Case Study on Jacketing of Bridge

Mr. Kunal Sudhakar Ambi[1], Mr. Kiran Sanjay Kamble[2], Mr.Paul Arjun Hegade[3], Mr. Shivraj Shankar Birajdar[4], Mr.Prathmesh Ashok Ambi[5], Mr. S.K Bhavikatti[6]
[1, 2, 3, 4, 5]Dept of Civil Engineering
[6]Assistant Professor, Dept of Civil Engineering
[1, 2, 3, 4, 5, 6]Sharad Institute of Polytechnic, Yadrav, Maharashtra, India

Abstract- *The Northridge earthquake inflicted various levels of damage upon a large number of Caltrans' bridges not retrofitted by column jacketing. In this respect, this study represents results of fragility curve development for two sample bridges typical in southern California, strengthened for seismic retrofit by means of steel jacketing of bridge columns. Monte Carlo simulation is performed to study nonlinear dynamic responses of the bridges before and after column retrofit. Fragility curves in this study are represented by lognormal distribution functions with two parameters and developed as a function of PGA. The sixty (60) ground acceleration time histories for the Los Angeles area developed for the Federal Emergency Management Agency (FEMA) SAC (SEAOC-ATC-CURE) steel project are used for the dynamic analysis of the bridges. The improvement in the fragility with steel jacketing is quantified by comparing fragility curves of the bridge before and after column retrofit. In this first attempt to formulate the problem of fragility enhancement, the quantification is made by comparing the median values of the fragility curves before and after the retrofit. Under the hypothesis that this quantification also applies to empirical fragility curves developed on the basis of Northridge earthquake damage, the enhanced version of the empirical curves is developed for the ensuing analysis to determine the enhancement of transportation network performance due to the retrofit.*

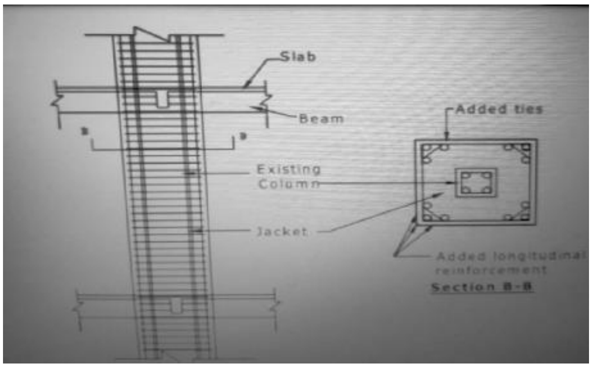
I. INTRODUCTION

Most of the structures in Afghanistan are weak and vulnerable to collapse because of the continuous war that lasted almost three decades These structures were bombed and subjected to different kinds of dynamic loads, which are still going on. Another reasons are ; use of unstandardized and low-quality construction material, equipment, practices ,overloading , aging, and corrosion, which significantly weakens even new structures and requires maintenance(2–12) . Considering that building new structures in totality is costly and entirely out of Afghanistan's budget (and other third-world countries), a cost-effective strengthening method should be introduced. Recently, for the strengthening of the weak and deteriorated columns, fiber-reinforced polymer (FRP), which is a new maintenance material in Afghanistan, is being used and thought to be an ideal replacement for RC-jacketing. FRP has caught the researchers' attention as a new strengthening material, and several studies have been conducted on its structural behavior and strength used as a maintenance material in the civil engineering field. FRP has been under study for few decades as a new strengthening method where it has proved its efficiency tremendously. Several studies have been conducted to scrutinize FRP's overall effectiveness, including strength and boundary conditions(13–17) and. FRP wrapping has promised improved ductility by averting brittle shear failure of columns(19,20) , increase in shear strength , and can delay the damage in compression zone and buckling in longitudinal reinforcement . Moreover, it prevents brittle shear failure, and the nominal shear capacity of the column can also be attained. Besides, it prevents the Poisson's effect by providing confinement pressure and keeping the RC column in its three-dimensional state. However, deboning is a major issue with FRP wrapping assessed so far. Moreover, while using FRP wrapping, it was also noticed that displacement ductility and drift capacity do not increase beyond a specific limit. Furthermore, the circular or elliptical wrapping (for circular or elliptical columns) is recommended because square or rectangular wrapping (for square or rectangular columns) cannot resist slipping (27,28) . Its brittle behavior, low resistance to heat, and lower ductility than steel is another demerit that should be considered while using this material. While FRP has been scrutinized as a strengthening material based on its structural characteristics, but some parameters directly affect the decision while choosing an efficient strengthening method for structures, which are often ignored by most of the studies, such as its total cost and time analysis, including environmental safety concerns (CO2 emission amount). On the other hand, RC-jacketing, which is one of the most frequently used techniques to strengthen reinforced concrete (RC) columns, has also been studied by several researchers for strengthening the weak structures to efficiently restore the load carrying capacity(29,30) . A statistical study conducted to investigate methods used for strengthening 114 concrete structures damaged by an earthquake in 1985 revealed that RC-Jacketing was widely used as the strengthening method. Looking at RC jacketing's structural characteristics, this method can enhance both strength and ductility with stiffness. In addition to increasing the target member’s strength and ductility, it uniformly improves the structure’s overall behavior. It was also proved that RC jacketing could change a strong beam weak column’s condition into a strong column weak beam. Furthermore, the RC-Jacketing method can enhance a damaged column’s strength three times as the original one. A similar study on RC frames showed a five times increase in lateral strength than the original frame. However, the RC-Jacketing procedure is not sophisticated and needs much care during surface curing; else, the jacket can be separated. On the other hand, RC jacketing can enhance a moderately damaged column’s strength only and is useless for strengthening severely deteriorated columns. Moreover, this method changes the column’s cross-sectional area, adds to the members’ brittleness, and decreases effective floor area, which also ends up in major architectural changes of the structure. Further, this method adds more load to an already weak structure, which puts rest members under extra load and leaves the whole structure vulnerable to further retrofitting. At the same time, it is more critical with high-rise structures.

II. REINFORCED CONCRETE JACKETING

Reinforced concrete jacketing can be employed as a repair or strengthening scheme. Damaged regions of the existing members should be repaired prior to their jacketing. There are two main purposes of jacketing of columns (i) Increase in the shear capacity of columns in order to accomplish a strong column-weak beam design and (ii) To improve the column's flexural strength by the longitudinal steel of the jacket made continuous through the slab system are anchored with the foundation. It is achieved by passing the new longitudinal reinforcement through holes drilled in the slab and by placing new concrete in the beam column joints as illustrated in figure 1. Rehabilitated sections are designed in this way so that the flexural strength of columns should be greater than that of the beams. Transverse steel above and below the joint has been provided with details, which consists of two L-shaped ties that overlap diagonally in opposite corners. The longitudinal reinforcement usually is concentrated in the column corners because of the existence of the beams where bar bundles have been used as shown in figure 1. It is recommended that not more than 3 bars be bundled together. Windows are usually bored through the slab to allow the steel to go through as well as to enable the concrete casting process.

III. CONSTRUCTION TECHNIQUE FOR COLUMN JACKETING



IV. METHODOLOGY

Fragility curves for retrofitted bridges indicate the influence of various retrofit measures on the probability of achieving specified levels of damage. This paper presents an analytical methodology for developing fragility curves for classes of retrofitted bridge systems. The approach captures the impact of retrofit on the vulnerability of multiple components, which to date has not been adequately addressed, and results in a comparison of the system fragility before and after the application of different retrofit measures. Details presented include analytical modelling, uncertainty treatment, impact of retrofit on demand models, capacity estimates, and component and system fragility curves.

V. ADVANTAGES

- A beam rests simply on the supports.
- The effects of thermal expansion and movements of the ground are easily sustained.
- A beam could also be engineered removed from the ultimate position and raised fleetly into place with the least disruption of traffic or navigation.
- Beam bridges are easy to construct.
- In comparison to other bridge types, beam bridges are less costly.
- Mostly used widely in urban and rural zones.

VI. DISADVANTAGES

- Beam Bridge contains forces, which are much larger than the load, and it needs to be relatively massive.
- Beam Bridges have a limited span and do not allow large boats or vehicles to pass underneath.
- Mostly heavy boat traffic or large ships cannot pass underneath.

- People may not find the design of beam bridges spectacular.

VII. CONCLUSION

Concrete Jacketing is pivotal for strengthening to add or restore ultimate load capacity of reinforced concrete columns. It is used for seismic retrofitting, supporting additional live load or dead load that is not included in the original design, to relieve stresses generated by design or construction errors, or to restore original load capacity to damaged structural elements.

AUTHORS PROFILE

Mr. S.K Bhavikatti
He has completed B.E in Civil Engineering. He is working as Assistant Professor in Sharad Institute of technology Polytechnic in Department of Civil Engineering.

Mr. Kunal Sudhakar Ambi
He is Studying in Sharad Institute of technology Polytechnic in Department of Civil Engineering in Third Year Diploma.

Mr. Kiran Sanjay Kamble
He is Studying in Sharad Institute of technology Polytechnic in Department of Civil Engineering in Third Year Diploma.

Mr. Paul Arjun Begade
He is Studying in Sharad Institute of technology Polytechnic in Department of Civil Engineering in Third Year Diploma.

Mr. Shivraj Shankar Birajdar
He is Studying in Sharad Institute of technology Polytechnic in Department of Civil Engineering in Third Year Diploma.

Mr. Prathamesh Ashok Ambi
He is Studying in Sharad Institute of technology Polytechnic in Department of Civil Engineering in Third Year Diploma.