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Enhancement of Flexural Strength of RC Beam ByUsing Kevlar Fabric

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ABSTRACT: The use of composite materials in infrastructure repair is still in its infancy. As such, most of the currently available solutions employ relatively dated composites technology and many of the early difficulties experienced in the aerospace, automotive and marine markets have been seen in the early implementation of composites for infrastructure strengthening. This project examines the benefits derived from using aerospace grade materials (Kevlar fabric) in infrastructure repair. It demonstrates that, the use of appropriately engineered repair strategies incorporating high quality pre-impregnated composite materials can provide substantial strength and stiffness improvements to conventional steel reinforced concrete beams.

KEYWORDS: Tensile Strength,UltimateStrength,Tharmal Properties

I. INTRODUCTION:

The maintenance, rehabilitation and upgrading of structural members is perhaps one of the most crucial problems in civil engineering applications. Moreover, a large number of structures constructed in the past using the older design codes in different parts of the world are structurally unsafe according to the new design codes. Since replacement of such deficient elements of structures incurs a huge amount of public money and time, strengthening has become the acceptable way of improving their load carrying capacity and extending their service lives.

Infrastructure decay caused by premature deterioration of buildings and structures has led to the investigation of several processes for repairing or strengthening purposes. One of the challenges in strengthening of concrete structures is selection of a strengthening method that will enhance the strength and serviceability of the structure while addressing limitations such as constructability, building operations and budget.

Structural strengthening may be required due to many different situations. Additional strength may be needed to allow for higher loads to be placed on he structure. This is often required when the use of the structure changes and a higher load carrying capacity is needed. This can also occur, if additional mechanical equipment, filing systems, planters, or other items are being added to a structure.

To allow the structure to resist loads those were not anticipated in the original design. This may be encountered when structural strengthening is required for loads resulting from wind and seismic forces or to improve resistance to blast loading.

II. MATERIALS AND METHODS:

1 Concrete:

The main ingredients of concrete are as follows,

1. Cement.
2. Fine aggregates (i.e. sand)
3. Coarse aggregate.
4. Water.

2 Mix design of concrete:

There are various methods of mix design. In the present work, Indian Standard method (IS: 10262 - 1982) is used for mix design.

Assumptions

Characteristics Strength required at 28 days = 30 Mpa

Max size of Aggregate = 20 mm (angular)

Degree of quality control = Good

Type of exposure = Mild.

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Procedure of Mix Design
Characteristics Strength = f_{ck} = 30 N/ mm^2
Target mean strength, $f_t = f_{ck} + t \times S$
t = 1.65 &
S = standard deviation from (Table 1 of I.S 10262-1982 page No.5, 6)
For M30 grade concrete & good quality control, S = 6
Target mean strength = 30 + (1.65 x 6) = 39.90 Mpa

Step 1:
To decide water cement ratio, which will give 39.90 Mpa refer graph from I.S 10262-1982 (page No.7)
Select Water/Cement ratio = 0.43; this is lesser than 0.55 prescribed in I.S 456-2000 for mild exposure condition for reinforced concrete (Table 5).

Step 2:
Now from Table 4 of I.S 10262-1982, page No.9 for maximum 20 mm size of aggregate water content per m^3 of concrete is = 186 kg and sand as percentage of total aggregate by absolute volume = 35 % (for W/C = 0.6)
Hence for W/C = 0.43, adjustment from Table-6 of I.S 10262-1982, page No.11,
Ratio of fine aggregate to total aggregate = $35 - \frac{(0.6 - 0.43)}{0.05}$ = 31.6%

Step 3:
To know the cement content,
W/C = 0.43
W = 186 kg / m^3
C = 186 / 0.43
= 432.55 kg/m^3

Step 4:
To decide naturally entrained air from Table 3 of I.S 10262-1982,For 20 mm size aggregate, entrapped air % of volume of concrete = 2%

Step 5:
Determination of water & fine aggregate content using equation 3.5.1 of I.S. 10262-1982, page no. 11, the total aggregate content per unit volume of concrete may be calculated from following equation,

$$V = \left[W + \frac{C}{S_c} + \frac{1}{P} \times \frac{F_a}{S_{fa}} \right] \times \frac{1}{1000}$$

$$V = \left[W + \frac{C}{S_c} + \frac{1}{1-P} \times \frac{C_a}{S_{ca}} \right] \times \frac{1}{1000}$$

Where,
V = absolute volume of fresh concrete which is equal to gross volume minus volume of entrapped air.
W = mass of water (kg) per cum of concrete.
C = mass of cement (kg) per cum of concrete.
S_c = Specific gravity of cement.
P = ratio of F.A. to aggregate absolute volume,
F_a,C_a = total masses of FA & CA (kg) per cum of concrete respectively &
S_{fa},S_{ca} = specific gravity of saturated surface dry fine aggregate & coarse aggregate respectively.

$$V = \left[W + \frac{C}{S_c} + \frac{1}{P} \times \frac{F_a}{S_{fa}} \right] \times \frac{1}{1000}$$

$$0.98 = \left[186 + \frac{432.55}{3.15} + \frac{1}{0.316} \times \frac{F_a}{2.652} \right] \times \frac{1}{1000}$$

F_a = 550.32 kg/ m^3

$$V = \left[W + \frac{C}{S_c} + \frac{1}{1-P} \times \frac{C_a}{S_{ca}} \right] \times \frac{1}{1000}$$

$$0.98 = \left[186 + \frac{432.55}{3.15} + \frac{1}{1-0.316} \times \frac{C_a}{2.664} \right] \times \frac{1}{1000}$$

C_a = 1196.59 kg/ m^3
The mix proportion then becomes - 1: 1.272: 2.766

Quantity of materials per cubic meter of concrete.

Material	Proportion by Weight	Weight in Kg/m^3
Cement	1	432.55
FA	1.272	550.32
CA	2.766	1196.59
W/C	0.43	186.0

III. CONCLUSION

The project demonstrates that, the use of appropriately engineered repair strategies incorporating high quality pre-impregnated composite materials can provide substantial strength and stiffness improvements to conventional steel reinforced concrete beams.

In this experimental investigation the flexural behaviour of reinforced concrete beams strengthened by Kevlar fabric was studied. From the test results and calculated strength values. In the range of service loads the Kevlar fabric reinforcement yields to lower crack widths and crack intervals. By strengthening the beam, performance of a weakened structure can be improved and it will protect many lives from sudden failure.

This method of strengthening does not reduce the headroom and prevents corrosion of the reinforcement effectively.

With this study carried out, it can be concluded that, this method of strengthening the flexural members in existing buildings is a better option for repair and maintenance.

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