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Evaluation of Rectangular Column Retrofitting Methods Using Various Wrapping Materials: A Quantitative Approach

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Abstract:

The structure can be retrofitted in cases when the damage is not severe. Numerous retrofitting techniques are accessible, according to an assessment of the literature that is currently available. Using Fiber Reinforced Plastics (FRP) is one of the most efficient and successful ways to repair damaged structures. There are many different causes of damage to civil engineering structures, including blasting, cyclones, earthquakes, and more. This type of loading results in the early collapse of the structure or significant damage to them. Previously, the FRP approaches have been used to restore a number of structures. This study includes case studies of mending civil engineering structures, an overview of applying FRP technology, and pertinent closing notes.

Keywords: Fiber Reinforced Polymer (FRP), Carbon Fiber Reinforced Polymer (CFRP), Glass Fiber Reinforced Polymer (GFRP), Retrofitting,

I INTRODUCTION

To regain its original strength, retrofitting is the best way chosen so far to improve the strength of that damaged structure. Retrofitting means improvements in strength to an existing structure. All the loads that are acting on the structure whether they are lateral loads, gravity loads, longitudinal loads, etc are transferred from beam to column and column then transfers it to the foundation. So the columns are very important in any structure for its stability and durability. Whenever there are higher loads acting on the structure, or there is an earthquake, structure gets damaged partially or fully and the structure loses its original strength. There are a lot of RC buildings and bridges and various RC structures that are in need of re-strengthening and therefore there is a need of retrofitting. There are a number of reasons that lead to retrofitting which are: seismic activity, higher load demand, higher strength demand, constructional errors, deterioration caused by environmental factors, change in use of the structures, etc. Micro cracks are also developed in concrete due to thermal variations. Due to the formation of micro cracks, there is a decrease in strength of a structure. So it regain its strength, a structure needs to be retrofitted. So to sum up, retrofitting is modification of existing structures to make them more resistant towards external loadings. In past years, significant research work has been done to make various strengthening and retrofitting techniques to enhancethe strength, load carrying capacity and lifespan of a structure.

Some of the strengthening methods that has been applied in the past are steel plate bonding, jacketing, external post tensioning, addition of new structural elements, etc and these method were Successful. Among all the methods, retrofitting with fiber Reinforced Polymers (FRP) materials has lead to a various achievements in the field of civil engineering in past one or two decades. Fiber-reinforced polymers (FRP) are light weight in nature, easy for implementation and have high tensile strength and also are corrosion resistance. Due to these reasons, FRP composites are preferred solutions for strengthening method of various reinforced concrete structural elements and are now extensively being used all over the world.

II LITRATURE REVIEW

Behaviour of FRP confined concrete in square columns. A. de Diegoa*, A. Arteagaa, J. Fernándezb, R. Pererab, D. Cisnerosa

A significant amount of research has been conducted on FRP-confined circular columns, but much less is known about rectangular/square columns in which the effectiveness of confinement is much reduced. This paper presents the results of experimental investigations on low strength square concrete columns confined with FRP. Axial compression tests were performed on ten intermediate size columns. The tests results indicate that FRP composites can significantly improve the bearing capacity and ductility of square section rein-forced concrete columns with rounded corners. The strength enhancement ratio is greater the lower the concrete strength and also increases with the stiffness of the jacket.The confined concrete behaviour was predicted according to the more accepted theoretical models and compared with experimental results. There are two key parameters which critically influence the fitting of the models: the strain efficiency factor and the effect of confinement in non-circular sections.

Review of Methods for Reinforced Concrete Column Retrofit Alexander Sichko1, Halil Sezen 2 When a reinforced concrete (RC) structure is deemed structurally deficient, strengthening or rebuilding are required. Outside of fiber-reinforced polymers (FRP), RC jacketing and external steel elements are two common retrofit methods for columns. Selected studies are reviewed and information surrounding key design considerations identified and presented. The emerging variation of RC jacketing using high-performance concrete (HPC) is highlighted. Additionally, a new slip coefficient is discussed to model the level of composite action between the concrete jacket and original column. addition to both concrete jacketing and external steel elements proving to be suitable retrofit methods based on performance increases, there are a few other key conclusions. 1) HPC can be used to reduce jacket size and reduce or eliminate the need for additional steel reinforcement, 2) while full composite action may not be achieved subject to the interface condition between old and new concrete, depending on the application it may not be necessary and the discussed model can help to predict composite retrofit performance, 3) steel cage method with stiffeners or widerend battens without need for grout can be an effective method for seismic retrofit, and 4) existing loading on the original column was not found to significantly impact retrofit performance.

Retrofitting of damaged reinforced concrete bridge structure Muhammad Fawada*, K. Kalmanb, R.A.

Khushnooda ,Muhammad Usmana the bridges are always prone to damages; as a result, they exhibit insufficient performance, both techniques are alwaysneeded for assessment and strengthening design of structures. This research involves the retrofitting of a damaged bridge structure. Assessment and observation of the existing situation of bridge lay a platform for selection of different strengthening techniques. A real life problem of an existing 50 years old continuous box-girder bridge (Hungary), having five spans of 138m length, is under

consideration. Based on the existing health analysis of bridge, steel plate strengthening and FRP strip strengthening have been suggested. Application of steel plate strengthening shows that the cracked area reduces to one-half, where deflection value reduces around 3/4th of total value. Crack width reduces significantly and comes within the allowable limit of 0.3mm. In case of FRP, strengthening work shows the remarkable results. The overall cracked area reduces to 1/5th of total cracked area and crack width reduces to its minimum value (0.037mm). Overall deflection also reaches to the lowest possible value. Feasibility analysis of these strengthening methods shows that the FRP strengthening is more efficient and feasible solution than the steel plate strengthening.

Retrofitting and Refurbishment of Existing Road Bridges. Claudio Modena, Giovanni Tecchio, Carlo Pellegrino, Francesca da Porto, Mariano Angelo Zanini and Marco Dona

The stock of existing road bridges in Italy and in most European countries exhibit insufficient performance, both in terms of structural safety and functionality, if compared to the demands of current structural codes, transportation systems and the necessity of reducing maintenance costs.

Reliable methodologies are therefore needed in the assessment and design phase to address the specific type of vulnerability of each class of bridges. Establishing principles for the assessment and rehabilitation of existing structures is essential as repair and retrofitting require an approach that is substantially different from the design of new structures, and entail knowledge beyond the scope of design codes. The ultimate aim is to limit construction interventions to a strict minimum, a goal that is clearly in agreement with the principles of a sustainable development. In the present chapter the application of such methodologies to different road bridge types is described. Common rehabilitation and retrofitting techniques for reinforced concrete, steel and masonry bridge typologies are presented, in connection with significant case studies, which showed deficiencies typical of such structures, due to poor maintenance as well as lack of durability rules in the original design, thus making the retrofitting descriptions suitable for considerations of a general order. The structural rehabilitation interventions described are usually coupled with functional refurbishments, and outline a methodological approach, which takes into account the typological characteristics of the structure, its state of maintenance, its functional requirements and the environmental aspects with the repair and strengthening systems connected Behavior of FRP confined concrete in square columns. A. de Diegoa*, A. Arteagaa, J. Fernándezb, R.Pererab, D. Cisneros

A significant amount of research has been conducted on FRP-confined circular columns, but much less is known about rectangular/square columns in which the effectiveness of confinement is much reduced. This paper presents the results of experimental investigations on low strength square concrete columns confined with FRP. Axial compression tests were performed on ten intermediate size columns. The tests results indicate that FRP composites cansignificantly improve the bearing capacity and ductility of square section reinforced concrete columns with rounded corners. The strength enhancement ratio is greater the lower the concrete strength and also increases with the stiffness of the jacket.

The confined concrete behaviour was predicted according to the more accepted theoretical models andcompared with experimental results. There are two key parameters which critically influence the fitting of the models:the strain efficiency factor and the effect of confinement in non-circular sections., 175 mm to 2380 mm long (i.e. with slenderness ratios ranging from 4 to 93), were tested under axial compression loads to examine the effects of number and type of CFRP layers, fibre orientation, and slenderness ratio. Transverse wrapping was shown to be suitable for controlling outwards local buckling in HSS short columns, while longitudinal layers were more effective in controlling overall buckling in slender columns.

III METHODOLOGY

Conventional techniques

Section enlargement.

External plate bonding.

External post tensioning.

Ferro cement covering.

Section Enlargement.

Section growth consists in putting additional concrete around an current structural Element to growth its seismic resistance. This is the oldest technique of seismic Retrofitting. Typical applications encompass bridge deck, column wrapping, and join Strengthening. This approach is easy and economically effective; however labor extensive Entire cross section of member is increased. Additional structural reinforcement metallic with shear stirrups. Process

involves surface preparation, additional Reinforcement and concrete curing.

External Post Tensioning.

In a post-anxiety system the brace members are rods which have been initially pre-confused. The main gain of pre-stressing is that it reduces the probability that the brace will shorten to the point of turning into slack. Secondly, if the brace stays in tension, then the Diminutions of the lateral stiffness are minimized. Finally, if the brace is pre-harassed toa excessive level, then the brace will yield and allow for major energy dissipation at a exceedingly small lateral drift. Research has proven that the level of pre-stress need to be saved at 50% of the yield energy or better to provide the simplest response. One difficulty with pre-pressured bracing is the effect of the pre-tension on the encircling members. During pre-stressing, forces are implemented on the adjoining columns creating excessive shear needs. When the earthquake comes, it will increase the shear needs and since those columns are already beneath excessive demand theycan fail prematurely. High power steel strands or pre-stressing tendons are used. Tendons are pulled and linked to anchor points on member. Very much appropriate for retrofitting of bridges.

IV RESULT

There are many different causes of damage to civil engineering structures, including blasting, cyclones, earthquakes, and more. This type of loading results in the early collapse of the structure or significant damage to them. Previously, the FRP approaches have been used to restore a number of structures. This study includes case studies of mending civil engineering structures, an overview of applying FRP technology, and pertinent closing notes. The structure can be retrofitted in cases when the damage is not severe. Numerous retrofitting techniques are accessible, according to an assessment of the literature that is currently available. Using Fiber Reinforced Plastics (FRP) is one of the most efficient and successful ways to repair damaged structures.

V CONCLUSION

Research indicates that employing the retrofitting technique allows us to obtain the highest strength at the lowest possible cost. CFRP is presented for the RCC Column based on the analytical analysis of nanocement. The overall deflection in Ansys with increasing load indicates that the RCC column has the largest deflection, while the CFRP has the smallest deflection by 10–20%.

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