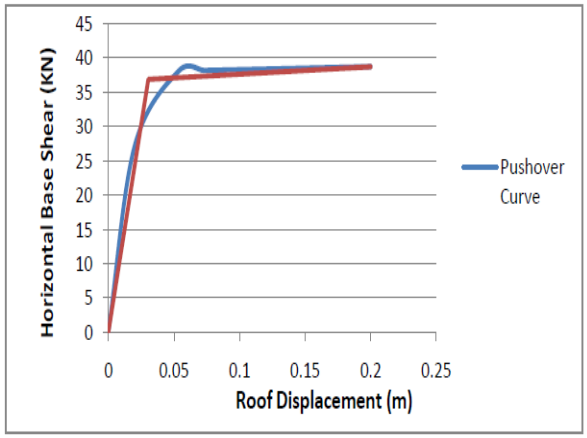
Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication

Graph shows comparative of seismic acceleration by different reviews

IV.VIBRATION CONTROLLING METHODS IN THE STRUCTURE

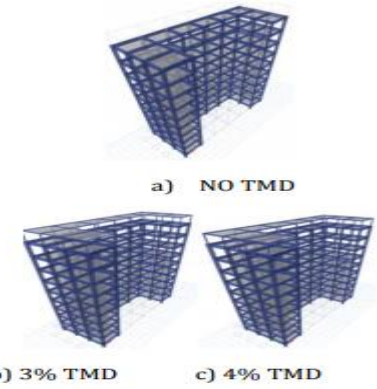
Precise displaying of parameters impacting the seismic execution of a structure is basic for evaluating its seismic execution. Most by far of these parameters are seen to be uncertain, as they incorporate an impressive proportion of factor inside. The response of the deterministic model may change appallingly from the certifiable model, inferable from workmanship, faulty practices at structure site and wrong assumptions in the midst of the examination. Also, seismic tremors are probabilistic in nature [36]. Gooey dampers have been commonly used as a vibration control instrument in flying applications and have been, starting late balanced for fundamental applications. Board extent of frequencies, absence of consideration to temperature, and conservativeness to the extent stroke and yield compel are clear focal points of these devices over TMDs [37].

The non-direct static sucker examination for the edge simply (Case I), gave an authoritative farthest point of the edge, close by the movement and rotate at outrageous disillusionment. The sucker twist was romanticized as bilinear using Caltrans deference show, with the true objective to procure yield and outrageous disillusionment centres [38].



It was seen that regardless of the way that the dampers did not contribute in the reduction of the best center point migration, as a rule mischief of the structure was unbelievably decreased. This develops hurt decline as one of the basic parameters to be considered for evaluation of reasonability of vibration control contraptions.

Fragile story TMDs are introduced at the best floor of all the game plan unusual structures as showed up on figure Properties of structures are remarkable, since it depends upon mass extent, repeat extent and damping extent [39].



Dislodging, quickening, base shear, story glide are more without the proximity of TMD. By setting TMD, best case scenario of the structures, removing, expanding speed, base shear, story skim are decreased. TMDs are all the more convincing in diminishing vibrations.

By dissected all enlivening results 36.38% reduction vibrations alive and well working than others, so in this characterization L-shape building is flawless.

A further point is to delineate and use the non-direct restricted segment (FE) procedure for strong invasion examinations [40]. Explicit thought is given to dynamic stacking, where the strong lead stands out differentiated from static stacking. The compressive and versatile characteristics increase as a result of the strain rate impacts. Beginning immovability increases, and also the strong strain limit is extended in special stacking. Usually, for gauge of the significance of invasion and pit course of action from segments and shots, exploratory associations are used, which are discussed here together with the effects of the effect wave that is brought about by the impact. To take in increasingly about the helper direct of bond presented to extraordinary stacking, an earth shattering mechanical assembly is to join advanced non-straight FE examinations and examinations. A reliable model must have the ability to get amend results from a couple of tests, including both the significance of invasion and the opening assessment. In this hypothesis, FE examinations of strong penetration with steel shots have been performed and stood out from existing test outcomes. In addition, the expanding speed amplitudes of the best stories are generally proportional in the two structures with a comparative proportion of impact and a comparative impact evacuate. It is suggested that the higher the structure [41], the more conspicuous is the effect of impact source separate on the change rate of floor dislodging and story coast. In this manner, acceptable prosperity partition should be settled by the mining conditions and helper stature in the midst of structure plan. An intensive audit on the guideline after effects of the shaking table tests

Published By:
Blue Eyes Intelligence Engineering &

finished on the models with and without special props [42]. Two unmistakable sorts of essentialness spreading and re-focusing bolsters have been considered to update the seismic presentations of the attempted model. They rely upon the hysteretic properties of steel segments and on the excessively adaptable properties of SMAs, independently. The extension of isolates control underpins in the invigorated strong packaging achieved gigantic underneath on the as a rule seismic direct. The seismic power making fundamental fold was widely raised, cover story buoys and shear controls in segments were certainly decreased. Normal frequencies of the helper vibration modes can be unstuck from those of the excitation essentialness of the exacerbation [primarily seismic excitation]. Essentialness dispersal devices can be united into the structure [43]. Development control forces can be made inside the structure to confine outside excitation and internal fundamental one of a kind powers that widen vibration.

Show Damping arranges dynamic essentialness from a structure's focal vibration mode (where a substantial part of the imperativeness lives for tall cantilever type structures) to some higher mode portrayed by higher vibration impedance. [44] To accomplish this objective, an uncommon incitation procedure and semi-dynamic analysis control contrive was created. A fundamental 3-point tendon was picked as the actuator. A nonlinear analysis control estimation was delivered to sagaciously screen and sort out the major tendon control that draws upon dynamic imperativeness of the vibrating structure itself to basically self make the essential control controls that sway the between measured essentialness trade. It will in general be shown that an individual vibration mode can be phenomenally invigorated when inside the adaptable deformation extent of a structure [45]. At the point when all is said in done, nodal expulsions were improved along most by far of the structure after the trade event, up to 40% at higher zones. Nodal speeds bring down in the structure did extended in degrees, on occasion practically 100%, while nodal speeds higher in the structure did as a general rule decrease when diverged from the ordinary system response. Mechanical vibrations in structures can incite a wide collection of negative effects, reaching out from human prosperity and comfort incapacity, to possible mischief, both to delicate apparatus and assistant sections [46]. In various conditions, enveloping vibrations can be used beneficially to remove gainful information about the essential lead, through the ID of mode shapes and frequencies. Particular conspicuous evidence results can as such be used as a bit of the vibration decline frameworks. The indicative establishment required by all of these two conditions is shown.

V. CONCLUSIONS

By undergoing study of researcher's views before most of the fundamental geometrical analysis with different combinations had been analyzed. The most sensible issues find in the area of earth quake zones, most of the structures are constructed at an idea of their past generations. As we know the lateral and internal forces of earth changing in progress new technologies have to adopt. At the other hand researcher's less focusing about the historical structures and its stability in seismic zones. New focuses and retrofit analysis of ancient old structures have to optimize in a theoretical as well as analytical simulations to stabilize for present conditions.

References

1. G. Mylonakis, "Simplified Modelling of Bridge Response on Soft Soil to Non uniform Seismic Excitation," Journal of Bridge Engineering,Vol. 6, No. 6, Nov./Dec. 2001.

2. Kishankumar Umeshbhai Patel1,"Comparison of Response Spectrum for Different Zone in India" International Research Journal of Engineering and Technology (IRJET) ISSN: 2395 -0056 Volume: 03 Issue: 02 | Feb-2016

3. T. Subramani et al. Int. Journal of Engineering Research and Applications "Analysis Of RC Structures Subject To Vibration By Using Ansys" "ISSN: 2248-9622, Vol. 4, Issue 12(Part 5), December 2014, pp.45-54

4.T, Subramani.M, Prasath.K ,"Analysis Of Three Dimensional Horizontal Reinforced Concrete Curved Beam Using Ansys" International Journal of Engineering Research and Applications, Volume. 4, Issue. 6 (Version 6), pp 156 - 161, 2014

5. S T G Raghu Kanth Modeling and synthesis of strong ground motion Department of Civil Engineering, Indian Institute of Technology, Madras Sci. 117, S2, November 2008, pp. 683–705

6. Sashi K. Kunnath and Huiling Zhao effects of near-fault vertical accelerations on highway bridge columns Earthquake Engineering and Structural Dynamics, Vol 22, pp.695-707.

7. Bozorgnia, Y. M. and Campbell, K. W. (2004). The vertical-to-horizontal response spectral ratio and tentative procedures for developing simplified V/H and vertical design spectra, J. Earthquake Engineering, Vol. 8, pp. 175-207.

8. S., Dumanoglu, A.A., and Bayraktar, A., 2005. Stochastic response of seismically isolated highway bridges with friction pendulum systems to spatially varying earthquake ground motions. Engineering Structures, 27(13), 1843–1858.

9.Breen, J. E., and Kreger, M. E. (1997)." Effect of vertical ground motion on bridge deck response."National Center for Earthquake Engineering Research, State Univ. of New York at Buffalo, N.Y., pp.249–263

10. G. Fenves, "Earthquake Analysis and Response of Multi-span Bridges and Viaduct Structures," Proceedings, Seismic Design and Retrofit of Bridges, June 1992.

11.Gazli (USSR) Kadid, D. Yahiaoui Dynamic response and reliability analysis of structures with uncertain parameters. International Journal for Numerical Methods in Engineering 62(2): 289–315

12. Imperial Valley Ballard, T. A., Krimotat Effect of vertical earthquake components on bridge responses." Ph.D. thesis, Univ. of Texas at Austin, Austin, Tex.1979

13. Morgan Hill Seismic shear strength of reinforced concrete columns." J. Struct. Eng., 1208 -2310–2329.1984

14. Gupta, P. R., and Erzican (Turkey) "Evaluation of shear design procedures for reinforced concrete members under axial compression."ACI Struct. J., 1992_4_, 537–547.

15. Landers Boore, D.M. Earthquake Ground-Motion Prediction Equations for Eastern North America. Bulletin of the Seismological Society of America 1992, 96:6, 2181- 2205.

16. Northridge Cornell, C. A., Bazzurro Development of performance-based seismic design method in Japan." Building Structure 1994; 30(1): 6-9.
17. J and Sasaki A Kobe (1995) Damping properties of buildings in Japan. Journal of Wind Engineering 59: 383–392.
18. Bozorgnia, Y., M. Niazi. Standard specifications for highway bridges, division I-A: Seismic design, 15th Ed., Washington, D.C.2004, Vol 22, pp.695-707.
19. Durgesh Birajdar.B.G, "Seismic analysis of buildings resting and developed guidelines for the seismic structures", 13thWorld Conference on Earthquake Engineering, Vancouver, B.C., Canada, Paper No. 1472, 2005.
20. Griffith M. C., Pinto A. V. (2000):"Seismic Retrofit of RC Buildings - A Review and Case Study", University of Adelaide, Adelaide, Australia and European Co
21. Kalkan, E., and Kwong, N.S., 2012, "Evaluation of fault-normal/fault-parallel directions rotated ground motions for response history analysis of an instrumented six-story building"
22. Abu Lego (2010) Fundamentals of Reinforced Concrete Design, New Delhi- 110001: PHI Learning Private Limited,
23. Leibovich, E., Rutenberg, A. and Yankelevsky, D.Z., "On eccentric seismic pounding of symmetric buildings", Earthquake Engg. and Struct. Dyn., Vol. 25, 1996, pp 219–233.
24. Abrahamson, N. & Silva, W. (2007). Abrahamson & Silva New Generation Attenuation (NGA) Ground Motion Relations for the Geometric Mean Horizontal Component of Peak and Spectral Ground Motion Parameters. Pacific Earthquake Engineering Research Center, USA.
25.Goel R. K. (2008): Evaluation of Current Nonlinear Static Procedures for Reinforced Concrete Buildings, The 14th World Conference on Earthquake Engineering October 12- 17, 2008,
26.Halkude et al "Seismic Analysis of Buildings Resting on Sloping Ground With Varying Number of Bays and Hill Slopes" International Journal of Engineering Research and Technology ISSN:2278-0181,Vol.2 Issue 12, December-2013
27.Gunay, Khalid Mosalam,Sashi K. Kunnath , "Effect of Vertical Ground Motion son Shear Demand And Capacity in Bridge Columns",A Technical Report Submitted to the California Department of Transportation under Contract 59A0688
28. Yamada K and Kobori T (2001) Fundamental dynamics and control strategies for aseismic structural control. International Journal of Solids and Structures 38: 6081.
29. Shome, N. and Cornell, C. A., 'Structural seismic demand analysis: Consideration of "collapse"', in Proceedings of the Eighth American Society of Civil Engineers Specialty Conference on Probabilistic Mechanics and Structural Reliability, 2000, Norte Dame, July 24–
30. Cronin, C. J.,and Mayes, R. L.2002 "Effect of vertical motions on seismic response of bridges." J. Struct. Eng., 128 12, 1551–1564.
*31. Deodatis G and Theoharis A P 1994 Seismic ground motion in a layered half-space due to Kani's method Soil Dynamics and Earth quake Engineering **13(4)** 293–301.*
32 Liu,W.K., Belytschko,T. &Mani, A. 1986. Probability finite elements for nonlinear structural dynamics. analysis the structural response Computer Methods in Applied Mechanics and Engineering 56: 61–81.
33. IS 1893 (Part 1), (2002), "Criteria for Earthquake Resistant Design of Structures Part 1 General Provisions and Buildings." (Fifth Revision), Bureau of Indian Standards Code (BIS).
34. Ramachander Damera, P.Supriya (2018), 'Seismic Response of Indian Designed Five Storey Structure with World Earthquake Ground Motions', Journal of Advanced Research in Dynamical & Control Systems, Volume 7, 13-Special Issue, ISSN: 1943-023X.
35. Gutenberg, B. & Richter, C.F.(1954). Seismicity of the Earth and Associated Phenomena (NDMA) Princeton University Press, New Jersey, 310p
36.Tharwat A. Sakr (2015) Vibration control of buildings by using partial floor loads as multiple tuned mass dampers, Housing and Building National Research Center
37.Shamja P P, Krishna Chandra V.N Vibration Control of High -Rise Reinforced Concrete Building Due To Seismic Excitations by Using Tuned Mass Damper International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056 Volume: 05 Issue: 04 | Apr-2018
38. Reyes and E. Kalkan, 2012, "Relevance of Fault-Normal/Parallel and Maximum Direction Rotated Ground Motions on Nonlinear Behavior of Multi-Story Buildings"
39. K.C. S. Kwok and Yukio Tamura (2012) "Performance And Cost Evaluation Of Smart Tuned Mass Damper Suppressing Wind Induced Lateral Torsional Motion For Tall Structures", Journal Of Structural Engineering.
40. Bandivadekar T.P and Jangid R.S (2012) "Mass Distribution Of Multiple Tuned Mass Dampers For Vibration Control Of Structures", International Journal Of Civil And Structural Engineering.
41. Chopra A.K., Fem analysis of structures – Theory and application to earthquake engineering (2nd edition.), Pearson Education, Inc, 2001.
42. Alavi, B., and Krawinkler, H. (2004)."Behavior of moment-resisting frame structures subjected to near-fault ground motions," Eq. Eng. and Str. Dyn., Vol. 33, No. 6, pp. 687-706.
43.Halkude et al "Seismic Analysis of Buildings Resting on Sloping Ground With Varying Number of Bays and Hill Slopes" International Journal of Engineering Research and Technology ISSN:2278-0181,Vol.2 Issue 12, December-2013
44. Cotton F and Campillo M 1995 Frequency domain inversion of strong motions: Application to the 1992 Landers earthquake; J. Geophys. Res. 100(B3) 3961–3975.
45. Yahyaabadi A and Tehranizadeh M (2011)"New scalar intensity measure for near-fault ground motions based on the optimal combination of spectral responses", Scientia Iranica, 18(6):1149-1158
*46. Beushausen, H., & Alexander, M. (2007). Localized strain and stress in bonded concrete overlays subjected to differential shrinkage. Materials and structures. **40**:189-199.*

Published By:
Blue Eyes Intelligence Engineering &