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(AN AUTONOMOUS INSTITUTION, AFFILIATED TO VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM, APPROVED BY AICTE & GOVT.OF KARNATAKA)

"Experimental Study on Load Transfer Mechanism in Columns Retrofitted By Bonding Precast Segment and FRP Wrapping"

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KEY WORDS

- Retrofitting,
- Rehabilitation
- Conbextre–GP2
- Confiment
- Loading Frame
- Repair

INTRODUCTION

In the present study, the small hairline gap between beam and pre stressed column joint are discussed. For this in previous studies strengthening of column is done. Rehabilitation is the process of returning a building or an area to its previous good conditions whereas retrofitting is the process of altering a building in retrospect to improve its performance characteristics. The structure is retrofitted keeping in mind its purpose of use, performance requirements, level of safety and durability required, with due consideration of the ease of maintenance, as well as overall economy. A comprehensive plan from health inspection through selection of retrofitting method, design of retrofitting structure and implementation of retrofitting work is prepared based on requirement. Retrofitting is the addition of new technology or features to older systems. Retrofits can happen for a number of reasons, for example with big capital expenditures like naval vessels, military equipment or manufacturing plants, businesses or governments may retrofit in order to reduce the need to replace a system entirely. Other retrofits may be due to changing codes or requirements, such as seismic retrofit which are designed strengthening older buildings in order to make them earthquake- resistant.

MATERIALS

The materials used for the experiments presented as follows,

1. **Micro concrete**

   It is used for repairs to damaged reinforced concrete elements, particularly where access is restricted and where vibration of the placed material is difficult or impossible. It is a cement-based coating applied to various surfaces like tiles and woods to provide the look and feel of concrete at fraction of the weight and cost of real concrete.

2. **Coarse Aggregates**

   For casting precast segments along with micro-concrete powder, coarse aggregates are in the ratio of 1:0.75 (Power: Coarse Aggregates). 10 mm down size aggregates are used after sieving through 10 mm IS Sieve.

3. **Carbon Fiber Reinforced Polymer (CFRP)**

   Carbon fiber reinforced polymer is extremely strong and light fiber reinforced plastics the contains carbon fiber. Tensile strength carried by CFRP falls between 1500 and 3500 MPa. It weighs around 0.55 pounds per cubic inch.

OBJECTIVES

1. To check the performance of different types of joints between top of precast segment and bottom of beam in present method of retrofitting
2. To determine the load carrying capacity of columns retrofitted by precast segment and FRP wrapping in which jointing between the top of precast segment and beams done by different methods
3. To determine the moment carrying capacity of columns retrofitted by precast segment and FRP wrapping in which jointing between the top of precast segment and beams done by different methods
4. To determine the effect of number of layers of CFRP used in carrying load and moment carrying capacity.

NEED FOR PRESENT STUDY

In upcoming method of retrofitting by shape modification using precast segments and FRP wrapping, the joint between the top of newly added pre-cast segments and beam plays a vital role in transferring the load from beams the precast segments as shown in below figure. Hence, by just attaching precast segment may not take care of this, because there may be hairline gap between the precast segments and beam. Hence, development and understanding of different methods of jointing technique needs to be studied.

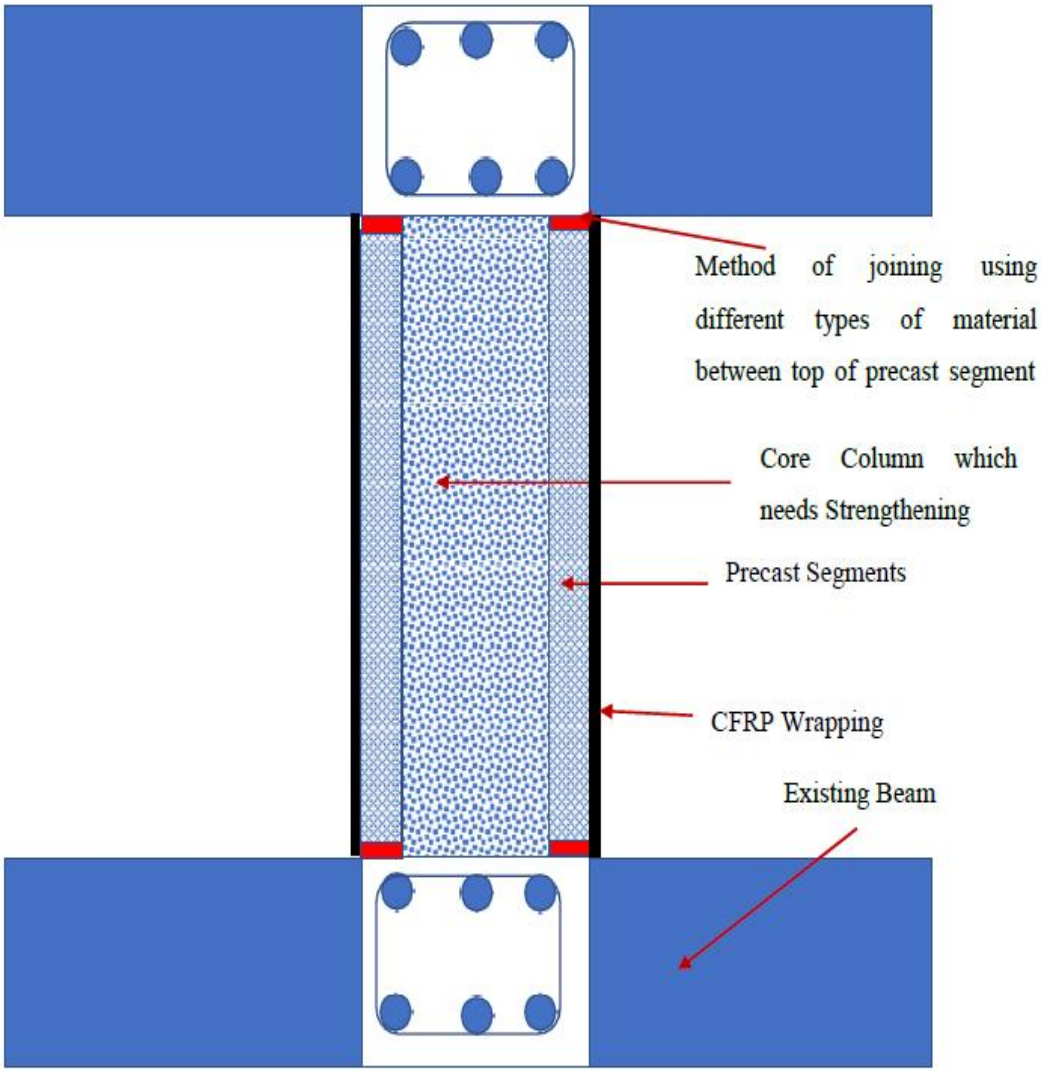

Figure (01) Need for present study

METHODOLOGY AND EXPERIMENTAL WORK

M20 concrete is used to prepare rectangular column. The prepared specimens were cured for 28 days. The precast segments different curve radii are prepared and cured which will be used to convert rectangular cross section of column to elliptical shape with different aspect ratio. The precast segments are attached to column by epoxy materials. FRP wrapping is done on to the columns in 1 to 2 layers. The gap at junction between the top of precast segment and bottom of the beam is filled using different materials such as epoxy material or cement mortar or left as it is without filling the gap. Testing is carried out in 200 T loading frame present in the structural Engineering Laboratory of NMIT. Monotonic load is applied gradually with suitable load interval up to failure and corresponding axial deformation and strains are recorded as the important points on the specimens. The following procedure is adopted while conducting experiments.

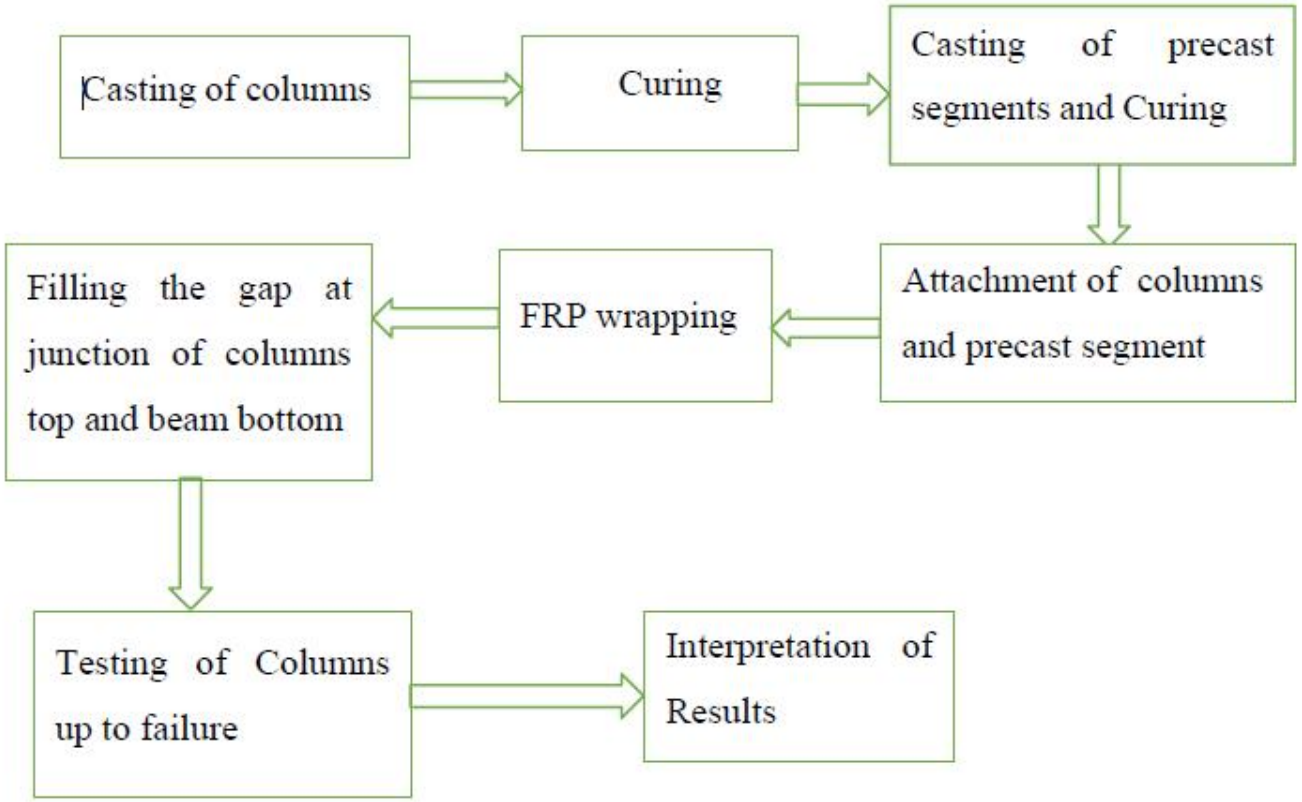

Figure (02) Flow chart of methodology

QUANTITY OF MATERIALS REQUIRED

The total quantity of adhesive, micro concrete and FRP wrapping required are given following table.01,

Table.01 Quantity of the materials required for the project

Quantity of the materials required for the project (Includes all specimen)				
sl.no	material type	surface area sq. meters	Quantity	remarks
1	Micro Concrete	_	20 Bags	Each bag contains 14 liters
2	Adhesive (column surface area) 0.9 m column	6.75		
	Adhesive (column surface area) 1.5 m column	6.75		
	Adhesive (ellipse surface area) 0.9 m column	11.58		this values is calculated based on no wrapping done to the columns
	Adhesive (ellipse surface area) 1.5 m column	13.7		this values is calculated based on no wrapping done to the columns
	total adhesive	38.78		meter square
		39		including wastages
3	FRP (wrapping)			
	0.9 m length columns (2 layers)	2.88		no of columns 3 aspect ratio 1
	0.9 m length columns (2 layers)	3.12		no of columns 3 aspect ratio 1.5
	0.9 m length columns (2 layers)	3.24		no of columns 3 aspect ratio 2
	0.9 m length columns (1.5 layers)	2.34		aspect ratio yet to decide

	0.9 m length column no FRP	0		no FRP wrapped
	1.5 m length columns (2 layers)	4.8		11.58 (sum of 0.9 m column ellipse surface area) double layer of FRP
	1.5 m length columns (1.5 layers)	3.9		strip layer of FRP included
	1.5 m length columns (2 layers)	5		rehabilitation column included
				13.7 (sum of 1.5 m column ellipse shape surface area
	total FRP area	25.28		
		26		Including wastages

EXPERIMENTAL INVESTIGATION

Formwork

The formwork used for preparing the precast segments is presented in here. Theformwork is made using thermocol, plywood and plastic sheet.

Thermocol

High density thermocol as in Fig-6.1.1 is required for casting the precast segments in the customized shape. The density of thermocol used is of 30 kg/m^3. The thermocol

Figure (03) Thermocol

Ply Wood

To prevent the breakage of thermocol plywood as shown in Fig.6.1.2 (a) and Fig.6.1.2 (b)is provided as support around it.

Wooden or plywood formwork for casting of precast segments.

Figure (04) Plywood

Figure (05) Thermocol supported plywood

Assembling formwork

The column which is to be retrofitted is of size 150×150 mm of two different lengths 0.9 m and 1.5m. First from the ellipse shape we have deducted the area of square size column and then from the remaining area of ellipse by varying the aspect ratio 3 different shapes of precast segments as shown in figure are created to attach it to the column after casting. The 3 different aspect ratios are AR 1.0 , AR 1.5 , AR 2.0

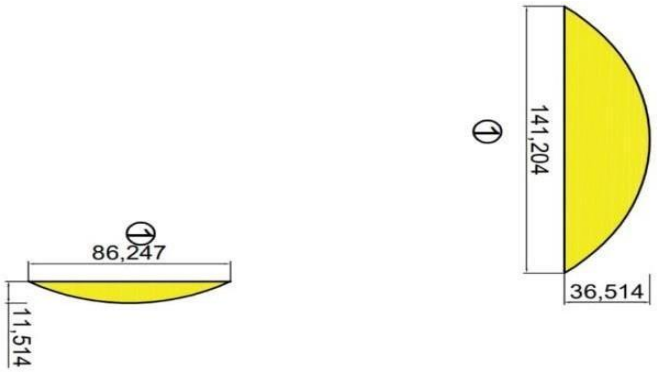

Figure (06) Aspect ratio of AR 1.0

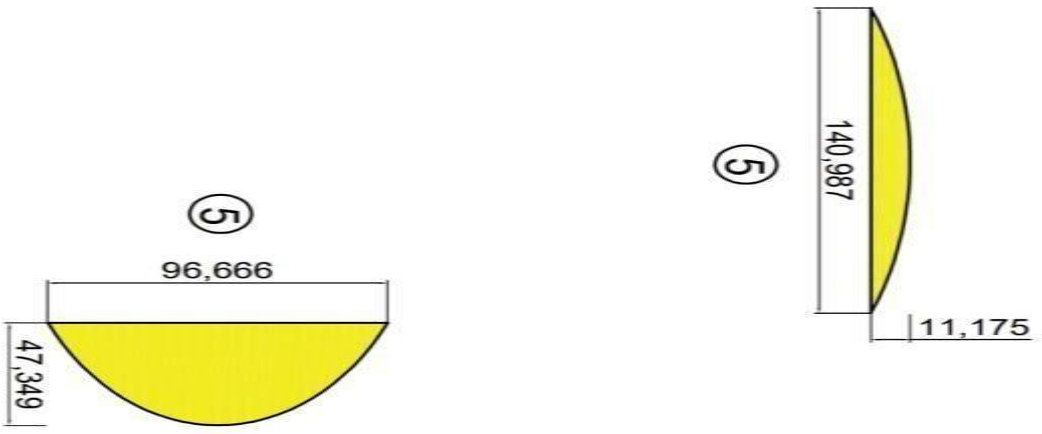

Figure (07) Aspect Ratio 1.50

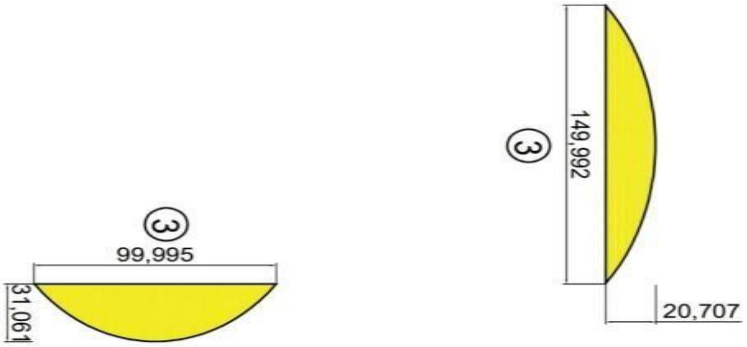

Figure (08) Aspect Ratio 2.0

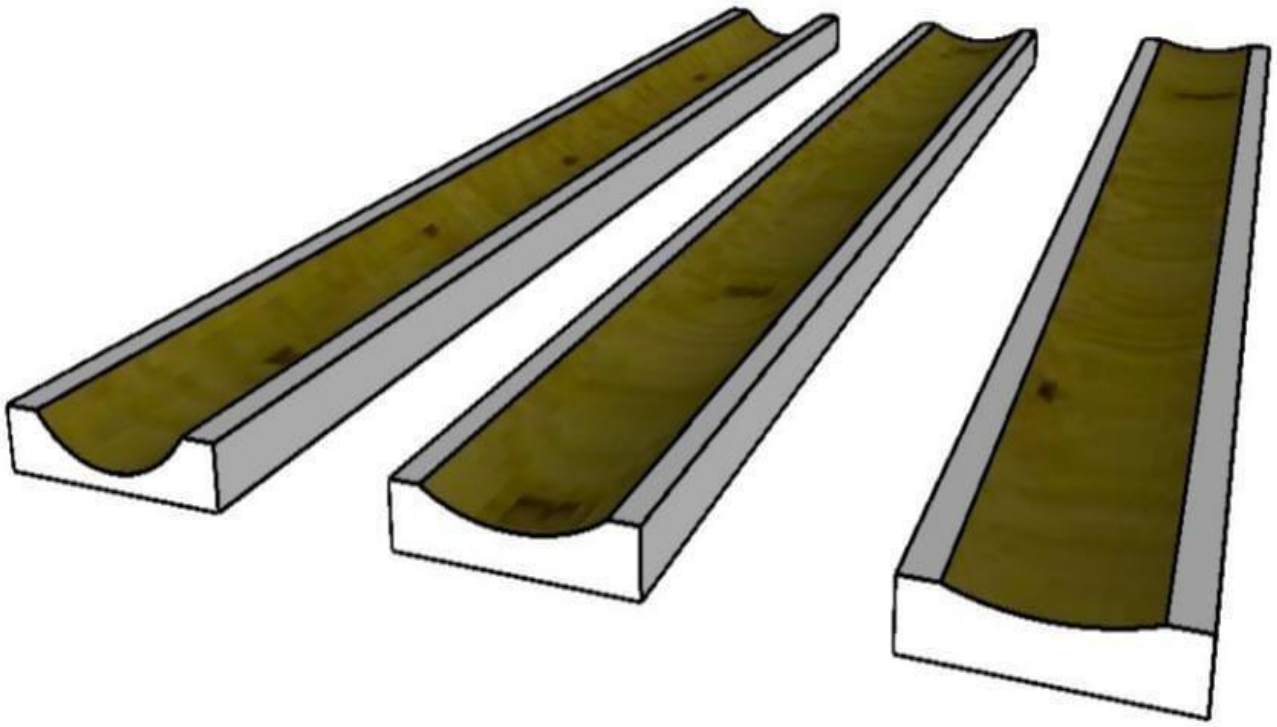

Figure (10) 3D view of the Drawing

Preparation of Precast Segments

First the retrofitting of column should be done by attaching precast segments to thecolumn. Hence the precast segments should be casted in earlier mentioned formwork.

Mixing of micro concrete

The concrete will be mixed by hand mixing because of fast setting property of microconcrete The mixing ratio of powder to coarse aggregates will be 1: 0.75 and water to powderratio will be 0.16: 1 i.e.

- Powder: Coarse aggregate = 1: 0.75
- Water/Powder = .160 i.e., for 1kg of micro concrete 160ml of water should be used.

Placing of Micro-concrete

As per the mix ratio provided by the manufacturer water content we can start mixing the micro concrete and 10mm down size aggregate. As we want cast for 12 specimens of column of size 150*150mm of 0.9m length and 1.5m length of 9 columns. Each column requires 4 pre-cast segments, we also considering different aspect ratio such as AR1, AR1.5, AR2. In 0.9m length AR1.5 for 6 columns, AR1 for 3 columns and AR2 for 3 columns. For 1.5m length AR1.5 of 8 columns and AR2 of 1 column.

Figure (11) Casting of Specimen

Figure (12) Casted Specimen

Curing of Precast segments

After 48 hours of casting the precast segment, the mold is removed and kept for curing. As it is structural retrofitting the precast segments are cured for 28 days in gunny bags without immersing it in the water.

Figure (13) Curing of Precast segments

Capping

Capping of the specimen at top and bottom end faces was done using a cementations grouting material (compressive strength 55-65 MPa after 7 days), to make the end surfaces smooth and perfectly perpendicular to the longitudinal axis of the compression members to ensure uniform distribution of applied compressive stress.

Figure (14) Capping

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