Impact Factor Value 4.046 **e-ISSN: 2456-3463**
International Journal of Innovations in Engineering and Science, Vol 5, No.3, 2020
www.ijies.net

Use of Thin Membrane Concrete Jacket To Repair and Strengthen Damaged Reinforced Columns

Prof. Pradeep Nirmal [1], Lokesh Singh[2], Rohit Kumar Chandrakar[3], Sanjeev Kumar Sahu[4], Ashwani Kumar Chandrakar[5], Priyanka Khute[6], Dolly Dewangan[7], Shraddha Kanojiya[8], Ravi Kumar Gupta[9]

[1,2] *Assistant Professor,*[3,4,5,6,7,8,9] *Under Graduated Student*
RSR Rungta College of Engineering & Technology, Bhilai, Chhattisgarh, India

Abstract *- The main aims of the Research is to investigate the efficiency of repaired damage concrete columns by using thin concrete jacketing. Sustainability necessitates the protection of infrastructure from any kind of deterioration over the life cycle of the asset. Deterioration in the capacity of reinforced concrete (RC) infrastructure (e.g., bridges, buildings, etc.) may result from localized damage sustained during extreme loading scenarios, such as earthquakes, hurricanes or tsunamis. In addition, factors such as the corrosion of rebars or ageing may also deteriorate or degrade the capacity of an RC column, thereby necessitating immediate strengthening to either extend or ensure its design life is not limited. The aim of this paper is to provide a state-of-the-art review of various strengthening and repair methods for RC columns proposed by different researchers in the last two decades. The scope of this review paper is limited to jacketing techniques for strengthening and/or repairing both normal- and high-strength RC columns.*
The paper identifies potential research gaps and outlines of the future direction of research into the Strengthening and repair of RC columns.

Key words *- Reinforcement, corrosion, Concrete Jacketing, Strengthening, Repair, Damaged RC Columns.*

I. NTRODUCTION

Seismic retrofitting and/or the strengthening of Reinforcement columns has been a popular area of research for decades. This is primarily because, in a building frame system or a bridge, the imposed seismic energy demand is dissipated by the displacement of the columns, thereby resulting in slight to severe damage depending on the severity of the earthquake, and hence the need for repair emerges to ensure the smooth post-earthquake recovery of the facility. The repair and rehabilitation of existing structures are major construction activities. Meanwhile, reinforced concrete (RC) is used widely as a construction material in most parts of the world. The need for strengthening and repair may also arise because of a number of other factors such as the ageing of structure, deterioration of concrete, change in building use and loading requirements, design errors, corrosion of reinforcement and construction mistakes during erection.

The failure of the most important structural elements, i.e., columns, may lead to the total collapse of frame structured buildings because they are the only structural elements that convey the total vertical loads of buildings to the soil. (ese members can lose their strength and stiffness due to damages during their service lives. (therefore, repair or reconstruction is necessary in case of noticeable cracks to ensure that loads are further carried and transmitted to the soil.

Strengthening methods depend on the type of structure and loading. Regarding structures subjected primarily to static loads, increasing flexural and axial compressive strength is essential. Regarding structures subjected primarily to dynamic loads, increasing flexural and shear strength is crucial. Improving column ductility and rearranging column stiffness can also be achieved with strengthening methods. Damages to RC columns may include slight cracks without damage to reinforcement, superficial damage in concrete without damage to reinforcement, concrete crushing, reinforcement buckling, or tie rupture. On the basis of the degree of damages, techniques such as injections, removal and replacement, or jacketing can be applied.

Many researchers have investigated the bond strength between two concrete layers and different techniques for increasing the roughness of the substrate surface. Nowadays, repairing techniques suitable in terms of low

cost and fast execution time should be identified. Hence, the current research studied the repairing and strengthening of square RC columns by applying two concrete jacketing types: using ultrahigh-performance fibre-reinforced self-compacting concrete (UHPFRSCC) and normal strength concrete (NSC) as jacketing materials with three methods of surface roughening, i.e., mechanical wire brushing, mechanical scarification, and using shear studs.

II. EXPERIMENTAL MECHANISM

The experimental work here in aims to investigate the bonding among the column cores and their jacketing and the ultimate load-carrying capacity and axial displacement of uniaxial loaded square RC columns repaired and strengthened using two jacketing types with three methods of surface roughening. (The obtained results are compared with those of the reference columns. Figure 1 presents the experimental plan of column specimens' fabrication.

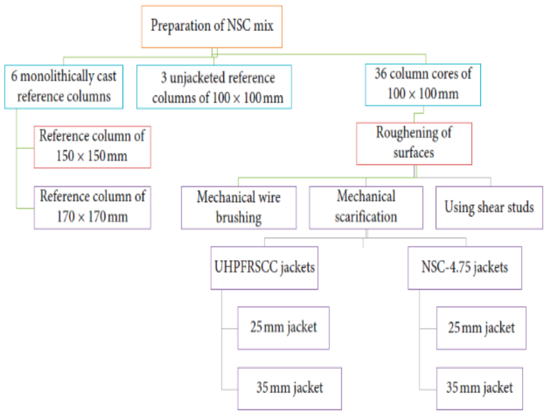

Figure 1: Experimental program.

III. TYPES OF CONCRETE MIXES

In this research, the following concrete mixes are designed on the basis of the targeted concrete compressive strength.

5.1 NSC ;- NSC mix is prepared and used to cast the UC reference columns, MC reference columns, and the column cores of the two groups A-B and X-Y. Table 2 shows the NSC mixing proportions.

5.2 *NSC-4.75;-* The NSC mix with a maximum aggregate size of 4.75mm (NSC-4.75) is prepared and used to cast the jackets of the A-B column specimens. (e absolute volume method recommended is used to compute the quantities of concrete materials required for the NSC-4.75 mix.

5.3 UHPFRSCC;- The UHPFRSCC mix is used to cast the jacket of the X-Y column specimens. It is prepared using the ingredients. The UHPFRSCC mix is designed to obtain a target standard cylinder compressive strength of approximately 120 MPa.

IV. COMPARISONS

The load–drift diagrams of all the specimens are compared in Fig. 13. The main results, both in terms of maximum bending moments and drifts. The corroded column shows a decrease of the maximum strength of about 26 % (rebar corrosion about 20 % in weight) and a marked decrease of maximum deformation (up to 50 %) with respect to the undamaged one.
The results obtained from the jacketed specimen showed the effectiveness of this technique for

strengthening columns with corroded longitudinal rebars. The maximum load for both positive and negative drifts is higher than the peak load reached by the undamaged specimen. The maximum load measured for negative drifts, the direction in which the strengthened specimen showed a correct failure mode, is increased of about 65 and 118 %, if compared to those of the undamaged and corroded columns, respectively.

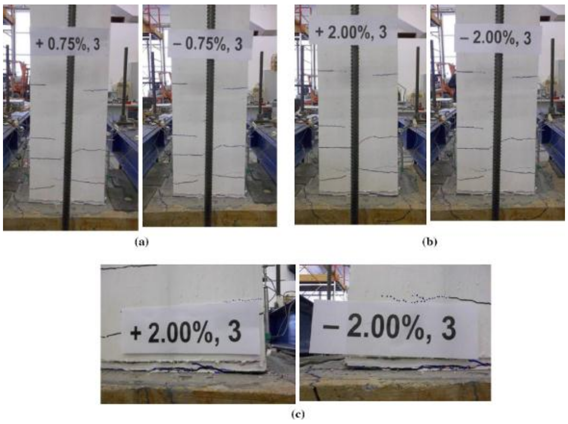

Fig. 2 Corroded reinforced column (CR): crack pattern at a drift of 0.75 % (a) and 2 % (b, c)

V- ADVANTAGES

- It increases the seismic capacity of the column.
- Amount of work is less as foundation strengthening does not require.
- It increases the shear strength of the column.
- It also increases the confinement of concrete in circular column.
- Steel jacketing does not increases significant weight of the column and also save construction time.

VI- DISADVANTAGES

- Cracks develop in concrete due to shrinkage and load.
- Conventional form work construction methods slow things down.
- Low tensile strength.
- Difficult to repair modified and extend.

VII- APPLICATIONS OF JACKETING

Jacketing is particularly used for the repair of deteriorated columns, piers, and piles and may easily be employed in underwater applications. The method is applicable for protecting concrete, steel, and timber sections against further deterioration and for strengthening.

Jacketing used for purposes other than covering the deteriorated concrete and providing lateral confinement, such as to bear longitudinal loads, needs special considerations. The existing column may have undergone full shrinkage and most of the creep and also has elastic strains due to carried loads, whereas the shrinkage and creep of the new material has to occur.

VIII- CONCLUSIONS

The outcomes of the experimental study can be summarized as follows:

- Applying two jacket thicknesses of 25 and 35mm with A-B and X-Y jacketing types considerably improves ultimate load-carrying capacity in almost a similar rate to the rate of increase in jacketing area.
- Repairing and strengthening using UHPFRSCC and NSC-4.75 jackets significantly increases the ultimate load-carrying capacities and axial displacements of the specimens with respect to the UC and MC reference columns.
- Although repairing and strengthening RC columns using NSC-4.75 as a jacketing material is effective, UHPFRSCC is more effective due to the use of steel fibres.

ACKNOWLEDGEMENTS

Special thanks and appreciation is given *to our guide* ***Pradeep Kumar Nirmal*** in accomplishing this work.

REFERENCES

[1] *Marini A, Meda A (2009) Retrofitting of R/C shear walls by means of high-performance jackets. Eng Struct 31(12): 3059–3064.*

[2] *Martinola G, Meda A, Plizzari GA, Rinaldi Z (2010) Strengthening and repair of R/C beams with fibre-reinforced concrete. Cem Concr Compos 32(9):731–739*

[3] *Meda A, Mostosi S, Riva P (2014) Shear strengthening of reinforced concrete beam with high-performance fiber-reinforced cementitious composite jacketing. ACI Struct J 111(5):1059–1067*

[4] *Preti M, Meda A (2013) RC structural wall with unbonded tendons strengthened with high performance fiber-reinforced concrete. Mater Struct. doi:10.1617/s11527-013-0180-8*

[5] *Kamal A, Kunieda M, Ueda N, Nakamura H (2008) Evaluation of the crack opening performance of a repair material with strain hardening behaviour. Cem Concr Compos 30(10):863–871*

[6] *Beschi C, Meda A, Riva P (2011) Column and joint retrofitting with high performance fiber reinforced concrete jacketing. J Earthq Eng 15(7):989–1014*

[7] *Paik JK, Melchers RE (eds) (2008) Condition assessment of aged structures. CRC, Boca Raton.*

[8] *Wanga W, Liub J, Agostini F, Davy CA, Skoczylas F, Corvez D (2014) Durability of an Ultra High Performance Fiber Reinforced Concrete (UHPFRC) under progressive aging. Cem Concr Res 55(January):1–13*

[9] *Resplendino J, Toulemonde F (2011) Designing and building with UHPFRC. Wiley-ISTE, London*

[10] *Ramadoss P, Nagamani K (2008) Tensile strength anddurability characteristics of high-performance fiber reinforced concrete. rab J Sci Eng 33(2B):307–319*

[11] *Tastani SP, Pantazopoulou SJ (2004) Experimental evaluation of FRP jackets in upgrading RC corroded columns with substandard detailing. Eng Struct 26:817–829*

[12] *Soylev TA, Richardson MG (2008) Corrosion inhibitors for steel in concrete: state-of-the-art report. Constr Build Mater 22:609–622*

[13] *Meda A, Rinaldi Z, Riva P, Mostosi S (2014) Experimental evaluation of the corrosion influence on the cyclic behaviour of R.C. columns. Eng Struct 76:112–123*

AUTHOR TABLE

Sr.No	Name of Author	Photo
1	Ravi Kumar Gupta 8TH SEM. Student RSR RCET Bhilai C.G	
2	Dolly Dewangan 8TH SEM. Student RSR RCET Bhilai C.G	. 
3	Rohit Kumar Chandrakar 8TH SEM. Student RSR RCET Bhilai C.G	
4	Sanjeev Kumar Sahu 8TH SEM. Student RSR RCET Bhilai C.G	
5	Ashwani Kumar Chandrakar 8TH SEM. Student RSR RCET Bhilai C.G	
6	Priyanka Khute 8TH SEM. Student RSR RCET Bhilai C.G	
9	Mr. Pradeep Nirmal Assistant Prof. Civil ENGG. Dept. RSR RCET Bhilai C.G