Scientific Journal of Impact Factor (SJIF): 4.72
e-ISSN (O): 2348-4470
p-ISSN (P): 2348-6406

International Journal of Advance Engineering and Research Development

Volume 4, Issue 3, March -2017

RCC Column Strengthening by CFRP

(Carbon Fibre Reinforced polymer)

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Abstract- *Some existing reinforced concrete structures do not have sufficient seismic capacity, therefore, various retrofitting techniques are proposed. However, such techniques are not always adequate from the viewpoint of the increase in weight and the maintenance of the function. In order to overcome these problems, The method developed a new method using carbon fibre, which is a material of high strength, light weight and good durability, and recently developed as a 'high-tech' material. In this paper, basic design, application techniques and durability of carbon fibre are introduced. This reinforcing system is more economical than conventional ones, and it has been used to improve the earthquake resistance of concrete structure. This system is also applicable to reinforcing buildings and freeway piers.*

Keywords- *Methodology, Application Procedure, Adhesive Mixing, Fabric Placement, Primer Application*

Methodology

Application Procedure: For application of Carbon fibre wrapping for deficient structure at any locations the various methods available in field. In that the below steps apply for execution of wrapping methodology.

Surface Preparation:

The surface must be dry and free of deteriorated concrete, bond inhibiting material and contaminants as dust, foreign particles, laitance, oil, grease, coatings, curing compounds, waxes and impregnation. Concrete substrates must be prepared mechanically using abrasive blast cleaning or grinding equipment. This will remove cement laitance, loose and friable material to achieve a profiled open textured surface. Surface defects such as honeycombed areas, blowholes and voids must be fully exposed by grinding. All prepared surfaces shall be air blasted and vacuumed clean with an industrial vacuum cleaner to a dust free condition. Edges & Corners must be generally rounded to a minimum radius of 25mm or as per the design specification. This can be achieved either by grinding or by building up with Epoxy mortars. Internal corners shall be smoothed by towelling epoxy mortar into the corners.

Fig.1 Surface Preparation

Adhesive Mixing:

The resins should be mixed and used as described below. Avoid aeration during all mixing actions. The pot life begins when the resin and hardener are mixed. It is shorter at high temperatures and longer at low temperatures. The greater the quantity that is mixed, the shorter the pot life becomes. To obtain longer workability at high temperatures, the mixed adhesive may be divided into portions. The sequence of operations shall be planned to ensure that the adhesive can be applied, joined and the work with it completed within three hours of mixing the adhesive or within 80% of the pot life, whichever comes first.

Primer Application:

Apply Epoxy Based Adhesive to the prepared substrate using a trowel, roller or brush, consumption 0.5 to 1.0 kg/m2, depending of the roughness of the substrate.

Fig.2 Primer Application

Fabric Placement / Lamination:

Place the wet Carbon Fibre Wrap fabric in the required direction onto the Epoxy Adhesive. Carefully work the fabric into the resin with the impregnation roller parallel to the fiber direction until the resin is squeezed out between and through the fiber strands and distributed evenly over the whole fabric surface.

Fig. 3 Fabric Placement

Finish after Sand Application:

After completion of fibre wrapping layer the whole peripheral surface of column sprayed by course sand for bonding purpose of cement mortar or other finish product application. The course sand also sprayed on the adhesive which apply on surface of the fibre sheet.

Fig. 4 Sand Application

Final Finish after Cement Plaster Application:

The application of plaster with cement mortar for complete finished surface after the completion of fibre wrap layer at all member which strengthened by fibre sheet. The ratio of cement to sand 1: 3(1 part cement and 3 part sand) more suitable for plaster application.

Fig.5 Cement Plaster Application

Results:

Below results obtained after number of wrapping to be operated and found satisfactory strength as per the design calculations. The results are tabulated in below table for easy understanding of column strength. Also cost comparison with conventional jacketing and CFRP are stated in table 2.

Table 1 Results for CFRP Test

Sr. No.	Identification Mark	Size of cube in mm	Grade of Concrete	Date of Casting	Date of Testing	Comp. load	Comp. Strength in N/mm2	Avg. Comp. Strength in N/mm2	Remarks
1	Block-B slab	150x150x150	M-35	03/12/16	12/01/17	1319.3	58.63	64.23	Regular Cube
2	Block-B slab	150x150x150				1461.3	64.94		
3	Block-B slab	150x150x150				1555.1	69.11		
4	Block-B slab	150x150x150	M-35	03/12/16	12/01/17	1601.1	71.16	70.63	Cube with one coating
5	Block-B slab	150x150x150				1572.5	69.89		
6	Block-B slab	150x150x150				1599.3	71.08		
7	Block-B slab	150x150x150	M-35	03/12/16	12/01/17	1745.1	77.56	78.36	Cube with two coating
8	Block-B slab	150x150x150				1774.1	78.85		
9	Block-B slab	150x150x150				1773.2	78.81		
10	Block-B slab	150x150x150	M-35	03/12/16	12/01/17	1882.3	83.66	85.42	Cube with three coating
11	Block-B slab	150x150x150				1902.6	84.56		
12	Block-B slab	150x150x150				1932.0	85.87		
13	Block-B slab	150x150x150	M-35	03/12/16	12/01/17	1899.9	84.44	92.53	Cube with four coating
14	Block-B slab	150x150x150				2181.6	96.96		
15	Block-B slab	150x150x150				2164.8	96.21		

Cost Comparison with conventional Jacketing and CFRP:

Table 2

Sr. No.	Description	Nos.	Unit	Measurement	Rate in Rs.	Amount in Rs.
	Cost for Jacketing					
1	Excavation	1	Cum	40.0	90.00	3600.00
2	Surface preparing	1	Sqm	16.0	55.00	880.00
3	Rebaring of steel	120	Nos.	120.0	160.00	19200.00
4	Reinforcement	1	Kg.	150.0	60.00	9000.00
5	Shuttering & De-Shuttering	1	Sqm	23.4	550.0	12870.00
6	Concreting	1	Cum	6.5	6500.00	42250.00
7	Earth filling	1	Cum	40.0	70.00	2800.00
	Cost for CFRP					90600.00
8	Carbon Fiber Wrapping	1	Sqm	23.4	2300.00	53820.00

