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Review on Seismic Analysis of Bridge

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Abstract:
Countless bridges built the world over were structured during the period when extension codes had no seismic plan arrangements, or when these arrangements were inadequate as indicated by the present principles. Additionally, because of maturing and the development of vehicular loads in greatness and volume, many existing extensions in India are encountering deterioration.Bridge models were examined by the parametric variety of the info components like the quantity of paths, carriage way width, number of longitudinal supports, number of cross braces, range length utilizing SAP2000. All the models were dissected under vehicular and seismic stacking. For vehicular investigation load combinations were utilized according to IRC: 6-2014 and seismic examination was finished with reaction range investigation and direct time history examination utilizing IS: 1893 section 3 (draft adaptation). Past experience and late research shows that soil structure interaction assumes a significant job on seismic reaction of bridge structures. Abutments draw in a huge bit of seismic forces, especially in the longitudinal direction. Accordingly, interest of backfill soil at the abutments must be thought of. An iterative plan method of progressive linear dynamic response investigations that considers the non linear conduct of the abutments brought about by backfill soil yielding is developed. The force and deformation capacity of reinforced concrete bridge columns (RCC) can be altogether influenced by the consolidated impact of dynamic loads (axial, shear, twisting and torsion); these load combinations can bring about startling enormous disfigurements and broad harm that can genuinely influence the seismic presentation of bridges. To contemplate the effect of various loadings combinations on circular and non-circular areas (twofold interlocking spirals), eight scaled cantilever-type RCC examples will be tried on the bidirectional shake table office at the University of Nevada, Reno (UNR).Also, a non-linear static investigation of the bridge-soil framework is conducted. For structures exposed to solid vibrations, the characteristic damping in the structure isn't adequate to alleviate the structural response. By and large, supplemental damping might be utilized to control the reaction of these structures. Pushover Analysis under the heading of non linear static investigation and believes the structure to be monotonically extending dependent on the lateral loads and the inertial forces that will be produced during a seismic tremor. This technique includes deciding the most defenseless part to danger, because of the use of steady loads the segments of the structure yields. In this manner the structure will be under incredible threat at each purpose of the load cycle. In this manner a non linear force displacement plot will be determined.This technique can obviously help in understanding the essential idea of the seismic loads and the relating reaction of the structure. It incorporates deciding shear-displacement plots, called capacity curve, and gives data of the quality and flexibility of the structure.
Keywords;

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I. INTRODUCTION

A seismic tremor can make harm, and in cases breakdown of structures, common structures, railroads, and bridges. On account of a seriously harmed or crumbled bridge the outcomes can be significant as far as budgetary misfortunes because of cost of repair or substitution of the bridge, notwithstanding the financial misfortunes through the estimation of lost time to general society by a more drawn out work drive. Bridges are commonly intended forever misfortune anticipation under huge seismic interest, which requires a plan that prevents structural breakdown under enormous cyclic demand. The reaction of bridges to tremor ground motion anyway is hard to anticipate and regularly requires thorough examinations. Consequently it might be profitable to distinguish basic vulnerabilities also, behaviour patterns with the end goal that seismic based bridge configuration can be better engaged Structural codes commonly group spans into seismic zones dependent on their area, the seismic zones of the territory, and the known introduction to active faults.

The 2001 M7.6 Bhuj Earthquake that stirred up the Indian Province of Gujarat was the most dangerous in India's written history. The latest 25 April 2015 M7.8 Nepal seismic tremor made harm the few ineffectively assembled and feeble brick work structures for the revealed shaking force of VII on MMI scale yet there was no harm in the bridges developed close to the fault region. Because of tremor risks happens as of late much thought

has been taken to assess the seismic vulnerability of the common structures. Writing and research works are accessible to get to the seismic defenselessness of the structures by methods for nonlinear analysis for example pushover analysis. Be that as it may, less thought towards existing bridges has been given. In our nation, the road bridges are planned by detail and proposal laid by Indian Road Congress (IRC) [1]. An extensive number of bridges are planned and developed overlooking the seismic force. Also, the productivity of examination of bridges receiving the linearly elastic methodology depends exclusively in elastic limit behaviour. In the event that the structural response surpasses elastic limit, the methodology is insufficient to finish exhaustive evaluation of the structures all together. This prompts extra approximating of structures consequently drawing extra seismic forces.

II. LITERATURE REVIEW

[2].Michael J KARANTZIKIS1 et al.have examined the impacts of soil-abutment interaction on seismic examination and structure of integral bridges. Past experience and late research shows that soil-abutment interaction assumes a significant job on seismic reaction of bridge structures. Abutments draw in an enormous bit of seismic forces, especially in the longitudinal heading. In this manner, cooperation of backfill soil at abutments must be thought of. A structure driven philosophy to display the abutment stiffness for either linear or nonlinear investigation, considering the backfill and pier foundation, is introduced. An iterative structure strategy of progressive linear dynamic response examinations that considers the non linear conduct of the abutments brought about by backfill soil yielding is created. Likewise, a non-linear static investigation of bridge soil framework is led. A three-spanbridge with monolithic abutments is chosen to exhibit the proposed systems. Parametric examinations show that, if bridge is dissected with the proposed technique rather than a straightforward strategy that disregards backfill stiffnessreduction, the moments and determined force at the pier are more noteworthy by 25%-60% and the displacements by 25%-75%, contingent upon soil properties.

[3]Abdullah Khan1, et al. Have explored the both RCC and Steel Bridges passing streams or brooks, basic practice in numerous nations is to give concrete wells to supportbridge girders. For some bridges that are deliberately significant as far as resistance or exchange, it is basic that they stay functional much after a solid earthquake hits the structure. The current situation with the craftsmanship for design of well foundation is as yet defaced with various vulnerabilities where an oversimplified pseudo static investigation of its reaction just wins, however load from superstructure, character of soil and its solidness assumes a significant job in characterizing its dynamic attributes. The current paper is in this manner an endeavor to introduce a dynamic analysis model attempting to oblige various such insufficiencies as referred to above and furthermore give a viable model (amiable to plan office application) that can be utilized to gauge the pier, well and soil's dynamic interaction.

The current examination titled "Impact of non-linear soil types on seismic reaction of bridge pier supported on well foundation" was planned with primary goals as

To consider base shear/moment and top displacement requests of changed bridge piers tallness with all out weight of embedded portion of well for various soil types and seismic zones.

To consider the impacts of soil-structure interaction on the plan base shear/moment for bridge pier.

[4].Priestley et al. contemplated the dynamic reaction of bridge piers displayed as single-stem and twofold stem exposed to common and manufactured records of earthquake ground motions thinking about foundation flexibility. Theextended leg of the pier under the ground was displayed replacing the soil by an equal spring system. The plastic hingebehaviour of the pier was displayed by a bilinear momentcurvature loop. The ductility requests were determined thinking about variousfoundationflexibility and contrasted withrigid foundation. The examination presumed that curvature ductility factor request is expanded while displacement ductility request is diminished because of foundation flexibility. The aftereffects of single stem bridge pier demonstrated that extra damping because of soil yielding had no huge impact on lessening dynamic reaction.

[5].Spyrakos)endeavored to assess the impact of soilstructure interaction on the seismic reaction of bridges and its noteworthiness for plan of bridge pier set on homogeneous shallow soil strata or on deep soil strata overrigid bedrock against horizontal tremor excitations. The bridge was demonstrated as three-degree of-freedom system with mass aggregated at deck level. The deck was viewed as inflexible and the equal stiffness as springs and comparable damping as dampers were utilized to display impedances of foundation soil (horizontal and rotational spring with related dampers) to represent soilstructure-interaction impacts. The examination was done for the longitudinal reaction of the bridgein horizontal way. The consequences of investigation demonstrated decrease in base shear esteems because of soil-structure-interaction impacts. The decrease in structural stresses prompted the end that SSI impacts ought to be represented in the seismic structure for decrease in configuration costs.

[6].Spyrakos)has examined the impacts of soil-structureinteraction on reaction of bridge pier with round foundation set on homogeneous shallow or deep soil stratum overlying rigid bedrock exposed to even seismic excitations. The soil upheld bridge pier with round foundation was demonstrated as spring and damper components in the rotational andhorizontal ways. The hysteretic, material and radiation damping proportions

were additionally thought of. The examination uncovered that the thought of soil-structure-interaction caused huge decrease of base shear and resulting decline in structural stresses affecting economy in auxiliary expense

[7].Carlo et al.has examined the impact of soil-structureinteraction consequences for the seismic reaction of bridge pier with circular shallow foundation. The pier was displayed as linear beam components, circulated masses and mass corresponding viscous damping. The material nonlinearity was considered in an inflexible plastic hinge with solidifying at the base of pier. The soil was admired as a linear space half space, displayed as lumped parameter. The examination indicated that the soil structure interaction impact builds the time of vibrating structures, increased the displacements at the pier top and diminishes the base shear values. The diminishing in base shear demonstrates traditionalist plan while increased displacement at the pier top underscores careful design of bearings and connections.

[8].Sextos et al. have built up a general useful PC model which utilizes complete technique for the seismic investigation of reinforced concrete bridge considering soil-structure-interaction. The model is equipped for changing time histories, spring-dashpot coefficients at each support bookkeeping spatial fluctuation, nonlinear and local site conditions conduct of soil and structural segment. This model can be utilized in any standard Finite Element programming with no exceptional dynamic SSI or inelastic highlights of soil, foundation and superstructure. All phases of the created model have been approved with accessible models/technique and test outcomes setting up trust in its application just as results. The dynamic reaction of 20 distinct bridges were inspected by the creators for different cases and for complexities associated with the investigation and were introduced in a companion paper.

[9].Jeremic et al.has introduced the impact of soilstructure interaction on the seismic reaction of expressway bridges. The investigation additionally incorporated the inelastic behaviour of soil just as the structure parts. The investigation has demonstrated that displacement demand increased because of extra soil-foundation flexibility while the impact on superstructure could be useful or inconvenient would rely upon the trait of movement. Nonetheless, in the greater part of the cases it was discovered that soil foundation structure interaction hadbeneficialeffect on seismic reaction of structure. It was demonstrated that it is practically difficult to come to general end results about the conduct of soilfoundation structure interaction during seismic movements. A way to deal with reproduce soil-foundation structure interaction utilizing space decrease strategy was introduced as an option to non-linear investigation joining soilfoundation-structure interaction.

[10].Tsigginos et al.has built up a systematic strategy for seismic investigation for bridge piers implanted in homogenous soil and supported on rigid caisson foundation. Rotational and Translational dispersed springs and dashpots to mimic soil-caisson interaction have been presented. Closed form solution for vertical s-wave excitations were given in the recurrence area. Aftereffects of proposed strategies were contrasted and limited component investigation just as other accessible techniques and saw as in great understanding indicating its reliability quality.

[11].Chowdhury et al.has introduced a scientific model for the seismic examination of a bridge pier upheld on well foundation considering soil-well-pier interaction. The model has been represented with a case of bridge supported on well foundation. The outcomes show that soil well interaction intensifies the reaction of fixed base pier and this impact increment with diminishing soil stiffness. The crucial mode related enhancements are generally basic.

[12]Xiaogang Liu, et al. Examined Time history analysis and Pushover analysis are led to investigate the bi-directional seismic behaviour of composite steel-concrete rigid frame bridge, which is made out of steel-concrete composite girders and RC piers. Both transverse and longitudinal bearings excitations are explored utilizing OpenSees. Right off the bat, the appropriateness of pushover analysis dependent on the basic mode is examined. Besides, an improved pushover analysis strategy considering the commitment of higher modes is proposed, and the pertinence on composite rigid frame bridges under bi-directional quake is checked. In light of this strategy, a way to deal with anticipate the displacements reactions of composite rigid frame bridge under arbitrary bi-directional seismic excitations by reexamining the elasto-plastic demand curve is likewise proposed. It is seen that the created strategy yield a decent gauge on the reactions of composite rigid frame bridges under bi-directional seismic excitations.

[13]Hong-Nan Li1 et al have examined the fundamental idea of the FAM is applied for nonlinear dynamic and static examination of RC bridges and the comparing overseeing conditions are inferred. In the FAM, the nonlinear structural responses are produced from local plastic components, which are doled out to structure individuals. In this paper, run of the typical local plastic components are presented for nonlinear dynamic and static examination. Coupling above nearby plastic components with the FAM, the nonlinear dynamic examination of RC bridges exposed to bidirectional quakes is additionally productive and stable. A numerical case of nonlinear dynamic investigation for a RC bridge is completed to represent the utilization of this examination.

[14]Juan G. et al. Have considered that after critical tremors have demonstrated that deformationand force limit of reinforced concrete bridge columns (RCC) can be essentially influenced by the consolidated

impact of dynamic load (shear, axial, torsion and bending); these load combinations can bring about surprising huge distortions and broad harm that can genuinely influence the seismic performance of bridge. To contemplate the effect of various loading combinations on both non-circular and circular areas (twofold interlocking spirals), eight scaled cantilever-type RCC examples will be tried on the bidirectional shake table office at the University of Nevada, Reno (UNR). As a feature of the investigation, an interesting inertial stacking framework named the Bidirectional Mass Rig was created to permit shake table testing of single RCC under biaxial ground motions. Two arrangements of circular and interlocking RCC will be exposed to various degrees of biaxial, torsion and vertical loads through constant seismic tremor movements. The presentation of the examples will be evaluated as far as strength, deformation, and disappointment mode.

[15]Jeena Dangol1et al.have considered a reinforced concrete two hinged arch bridge situated in Chobhar, Nepal has been chosen for the exploration reason. This paper presents the assurance of seismic execution of a reinforced concrete arch bridge under various ground motions. The seismic info was taken as five different quake ground motions accounts having distinctive V/H peak ground accelerationratio for time history analysis. Displacement capacity of bridge was resolved from pushover analysis. Time history analysis was directed in two unique advances: First just horizontal acceleration up was applied and next vertical acceleration was applied addition tohorizontal ground motion. Examinations were made between the reactions of the bridge for these two cases. It was discovered that consideration of vertical part of ground motion has immaterial impact in variety of longitudinal relocation. Be that as it may, there was noteworthy impact in axial force variation. Critical impact in axial force variation in arch rib was seen as V/H proportion expanded despite the fact that the impact in longitudinal relocation with increment in V/H proportion was unimportant. Moment demand also increased because of high axial force variation in light of vertical ground motion.

[16]Amit Saxena1, et al.contemplated a two lane simply supported RCC Box Girder andRCC T-Beam Girder Bridge was examine for IRC moving load and dead load. The live loadlinear analysis is done on Staad Pro and for dead load computation has been done physically. The objective of study is to decide most great alternative from over two. The choices dependent on evident component of designing that are wellbeing, functionality and economy. Following these angle a plan for both T-Beam and Box Girder has been performed. After figuring two fundamentals material utilization steel and cement the most affordable has been chosen. This investigation is based on moment of resistance of section, shear limit of area and financially effective arrangement from both Box Girder and T-Beam Bridge. The investigation gives the arrangement dependent on the predominant paces of development cost to be embraced by configuration Engineer

[17]Er. Suhaib Alam Bhat Have examined non linear static analysis and believes the structure to be monotonically extending dependent on the inertial forces and the lateral loads that will be created during a quake. This technique includes deciding the most vulnerable part to threat, because of the utilization of steady loads the segments of the structure yields. In this way the structure will be under incredible threat at each purpose of the load cycle. In this manner a non linear force displacement plot will be determined.This strategy can help in understanding the fundamental idea of the relating reaction and the seismic loads of the structure. It incorporates deciding shear-displacement plots, called capacity curve, and gives data of the ductility and quality of the structure. There is no much exertion accessible in writing for seismic assessment of existing bridges despite the fact that bridge is a significant structure in any nation. There are by and by no complete rules to help the rehearsing basic designer to assess existing bridges and propose retrofit and design plans. So as to address this issue, the points of the current venture were to do a seismic assessment contextual investigation for a current RC bridge utilizing nonlinear static (pushover) analysis. Bridges expands horizontally with its two ends restained and that makes the dynamic attributes of bridge not quite the same as building. Modular examination of a 3D bridge model uncovers that it has some intently separated modes. Partaking mass proportion for the higher modes is exceptionally high. Along these lines, pushover analysis with single loadpattern may not yield right outcomes for a bridge model. A 12-span existing RC bridge was chosen for the contextual investigation. Standard pushover analysis utilizing FEMA 356 (2000) displacement coefficient technique and an improved upper bound pushover analysis strategy were utilized to analyze the structure. A portion of the examination parameters were reasonably altered to use in a bridge structure. The assessment results introduced here shows that the chosenbridge doesn't have the ability to meet any of the ideal execution level.

[18]Sruthy Krishnan1,et al. Have contemplated Ground shaking and crack are the significant impacts produced by seismic tremors. It has social as well as financial results, for example, causing death and injury of living things particularly people and harms the fabricated and indigenous habitat. So as to play it safe for the harm of structures and the death toll because of the ground motion, it is critical to comprehend the attributes of the ground movement. The most significant powerful qualities of tremor are frequency content, peak ground acceleration (PGA), and duration. These qualities assume dominating job in contemplating the behaviour of structures under seismic loads. The quality of ground motion is estimated dependent on the PGA, recurrence substance and to what extent the shaking proceeds. Ground movement has distinctive frequency content, for example high,intermediateand, low. Present work manages investigation of frequency content of ground motion

on reinforced concrete bridge. Linear time history analysis is acted in structural analysis and design (ANSYSIS) programming. The proposed strategy is to contemplate the reaction of little, medium, and long span reinforced concrete bridge under low, halfway, and high-frequency content ground motions having equal duration and peak ground acceleration. The reaction of the bridges because of the ground motions as far as velocity, displacement, base shear and acceleration can likewise be discovering. The outcomes got from the three sorts of bridges are analyzed and discover the most reasonable span for bridgesbuilt in seismic prone region.

[19]Vivek Gajera1, et al.has studied the seismic behaviour of bridge piers. With the advancements in technology and subsequent researches in Infrastructure fields, IRC guidelines are updated and revised time-to-time. Introduction of IRC SP: 114-2018 guideline for earthquake forces in bridges is an example of such developments.Seismic analysis of Reinforced Cement Concrete (RCC) bridge pier is carried out as per provisions of prevailing guideline IRC: 6-2017. Base shear value of IRC: 6-2017 is compared with IRC SP: 114-2018 which now supersedes seismic provisions of IRC: 6-2017. For analysis, different span lengths of 25 m, 30 m and 36 m are used. To assess the impact of height of piers in earthquake analysis, various pier heights such as 10m, 20m and 30m are assumed. The analysis is carried out as per Elastic Seismic Acceleration Method with consideration of different zones and importance of the bridge as per IRC guidelines. Effect of vertical ground motion is also considered in analysis. From analysis, it is observed that base shear and vertical forces have been increased remarkably as per IRC SP: 114-2018 compared to IRC: 6-2017.

[20]Dnyanraj M. Patil et al. Have considered Performance-based earthquake engineering (PBEE) strategy has been generally evolved during the previous two decades, and has become a key methodology for design and seismic analysis. However such a methodology has not been actualized in Indian structural codes. Hence, further research is required to build up a domestic approach for Indian applications. In this paper, the seismic capacity of a typical Igirder concrete highway bridge planned according to Indian Standards is assessed through a probabilistic strategy just as nonlinear static examination (pushover analysis) for substructure type of multi-column bents and single-column bentsindependently. Fragilitycurves are created and utilized for assessment purposes. These fragility curves speak to the likelihood of structural harm because of different ground shakings. Also, more so they portray a connection between level of harm and ground motion. This paper presents the strategy just as the outcomes as vulnerability and structural reliability relations dependent on two harm capacities.

[21]Kubilay KAPTAN1 Have studied that it is essential to determine the non-linear behaviour connected to structural damage. For the precise assessment of these types of non-linear behaviours, it is essential to evaluation of how these structures will function when exposed to specific earthquake movement. To determine the behaviour, non-linear static or nonlinear time history analysis approach can be utilized, but the locally destroyed impact has to be also regarded. With the prominent impact of basic mode of non-linear static approach, non-linear time history evaluation approach is broadly utilized for the evaluation of complex non-linear behaviour with many degrees of freedom and with local damages. In this study, the non-linear time history evaluation method with some restricted higher modes accounting the impact of local damages is suggested. Specifically, some RC piers are presumed to be surpassed the yield capability throughout earthquakes and trigger large inelastic deformations and damage. To identify the seismic response extremely impacted by the hysteretic behaviour of destroyed RC piers, the modified Takeda model is presented. As a confirmation of effectiveness of suggested approach, the non-linear responses of damaged bridge structure are investigated among suggested approaches and above described traditional non-linear analysis approach.

[22]Hafsa Farooq[1], et al. Have studied Damage to bridges has become quite common, which has led to new interest among engineers and researchers. Before the introduction of seismic codes, bridges were designed without any provision for ductility, thus being vulnerable to any seismic activity. In India, many bridges exist and since being constructed long time ago, they need to be made resistant to any disaster which can lead to their failure. Retrofitting is the process of making any structure seismically resistant. Instead of replacing any structure, a better solution is to retrofit. In this research, a RC bridge has been retrofitted using restrainers. A three span bridge has been selected which is supported on three circular piers. Restrainers have been used to connect pier cap to the deck slab. The linear and non-linear analysis has been carried out using SAP2000. The effect of restrainers has been later checked using the certain analysis. The evaluation results show that a certain difference occurs on using the restrainers when analysed especially in case of non linear analysis.

[23]Jun Zhao a), et al. This investigation considers vulnerabilities in material qualities and the demonstrating which have important affect onstructuralresistance force dependent on reliability hypothesis. In the wake of investigating the destruction mechanism of a RC bridge, structural functions and the reliability were given, at that point the security level of the piers of a reinforced concrete continuousgirder bridge with structural parameters against seismic tremor was analyzed. Utilizing response surface method to ascertain the failure probabilities of bridge piers under significant level tremor, their seismic reliability for various harm states inside the structure reference period were determined applying two-stage design, which portrays seismic wellbeing level of the builtbridge somewhat.

III. CONCLUSION

➢ Two procedures to consider non-linear soil-abutment interaction under seismic loads have been developed. The first through iterative linear dynamic response analyses, and the second through non-linear static analysis. The procedures are relatively simple and easy to apply forbridge design. However one of the greatest uncertainties in applying these procedures is the determination of an appropriate value of the soil shear modulus, G0. Determination of soil shear modulus with in-situ measurements at several bridge sites would be a valuable contribution in this area.

➢ The seismic investigation assists with learning about the behaviour of working under tremors. This works incorporates the seismic reaction of RC bridge with two sort of bearing withviscous damper give all through the bridge. The discoveries are recorded underneath:

- There is a noteworthy decrease in the displacement response of an bridge exposed to ground acceleration with the utilization of viscous dampers.
- A normal decrease of up to 47% can be accomplished by consolidating a general arrangement of damping.

➢ Time history and Pushover analysisare led for composite rigid frame bridge utilizing OpenSees. A bi-directional pushover analysis expectation approach for target displacement response is likewise proposed.

- The impact of high vibration modals ought to be considered for composite rigid frame bridge with large spans and high piers. The new pushover analysis technique by the combination of target displacements of significant modals as per identical mass coefficient can predict the displacement response of rigid frame bridge in longitudinal and transverse way.
- The elasto-plastic interest fix ought to be reexamined to represent the impact of bi-directional seismic excitations.This bi-directional pushover analysis strategy considering the arbitrary contribution of seismic excitations gives the adequate forecast of target displacement response.

➢ Some efficient modal methods to analyze the nonlinear hysteretic behavior of locally damaged RC structures are proposed and compared with the time integration schemes which are usually used in the analysis of nonlinear structural dynamic systems having inelastic behavior. The hysteretic model is reproduced using the modified Takeda model, in which important nonlinear characteristics of the damaged RC members, such as stiffness degradation, pinching effect and strength deterioration are included with a limited number of parameters.

IV. SUGGESTIONS FOR FUTURE RESEARCH

❖ This work was done considering properties of soil as non-linear. In any case, as a general rule soils just as surface the two doesn't behave linearly. The work can be done considering non linearity of soil.

❖ While investigation only case were considered thinking about all out mass of embedded segment of well. Investigation can likewise be performed thinking about half mass of embedded portion of well and furthermore by disregarding absolute mass of embedded portion of well. The mass of embedded portion of well can likewise be changed regarding tallness and for this code arrangements could be utilized.

REFERENCES

[1]. IRC 6-2010. "Standard Specifications and Code of Practice for Road Bridges". Section II. Loads and stresses. The Indian Roads Congress. New Delhi, India,

[2]. Michael J Karantzikis1 And Constantine C Spyrakos2; Seismic Analysis Of Bridges Including Soil-Abutment Interaction;2000

[3]. Abdullah Khan1, Rohit Rai2; Effect Of Non-Linear Soil Types On Seismic Response Of Bridge Pier Supported On Well Foundation; International Research Journal of Engineering and Technology (IRJET) Volume: 05 Issue: 06 | June -2018

[4]. M. J. . Pristley, R. Park, and N. K. Heng, "Influence of Foundation Compliance on the Seismic Response of Bridge Piers," Bull. New Zeal. Soc. Earthq. Eng., vol. 12, no. 1, pp. 22– 34, 1979.

[5]. C. C. Spyrakos, "Assessment of SSI on the longitudinal seismic response of short span bridges," Eng. Struct., vol. 12, pp. 60–66, 1990.

[6]. C. C. Spyrakos, "Seismic behavior of bridge piers including soil-structure interaction," Comput. Struct., vol. 43, no. 2, pp. 373–384, 1992.

[7]. G. DE Carlo, M. Dolce, and D. Liberatore, "Influence of soil-structure interaction on the seismic response of bridge piers," in Twelfth World Conference of Earthquake Engineering, 2000, pp. 1–8.

[8]. A. G. Sextos, K. D. Pitilakis, and A. J. Kappos, "Inelastic dynamic analysis of RC bridges accounting for spatial variability of ground motion , site e ects and soil – structure interaction phenomena . Part 1 : Methodology and analytical tools," Earthq. Eng. Struct. Dyn., vol. 32, pp. 607– 627, 2003.

[9]. B. Jeremic, S. Kunnath, and L. Larson, "Soil– Foundation–Structure interaction effects in seismic behavior of bridges," Proc. of the13thWorld Conf. on Earthq. Eng., Vancouver, B.C., Canada, Pap. no. 294, pp. 1 - 11, 1 - 6 Aug., 2004.

[10]. C. Tsigginos, N. Gerolymos, D. Assimaki, and G. Gazetas, "Seismic response of bridge pier on rigid caisson foundation in soil stratum," Earthq. Eng. Eng. Vib., vol. 7, pp. 33–44, 2008.

[11]. I. Chowdhury, J. P. Singh, and R. Tilak, "Seismic response of well foundation with dynamic soil structure interaction," Proc. of theFifthteenth world conf. on Earthquake Eng., Lisboa,24 - 28 Sept., 2012.

[12]. Xiaogang Liu, Jiansheng Fan*, Jianguo Nie, Guo Li Behavior Of Composite Rigid Frame Bridge Under Bi-Directional Seismic Excitations; Journal of Traffic and Transportation engineering(English Edition) 2014,1(1) :62-71

[13]. Hong-Nan Li1, Yu Zhang2, Gang Li3 and Suyan Wang4 Nonlinear Analysis of Reinforced Concrete Bridges under Earthquakes; 6th International Conference on Advances in Experimental Structural Engineering 11th International Workshop on Advanced Smart Materials and Smart Structures Technology August 1-2, 2015, University of Illinois, Urbana-Champaign, United States
[14]. Juan G. Arias-Acosta1 and David H. Sanders2 Performance Of Bridge Reinforced Concrete Columns Under Combined Actions Throughout Shake Table Testing; July 25-29, 2010, Toronto, Ontario, Canada • Paper No 208
[15]. Jeena Dangol1, Rajan Suwal2 Seismic Performance Evaluation of a Reinforced Concrete Arch Bridge Journal of the Institute of Engineering, 2016, 12(1): 120-126 © TUTA/IOE/PCU Printed in Nepal
[16]. Amit Saxena1, Dr. Savita Maru2 Comparative Study of the Analysis and Design of T-Beam Girder and Box Girder Superstructure; IJREAT International Journal of Research in Engineering & Advanced Technology, Volume 1, Issue 2, April-May, 2013 ISSN: 2320 - 8791
[17]. Er. Suhaib Alam Bhat Evaluation And Application Of Rcc Bridge By Using Pushover Analysis; International Journal For Technological Research In Engineering Volume 5, Issue 12, August-2018
[18]. Sruthy Krishnan1,Aswathy S. Kumar2 Seismic Behaviour of Reinforced Concrete Bridge under Significance of Fluctuating Frequency; International Journal of Science and Research (IJSR) Volume 5 Issue 7, July 2016
[19]. Vivek Gajera1, V. R. Panchal2, Vishal Vadgama3 Comparative Study of Seismic Analysis of Pier Supported on Pile as per IRC:6-2017 and IRC SP:114-2018; J. Today's Ideas - Tomorrow's Technol., Vol. 7, No. 1, June, 2019, pp. 37-45
[20]. Dnyanraj M. Patil and Rakesh K. Khare Seismic Evaluation Of Typical Indian I-Girder Concrete Bridges; International Journal of Civil Engineering and Technology (IJCIET) Volume 8, Issue 5, May 2017,
[21]. Kubilay KAPTAN1 Non-Linear Analysis Of Bridge Structures; Trakya University Journal of Engineering Sciences, 18(1): 17-30, 2017
[22]. Hafsa Farooq[1], Abdul Arafat Khan[2] Effect Of Restrainers On Rc Bridge Using Linear And Non Linear Analysis; IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) Volume 13, Issue 6 Ver. VII (Nov. - Dec. 2016),
[23]. Jun Zhao a), Junqi Lin, Jinlong Liu and Jia Li Study on Safety Level of RC Beam Bridges under Earthquake; AIP Conference Proceedings 1864, 020062 (2017);

Javid Ahmad Bhat. "Review on Seismic Analysis of Bridge." *International Journal of Engineering Research And Development*, vol. 16(9), 2020, pp 37-43.