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Retrofitting of Existing, Extant Bridges, Highway Road Bridges in C.G. India

Vikash Kumar Dwivedi[1], R. C. Singh[2]

[1]M. Tech, Civil Engineering, Specialization Structural Engineering, RSR RCET Bhilai, Durg C.G., India

[2]Assistant Professor, Civil Engineering Department, RSR, RCET, Bhilai, Durg C.G., India

Abstract: ***The extensive, broad or pervasive damage, harm, illness or disturbance to bridges world over in earthquakes has generated considerable interest amongst/throughout the engineers and researchers, investigator scientist on the seismic design of new bridges and retrofitting of existing, extant ones. Retrofitting of existing bridges is one of the most important things for any type of highway and flyover bridges which are damaged or injured by some reasons. So retrofitting is the process & techniques which is used for the improving or modifying the strength of the structure by addition or subtraction of some equipments & things. Retrofitting is the most convenient accordingly to cost & working. The main objective of this paper & this study to find out the problem of any type of structure, highway bridges in CHATTISHGARH which are damaged or injured due to some specific reasons.***

Keywords: Retrofiting, Highway Bridges, Seimic Forces

1. Introduction

The extensive damage of bridges all over the world in recent earthquakes has been the motivation in significant advancement in the earthquake resistant design and retrofitting of bridges. Many of the reinforced concrete piers designed earlier had inadequate shear capacity due to lack of transverse steel and confinement, inadequately lapped longitudinal steel, and premature termination of longitudinal steel. The superstructures were vulnerable to falling down in the absence of restraining devices; bearings were deficient in accommodating large seismic displacement and bearing seat was inadequate. These deficiencies had an adverse impact on the performance of bridges. An existing bridge can be replaced by a newly designed bridge to meet earthquake demands or upgraded in its strength by appropriate retrofitting measures. The retrofitting is often an economical alternative than replacement. The retrofitting of bridges has received considerable attention in recent years because need of their safe operations in post-earthquake scenario for relief and rescue operations. There are two types of situations that require retrofitting in bridges, (i) the existing bridges that are deficient to meet requirements of current codes but are vulnerable to damage; these bridges have not yet experienced even moderate earthquakes, (ii) the existing bridges that are damaged in earthquakes. The bridges in the later category require both repair and retrofitting. There are many retrofitting techniques developed for upgrading earthquake resistance in bridges. The techniques are equally applicable to bridges damaged in earthquakes. The principal issues facing the retrofitting are: evaluation of seismic capacity of existing bridges, identifying structural deficiencies, ageing effects, decision on level of retrofitting, hazard levels for design, performance criteria, developing

2. Literature Survey

1) **Dr. S.K.Thakkar, Ex. Professor Railway Chair and Professor of Earthquake Engineering, Indian Institute of Technology, Roorkee**.The bridges need retrofitting primarily because of two reasons (i) these were designed for smaller forces than that can occur, and (ii) these may be lacking in ductility in the absence of ductile detailing of reinforcement. The structural deficiencies in many of the existing bridges have been observed from seismic behavior in recent earthquakes. Several bridges constructed prior to existence of modern seismic codes fail to meet requirement of safety. Seismic retrofitting is required for protection of such bridges in future earthquakes. It is possible to retrofit many of the existing bridges against falling of spans and other distress by simple retrofitting measures. The key issues in retrofitting are: retrofit philosophy, seismic assessment, retrofit techniques, validating effectiveness of retrofit measures, application of composite materials and smart materials, in retrofitting. The bridge retrofit program is a necessity for the country and should be undertaken for vulnerable bridges that have not yet experienced earthquakes. The retrofitting of existing bridges has direct relevance towards mitigating disaster caused by earthquakes.
2) **Dr. A.K.Pandey, Scientist and Dr. Rajesh Deoliya, Scientist, Structural Engg. Division, Central Building Research Institute, Roorkee, Uttaranchal**A large number of highway bridges and flyovers are showing sign of distress all over the globe. Identification of the cause and level of distress/damage is a very important step for successful repair and to achieve the designed service life of the bridge. Several new techniques new radar mapping, infrared thermography and impact echo to detect flaws in concrete bridge decks has been tried which are intended to look into invisible defects in concrete in early stages. Various steps in distress diagnosis include determination of concrete compressive strength form non destructive tests, signature/vibration analysis, load tests, tests for state of corrosion etc. Distress diagnosis is important step for implementing proper repair scheme to achieve the designed life of the bridge. In view of large number of distressed bridges monitoring of state of health of important bridges through instrumentation

during the construction stage will help in early detection of flaws and suggesting suitable strengthening scheme.

3) Dinesh Dhanji Patel, DevijiKuverji Patel, KhimjiLaljiPindoria. (http://www.sklpconline.co.uk.) www.arup.com. Authors have listed the causes of damages that occurred in Bhuj earthquake, Gujrat, India, of 2001. The distinct reason out of all others is, old structures predating modern construction practices. Photographs are produced, showing respective details under different categories of failures and is therefore a very good documentation of the sort, and last but not the least have detailed the guide lines for the benefit of public at large, owners, and engineers about dealing with rehabilitation of different types of structures, as well as for new structures.
4) UgurErsoy, GuneyOzcebe, TugrulTankut,UgurhamAkeyuz. Strengthening of infill Walls with CFRP Sheets Post earthquake Rehabilitation and books.google.co.in Study made by authors of survey of RC buildings, in Turkey, were deficient in one or more, specifications of seismicity of the then code of practice. Further, the structures possessed, defects like, weak column connected to strong beam, soft story etc.. The option of engineered construction of RC infill walls was effective (earliest use in 1971) but the process is time consuming and prerequisite was need to evacuate the building. This preposition gave rise for search of better technique which would surmount the prerequisites. The authors reviewed the technique of brick masonry rehabilitation using FRP. They observed that, this technique improves the capacity of the structure, still maintaining the stiffness. On top of all, the prerequisites were surmounted and without evacuation ofoccupants.
5) Ivo OPRŠ AL, Jiř í ZAHRADNÍK, Anna SERPETSIDAKI and G-Akis TSELENTIS 3D Hybrid Simulation of the source and site effects during the 1999 Athens (13th WCEE Aug., 2004 P. No. 3337). Authors have brought forth a different aspect of reason, of differentiated effects, compared to the surrounding area of AnoLiocia (4km x 4km) of Athense city. They examined by experimenting. 400 shock recording stations were established all-around and within this area which measured the minor shocks. The recorded data showed wide variation in intensity of seismic force within and surrounded stations. The reason pointed is the local strata. They, studied the phenomena with 3D simulated model and conclude that source-path-site make the difference.
6) F. Lazzali, S. Bedaoui. Seismic Performance of Masonry Buildings in Algeria. The authors have categorized data of numbers and types of house construction in Algeria. They have observed following types of damages after the 21st May 2003, Boumerdas earthquake :Horizontal cracks between walls and floors, Vertical cracks at wall intersections, Out of plane collapse, diagonal cracks in piers, Cracks in spandrel walls, Partial or complete disintegration of walls, partial or complete collapse of building. In the conclusion they point out the vulnerability is due to, Heavy weight of construction material, Substandard workmanship, Inferior quality of mortar.
7) Rajandre Desai, Rupal Desai. Housing Technology and Its Impact: Latur Earthquake Rehabilitation (Case Study). (www.ncpdpindia.org). The authors have submitted this case study paper at," Workshop of low cost housing and community participation in construction," at Cebu Philippines, in reference to 1992 Latur earthquake. They have pointed out the fact of majority of houses collapsed, were from low cost category. About reasons of the collapse,they strongly opine that, these traditionally constructed were, with broader stone masonry, in poor mortar, and heavy roof improperly clamped to peripheral walls. Further, they enlightened the issue, why the houses in rural area are built in 'traditional manner' They state that, the use of Socio-Eco friendly pattern and materials, in the construction of these houses, is evolution based on wisdom and experience of centuries of respective areas, not only in Kachchh but all over the country. Most of the material used in construction of traditional buildings are more economical, easily recyclable and produces no or less pollution. The day in and day out, use of cement and steel is skyrocketing, leading to very high rate of exploration, which will generate a situation, of scarcity of the recourses, in the coming decades, in our country. Authors therefore are calling for the attention of, researchers and designers and suggest that it is the need of the hour to develop a methodology which will upgrade the traditional methods to comply seismic resistivityspecifications.
8) M.Haseeb, Xinhailu, AneesaBibi, JahanZabKhan. www.ijbssnet.com. The authors are referring to 8th Oct. 2005 earthquake in Pakistan. The majority of the houses collapses were located on the hill slopes or in vicinity hence, when earthquake struck; landslides, rock slides and subsidence followed it, they automatically became culprit of no single but quadraphonic attack. Un-engineered structures constructed in traditional stone masonry pattern, with poor quality cement or mud mortar, and without use of steel reinforcement, as the causes of such large scale of massacre. They therefore compared the provisions of earthquake resistant cods of Pakistan with Japan.
9) RalucuPlesu, George Taranu, Denial Covetarin, Ionut-Dan Gardinariu(2011) www.ce.tuiasi.ro. Strengthening and rehabilitation of Conventional Methods for Masonry Structures. In this paper authors are reviewing both the traditional construction and their traditional methods of retrofitting of masonry buildings. They insists that, the causes of deterioration of construction (weathering, aging, unaccounted settlement of the foundation etc.) must be ascertained, along with the potential strength of the structure as on date. They further, opinion that these factors and then consideration; of capacities as tensile, shear, flexure, member's stability, compressive as well as ductile capacity, energy dissipation , strength or stiffness or both should be accounted in deciding the methodology for retrofit, on case by case basis. This approach will give justification to strengthening ofstructure.
10) Joseph M., Barcia, Sashi K Kunnath JSE Jan. (1997) paper no. 10373. Seismic Performance and Retrofit Evaluation of RCC Structures.The authors opine that, in high rise buildings, reliance only on the inertia force developed by roof or top stories, as design criteria will

be underestimation. Therefore authors studied. "Acceleration displacement response spectrum (ADRS) format, in this paper. The authors then carried out dual analytical experimental shocking table study and recorded the seismic deficiencies incorporated and tabulated the results. A retrofitted model was tested with same parameters and results were tabulated. Authors concluded the study as: -Using ADRS format, comparison of various proposed seismic retrofitting schemes can be done, as in this case study, for relative improvement in strength and deformation demands and capacities of original and modified structure. Thus one can ascertain the best suitable method for adoption.

11) Murty C.R.V., DattaJayanta, Agrawal S.K. (EE&EV). V.3; no.2 Dec. 2004. Twin Lintel Belt in Steel for Seismic Strengthening of Brick Masonry Buildings. The authors tested the brick masonry structures with precast R.C. Roofing for the aim of strengthening it. The collapse can be attributed to out-of-plane, in-plane. And improper connection between slab and roof with masonry walls. Their findings are twin lintel belt along with vertical corner reinforcement, and proper anchorage between slabs /roof though provide better seismic resistance as compared to traditional repair methods. They opine that, this system is vulnerable to strong horizontal and vertical ground motions.
12) Sekar T.; Ramaswamy S.N.; Nampoothari N.V.N. Study on Strengthening of Brick Masonry Structures in Fire Work Industry against Accidental Explosion. (AJCE, V.13, no.6.2012 p.743. Authors have published this paper with the aim to suggest retrofitting measures for safe guarding work force and explosives contents stored in single storied structures in explosive producing factories. The explosion creates seismic type simulations and the major dominating action in single storied structures is due to horizontal force. After carrying out the experiments on models authors concluded and recommend to provide seismic protective bands at plinth, lintel,and roof level, RCC Columns at jambs ofdoor.
13) Hafiz Hliyil Mohammad. Retrofit Corrosion Control for Al Zubare Harbour Main Structure. MAS V.4, no.8, (Aug. 2010). Author carried out experiments on corrosion of reinforcement. The rate of corrosion due to chloride ingress was found @ 3.5 mm/ yr. as against that of humidity or water @ .05 mm /yr. He further, observed that, though the corrosion control systems have been installed, they were defunct for want of maintenance and awareness. The corrosion of reinforcement steel results in reduction of size and in turn the strength, endangering the structure and the life of users.
14) Mayorca Paola, MEGURO Kimiro, 13, WCEE, Aug. 2004, pp 24311. Proposal of an Efficent Technique for retrofitting Unreinforced Masonry Dwellings. The authors are presenting innovative techniques for masonry retrofitting using Polypropylene bands embedded in a mortar overlay. They observed that, though no increase in strength, the lateral drift was larger by 2%. PP band mesh an innovative method proves to be more economical and is easy to construct. However, the authors opine that there test was in-plane loads and there is need to further test the effects on the out-of-plane behavior. Efficiency to prevent corner cracking and separation and effectsonrealdwellingsubjecttodynamicmotionrequires furtherinvestigation.
15) Pavankumar V.S.R.; Raju P. Polu, Incorporation of Seismic Retrofitting Techniques and Mayerils for RCC Framed Buildings Using SAP2000. (IJETE April 2012). The authors recommend analyzing the structure to assess the weakness and residual potential strength, which will the basis for selecting the method of retrofit. In retrofitting strengthening stiffness of member and structure is equally important along with other factors. Hence, authors recommend FRP wrapping techniques and advocate that these are light weight, economical, eco-friendlyprocesses.
16) Kevadkar M.D., Kodag P.B. (IJMER). Lateral Load Analysis of RCC Buildings. (IJMER). The authors have stressed, the need of "Lateral Load Analysis" as these loads can develop high stresses, produce sway movement or cause vibrations. It is therefore important for such structures as well as for new structures to possess strength for vertical and lateral forces. Further, they discuss the methods of strengthening like, provision of shear wall, steel bracing. They compared steel bracing to shear wall method and conclude as steel bracing is preferable to shear wall.
17) Fatemi Amir Abbas, TabriziemZahara, GhodvatiG.Amiri, HosseinM.AliBeigi, IJESE (Oct.2011). V. 4, no. 06SPL. Seismic analysis of Steel Braced Reinforced Concrete Frams. Authors have observed damages like fatigue and wear-tear, which they contribute as a result of increase in volume and weight of traffics on the bridges. This situation prevails upon need of retrofitting of the bridge. The authors conclude that selection of method of retrofitting depends on a) Cost that would generate due to delay of traffic during execution of work, b) simplicity of method of application. Classification of damagesandrelativeretrofittingmethodisessentialtoarriveatappropriatedesign.
18) Member level and different methods with their advantages, viz. shear wall, steel bracing, base isolation of supplemented device techniques and jacketing with FRP or steel. They carried out 3D model analysis with STAAD Pro V8i software and based on the results concluded as follows: - For multi storied structures steel bracing provides better strengthening, do not change weight of the structure significantly, further reduces flexural and shear demand of beam, columns and transfer load through axial mechanism, lateral displacement is reduced and X type bracing have maximum bending movement in compression.
19) Jag Mohan Humar, David Lau and Jean-Robert Pierre (March, 2001). (www.caee.uottawa.ca). Performance of Buildings During the 2001Bhuj Earthquake.The authors visited the earthquake (Jan 2001) affected, Kachchh province of Gujrat, India during 11-18 March 2001, to study the performance of buildings during earthquake. They observed that the majority of buildings constructed in villages and around out-skirts of urban areas were load earring masonry structures;

build with large size blocks, stones, bricks, solid or hollow concrete blocks, in poor quality mortar. The majority of structures had no engineering input and developed in traditional way. The heavy roof portion supported with wooden purlins and rafters. The RCC framed structures had deficiencies like ground floor left open for parking, culminating into a soft story behavior, under reinforced for seismic resistivity. They summarized the need of extensive study in improving seismic resistivity of these structures on the following points, within traditional methods, and economical, beneficial effects of unreinforced, un-clamped infill walls in RCC framed structures, need to endow legal status to IS Code specifications.

3. Conclusion

BY the study of above articles of different authors we are concluded that retrofitting is most important thing for every existing structure which are damaged by the static as well as dynamic loads or other types of forces and by seismic forces. By this study we are noticed that the any type of structure is generally damaged by the seismic forces and in this article we are designing the retrofitting in Chhattisgarh area, which are save from the seismic forces due to very least seismic zone. So for the Chhattisgarh reason there are no more safety are required against the seismic forces, so there are vey less chances of damaging structure in C.G. further there are no need of the retrofitting of the bridges structure which are damaged by seismic forces. There are only the need of maintenance for the bridges which are illed by the static & dynamic loads.

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