REHABILITATION METHOD OF BEAM COLUMN JOINT USNG NANO COMPOSITE FERROCEMENT JACKETING WITH CFRP

LITERATURE REVIEW

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Abstract - This research provides an overview of structural rehabilitation using integrated jacketing and CFRP-based Nano-based cement composites.

The most vulnerable structural element subjected to lateral loads in reinforced concrete (RC) framed structures is the beam-column connection, and retrofitting of structures has become an unavoidable part of the construction process.

It is important to strengthen the load carrying capability from the outside using a jacketing procedure. To improve performance, Ferro cement, consisting of Nano SiO2 based mortar and wire mesh, was used to replace concrete cover. This is one of the accepted and feasible ways to strengthen.

This research looked at Nano silica-based cementation matrices that might be used with layered CFRP. It performs better in terms of strength and durability, as well as joint shear strength.

Key Words: CFRP, Retrofitting, Cementitious matrices, Ferro cement jackets, Nano SiO2 based mortar

1. INTRODUCTION ON RETROFITTING TECHNIQUES UNDER SEISMIC LOADING

The structure must be designed in such a way that it is appropriate for its intended use and is both safe and durable, taking into account the ease of retrofitting construction and post-retrofitting maintenance, as well as overall economy and environmental friendliness.

The structures must meet a variety of performance criteria. Retrofitting structures to improve performance that is directly tied to mechanical properties is one of these performance needs. According to the type of structure, purpose of use, degree of importance, and other considerations, the performance that the structure to be retrofitted should have over its remaining service life after retrofitting is specified. Furthermore, because "durability" refers to a structure's resistance to a reduction in various performance values over time, it is linked to all performance.

1.1Ferro cement Jacketing Process

Wire meshes and cement mortar make up Ferro cement, a construction material. Ferro cement is a composite building material made up of 95 percent cement mortar and 5% wire mesh. It is made up of single or multilayered steel mesh that is closely spaced. It's a thin element with a lot of power. It is fire and corrosion resistant, as well as resistant to elongation, ductility, and impact stresses of reinforced concrete structures. Because of its low self-weight, lack of qualified personnel, and absence of need for framework, ferrocement has a wide range of applications in building. One of the retrofitting approaches is ferrocement jacketing. The sides of the column are restored after a degraded and failing reinforced concrete structure is fixed with cement mortar.

1.2 Fiber-reinforced plastic bonding method

Glass FIBERs, carbon FIBERs, aramid FIBERs, or other continuous FIBER materials (continuous FIBER sheets, etc.) are bonded to the outside of the concrete section, bonding to the existing members to form a composite configuration, after which an organic or other material coating is applied on top, both to prevent the entry of carbon dioxide, chloride ions, moisture, and other contaminants, and to provide the required performance improvement. For bridge decks and practically all other concrete members, this approach is used.

1.3 Nano-material and cement composites

Substantial research is being conducted in the construction industry to improve the performance of various building materials, one of which is the development of durable and sustainable concrete. Because of its pozzolanic reactivity as well as the pore-filling effect, Nano-silica is the most extensively employed Nano-material in cement and concrete to increase performance.

2. LITERATURE REVIEW

The beam-column joint is one of the most critical parts of a structure. Several researchers looked into ways to enhance the beam-column junction. Adding fiber sheets and jacketing is one way to increase strength. This chapter gave a general evaluation of journals related to CFRP and Ferro cement jacketing on reinforced concrete, beam-column joint, steel fiber reinforced beam-column joint, and hybrid fiber reinforced beam-column joint, and they are listed in the report's references section.

2.1 REVIEW OF LITERATURE

Addition of external steel elements; and 6) strengthening with fiber-reinforced polymeric (FRP) composite applications. Each method of repair or strengthening is reviewed with emphasis on its application details, required labor, range of applicability, and performance. Relative advantages and disadvantages of each method are discussed

J. Revathy, P. Gajalakshmi, M. Aseem Ahmed (2020)

A laboratory experiment was conducted to produce rich and flowable nano silica-based cementations matrices that may be used for structural repair and retrofit. To determine the strength and durability qualities of Nano-based cement composites, research was done. The flowable nano-silica cementitious mortar had a considerable improvement in compressive strength in the range of 7.5–50% over the control cement mortar, according to the findings. Cementitious matrices' splitting tensile strength improved from 2.28 to 3.98 MPa. When compared to the other mortar specimens, nano-silica with a 3 percent content showed the least amount of water absorption. According to the findings, 3 percent nano-silica might be employed to make a flowable nano SiO2 based mortar. It outperformed the competition in terms of strength and durability. In comparison to the control column, ferrocement jacketed columns have a load-carrying capacity of roughly 40% and a 95 percent axial displacement. In all of the ferrocement jacketed columns, a ductile mechanism of failure was observed.

Murat Engindeniz, Lawrence F (2020)

This research includes a complete up-to-date literature search relative to the performance of non seismically designed reinforced concrete beam-column joints, as well as repair and strengthening approaches, published between 1975 and 2003. 1) epoxy repair; 2) removal and replacement; 3) concrete jacketing; 4) concrete masonry unit jacketing; 5) steel jacketing and installation of exterior steel elements; and 6) strengthening with fiber-reinforced polymeric (FRP) composite applications were among the techniques used. Each method of repair or strengthening is examined in detail, with a focus on the application details, labor requirements, applicability range, and performance. The relative benefits and drawbacks of each strategy are explored.

Varinder Singh, Prem Pal Bansal (2014)

The effect of retrofitting CFRP jackets on the strength of beam-column junctions initially strained to three different stress levels is reported in this paper. Under static loading conditions, 9 RC beam-column joints were examined. CFRP strengthening has been carried out for beam-column joints already stressed to three different stress levels. In two layers, the jackets were given in an L-shape and at a 45-degree angle to the junction. The final load has improved as a result of the findings. carrying capacity (7–12%) of the retrofitted beams, when compared to the control beams along with an increase of 15% in yield load for each of such exterior beam-column joints

Paratibha Aggarwal, Rahul Pratap (2015)

The influence of nano-silica addition on the mechanical, durability, and microstructure characteristics of paste, mortar, and concrete are summarized in this review paper. It describes the current state of the nano-silica application in paste, mortar, and concrete. Finally, the future trend/potential of nano-silica in cement-based materials is examined, as well as its implications.

Kondraivendhan and Pradhan (2009) The effect of ferrocement confinement on concrete behavior was investigated. By maintaining all other variables constant, the effect of different grades of concrete confined with ferrocement was investigated. It was discovered that as the compressive strength of concrete increased, it improved dramatically in lower classes of concrete, such as M25, which increased by 78 percent, compared to higher grade concrete, M55, which increased by 45.3 percent.

Turgay et. al. (2010) large-scale square/rectangular columns covered in the fiber-reinforced polymer were explored in this study for their influence and failure mechanisms (FRP). The performance of large-scale square RC columns coated in carbon fiber reinforced polymer (CFRP) sheets was investigated as part of the experimental research program. Furthermore, the study focused on the overall influence of longitudinal and transverse reinforcement, as well as FRP jackets, on the behavior of concentrically loaded columns. The structural laboratory manufactured and tested a total of 20 large-scale RC columns to failure under axial force.

Kaish et. al. (2012) With certain adjustments, the effect of ferrocement jacketing was investigated. To confine the column specimens, three types of ferrocement jacketing techniques were used: square jacketing with single layer wire mesh and rounded column corners (RSL); square jacketing with single layer wire mesh and shear keys at the center of each face of the column (SKSL), and square jacketing with single layer wire mesh and two extra layers mesh at each corner (SLTL).

Ornela Lalaj, Yavuz Yardım, Salih Yılmaz (2015) Ferrocement, according to the author, is the oldest form of reinforced concrete, dating back two centuries. It's made of galvanized steel wire mesh and masonry. It's employed in a variety of applications, including boat construction, water tanks, slabs and roofing, and tunnel lining. Reinforced concrete is a well-known and commonly utilized material nowadays, but ferrocement has a limited range of applications. High strength/weight ratios, as well as outstanding resistance to cracking and impact loadings, are putting ferrocement back into the spotlight.

Naveeena et.al. (2016), To improve their strength and stiffness, the outer beam-column junction is strengthened or retrofitted. The sheer capacity of a carbon fiber reinforced polymer is predicted using an analytical model (CFRP). The axial force was applied at the surface's column top and remained constant throughout the test. The beam's free end is subjected to cyclic loading. Two specimens, one unstrengthen and the other CFRP-strengthened were modeled and studied. To enhance the ductility of the beam-column joint and transfer the failure mode to the beam or delay the shear failure mode, an effective re-habitation method is to increase the ductility of the beam-column joints. To trigger cyclic loading in testing, the specimens are loaded with a step-by-step load increment process. The results of the stress and deformation tests were compared to those of reinforced and unstrengthened specimens. The numerical result demonstrates that strengthening the beam-column junction using CFRP can improve structural stiffness, strength, and energy dissipation capacity.

Gia Toai Truong et al. (2017), has employed a variety of retrofit methods for concrete columns, including steel jacketing, Carbon FIBER Reinforced Polymer (CFRP) wrapping, concrete jacketing with non-shrinkage mortar, and new concrete jacketing using amorphous metallic Fiber (AMF) reinforced concrete. On the control specimens, two different retrofit procedures were used: partial refit in the plastic hinge zone, primarily to increase deformability, and full retrofit across the entire range of columns, primarily to increase shear strength and deformability. The test findings revealed that the retrofitted specimens had ductile failure mode and increased dissipated energy and damping ratio, however, the effect varied depending on the retrofit method.

Yazan B. Abu Tahnat (2018) FRP sheet wraps are one technique to improve the ductility of such junctions. The purpose of this study is to see how utilizing FRP wraps around beams affects the ductility of outside R.C beam-column joints. This study focuses on the major characteristics that govern joint ductilities, such as the relative inertia of the column to the beam (G), the amount of transverse steel in the joint (Av/s)J, and the amount of transverse steel in the beam (Av/s). B. The ductility behavior of R.C joints enhanced by FRP is investigated using Finite Element (F.E.) analysis utilizing commercial F.E. software (ABAQUS). The aforementioned parameters are numerically examined. The use of CFRP wraps around beams turns brittle failure into ductile failure, according to the findings.

3. CONCLUSION

The structural behavior of beam-column joints has been extensively studied in the past decades. Experimental and analytical solutions have been conducted and proposed by many other researchers to understand the behavior of the beam-column joints. However, the NANO composite cementitious-based jacketing technique with integrated CFRP in retrofitting beam-column joint has yet to be investigated. This study was pointed out for future research due to the limited number and gaps found. In-depth investigations must be undertaken to gain a more thorough understanding of the results on the behavior of retrofitted beam- joint using nanocomposite ferrocement jacketing with CFRP

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