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Retrofitting of short column with the help of textile fabrics

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Abstract — *When the RCC column is subjected to loads, it may behave in different way and may get damaged or failed. There are several methods to prevent such damages or failure, as well as to increase the load carrying capacity of column. In this experimental work, the columns were wrapped by textile fabrics in different patterns and studied the behavior of the column in terms of linear expansion/contraction of column, the crack patterns development and the ultimate load carrying capacity of column subjected to axial compression load. This work is done to conclude the utility of the textile fabrics, the extent of the wrapped column that would carry the load, the changes in behavior of column, and the pattern of textile fabrics that would give the effective results.*

Keywords- *Concrete, Short columns, Retrofitting, axial load, Textile fabrics, linear expansion/contraction, Universal Testing Machine*

I. INTRODUCTION

Concrete column or pillar in architecture and structural engineering is a structural constituent that transmits, through compression, the weight of the constitution on top of two other structural elements below. In other words, a column is a compression element. Columns are commonly used to support beams or Acheson which the upper parts of walls or ceilings rest. They are vulnerable in situations where there is an increase in structural capacity. The treatment and upgrading of structural constituents, is one of the most crucial problems in civil engineering. Also, a large number of structures having older design methods in different parts of the world are structurally not safe as per the new design methods. Retrofitting has become the best suitable way of improving the load carrying capacity and extending the service lives of these structures since replacement of these defective constituents requires a large amount of time and money. The major challenge in strengthening of concrete structures is choice of a strengthening method that will enhance the serviceability and strength of the structure along with addressing limitations such as structure operations, financial plan and constructability.

One of the method of strengthening or repair or retrofitting of RCC column is external bonded reinforcement. This can be done using non-woven or woven fabrics or jackets or steel plates. But reinforcing with steel is time consuming and non-economical. There are large number of projects have been done with textile fibers and it has be concluded that this technique is suitable for structural repair and strengthening. So our purpose is to identify that textile fabrics can also be used for the same!! This technique is one of the latest and less used developments in the civil engineering industry.

1.1. Aim and Objective of the work

The main aim of this project is to study how much useful and effective textile fabrics to strengthening of RCC column and effect on load carrying capacity of load by increase in no of fabrics layer. Objectives of the project are:

- To study the basis of textile fabric strengthening.
- To compare the load carrying capacity and compressive strength of an ordinary RCC column and RCC column wrapped with textile fabrics.
- To compare the result by wrapping with full manner and in stripping manner.
- To compare the strength result by wrapping the fabrics on full surface, L/4 portion of top and bottom portion and middle L/2 portion.
- To compare the load carrying capacity increment by wrapping fabrics with single and double layer.
- Finally to use woven textile fabrics for external reinforcement to check whether to check increment in load carrying capacity and it can be use for repairing work instead of retrofitting.

II. EXPERIMENTAL PROGRAM

The casting and testing of columns was consisted in experimental work. All the columns have same dimensions and same concrete mix.

2.1. Casting of columns

The columns used for the experimental work are rectangular in shape. The dimension of columns is 150x150x750 mm. 4 numbers of 8mmØ bars are used as longitudinal steel and 6mmØ steel bars are used as lateral tie at 90mm c/c distance, i.e. 2-legged 6mmØ bars with 90mm c/c distance. The concrete mix was prepared to targeted strength of M20, i.e. 20 N/mm^2. The materials used in concrete have following properties: Cement – 53grade ordinary Portland cement, Sand – white sand, coarse aggregate. For retrofitting Polypropylene is used for wrapping the columns is of 120GSM. The adhesive used is Sikadur31.

2.2. Preparation of columns

Moulds are filled with concrete and compacted with tamping rod and vibrator machine. After 24 hrs columns was unmolded and cured for 28 days in water tub. Then they were removed from the water and cured for one day in atmosphere. Wrapping work is then done on them and again cured for 7 days.

The test columns are divided into following groups:

Table 1. Detail of specimens

Sr. No.	Specimen Indication	Description
1	Normal column	Reference column used without wrapping
2	FSL	Full single layer
3	FDL	Full double layer
4	¼ SL	¼ from top and bottom single layer
5	¼ DL	¼ from top and bottom double layer
6	MSL	Middle single layer
7	MDL	Middle double layer

2.3. TESTING OF SPECIMENS

Test of all the specimens were done on 'Universal Testing Machine-UTM' of 1000kN capacity. First of all the reference column was tested and then other wrapped columns. Load was applied on the column up to its ultimate capacity and the ultimate load was noted digitally for each specimen.

Figure 1. Arrangement of column in UTM

III. RESULTS

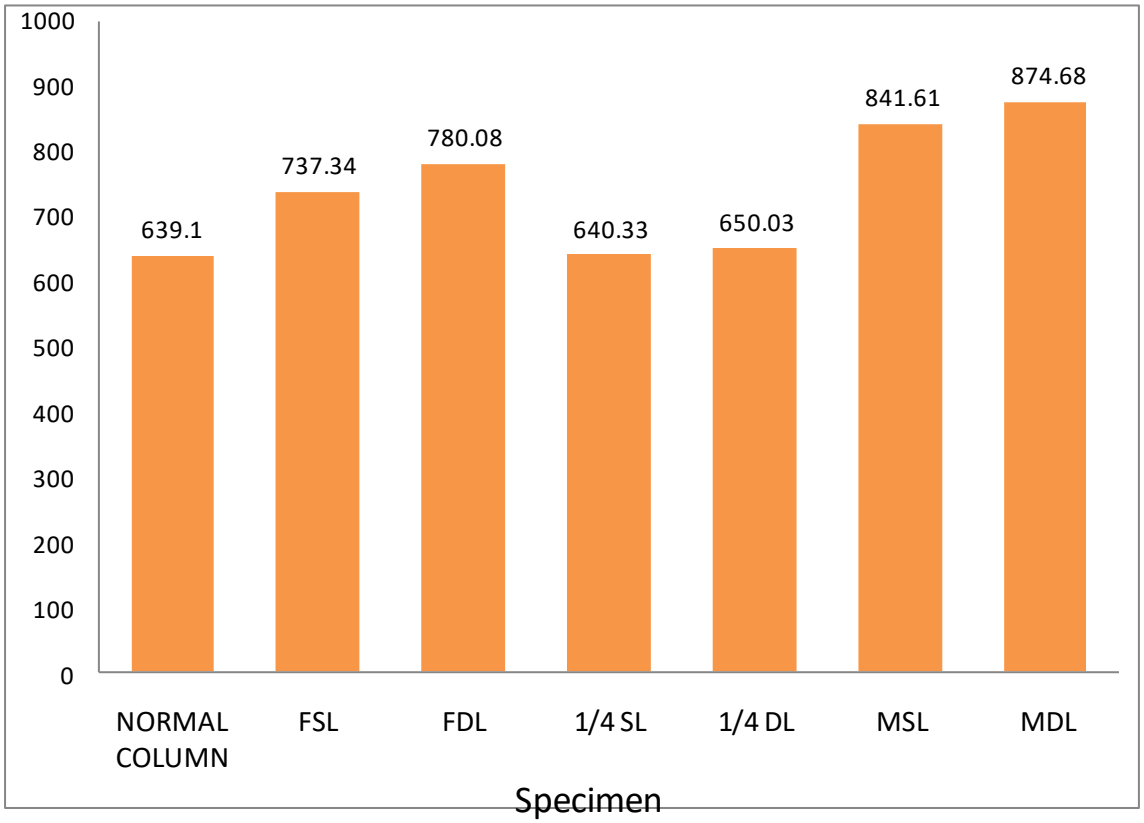

Figure 2. BAR Chart

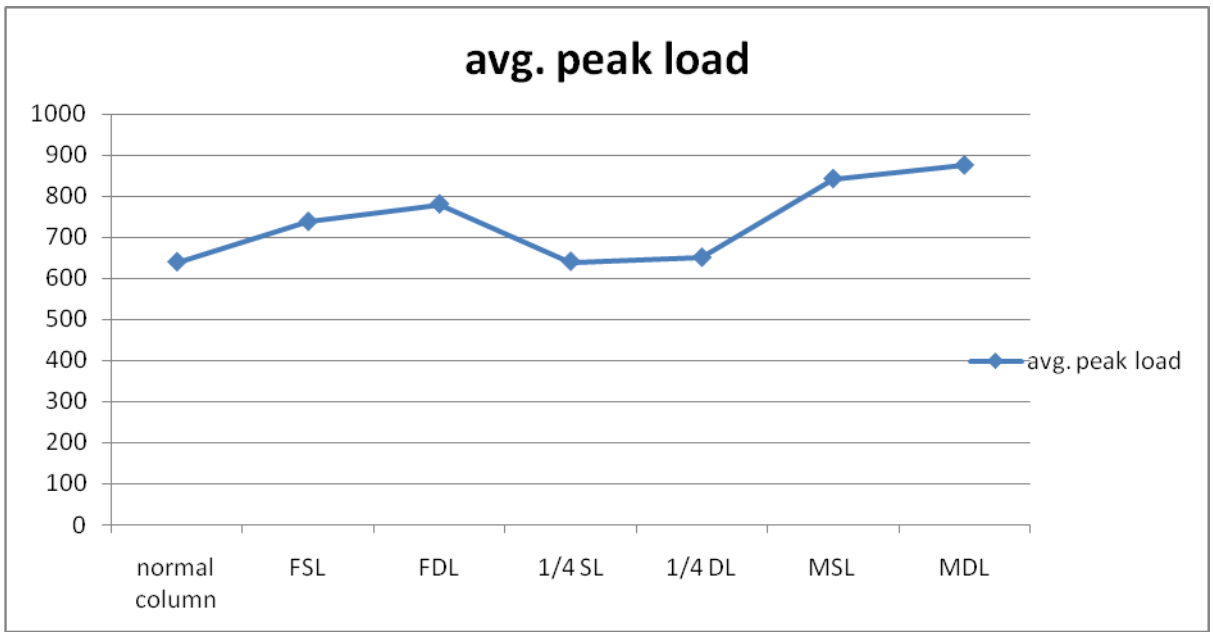

Figure 3. LINE Chart

Figure 4. Failure of MDL

Table 2. Results of tests on various specimens

Sr. No.	Specimen Indication	Description	Ultimate Load (kN)	% increase in load carrying capacity (%)
1	Normal column	Reference column used without wrapping	639.1	----
2	FSL	Full single layer	737.34	15.37
3	FDL	Full double layer	780.08	22.06
4	¼ SL	¼ from top and bottom single layer	640.33	0.1925
5	¼ DL	¼ from top and bottom double layer	650.03	1.71
6	MSL	Middle single layer	841.61	31.69
7	MDL	Middle double layer	874.68	36.86

Here, we can observe that the ultimate loads of wrapped columns are more than the reference column. So increase in load carrying capacity of full single layer wrapped column, full double layer wrapped column, ¼ single layer wrapped column from top & bottom, ¼ double layer wrapped column from top & bottom, middle single layer column and middle double layer column in percentage respectively 15.37%, 22.06%, 0.1925%, 1.71%, 31.69% and 36.86%.

IV. CONCLUSIONS

From the experiment result we can conclude that wrapping at middle one half portions is more effective than the other two methods. This may be because of providing external support at the most affected area of the column as short column fails by crushing. The crushing of column occurs in that region. Due to failure of column crushing will occur. As the column is wrapped at middle one half portions, it gives the extra external support at the most affected area. So the capacity of withstanding the column against the compressive load is increased.

The load carrying capacity of wrapped column at middle one half portions is more than the fully wrapped column. As we have seen that the increment in load carrying capacity of column wrapped at ¼ top and bottom portion is

negligible. So in the fully wrapped column those portions' wrapping are negligible and non effective. As these will act as silent mode and hence the load carrying capacity has not increased much.

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