Behavior of RCC Rectangular Beam with Encased U-Shaped Welded Wire Mesh under Flexure and Shear

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Abstract - *Retrofitting techniques are very useful for strengthening of existing structures. FRP, CFRP, GFRP, Sisal Fiber, Jute Fiber are some materials used in retrofitting techniques also recently research on Ferro-cement Jacketing has been laid by the some researcher, but retrofitting techniques are effective for existing structures they cannot overcome the inherent weakness of concrete and not utilized for purposed structures. However there is also way to utilize the WWM (Welded Wire Mesh) in body of concrete due to its high tensile strength and because of encased of WWM with concrete they form a new type of good composite material. In these present experimental work on the behavior of RCC Rectangular beam with encased U-shaped Welded Wire Mesh under Flexure and Shear carried out. Control beam specimens, beam containing welded wire mesh with stripes wrapping and beam containing welded wire mesh with fully wrapping beam specimen was casted and tested under two point loading system. The results were used to study the flexural and shear strength behavior. It is obtained beam containing welded wire mesh with fully wrapping beam specimens gives the maximum carrying capacity of load over than control beam specimens and beam containing welded wire mesh with stripes wrapping beam specimens*

Key Words: Fibre Reinforced Polymer, Ferro-cement, Welded Wire Mesh, Flexure strength, Shear strength.

1. INTRODUCTION

Maintenance of RCC structures is one of the most thing. There can be many reasons for the deterioration of structures, lack of skilled labor, inadequate design, some environmental influence etc. therefore huge need repair and strengthening of deterioration structures. Generally mostly used in two techniques i.e. Fiber Reinforced Polymer and Ferrocement Techniques.

Fibre reinforced polymer is also called as fibre reinforced plastic. It is composite material made of a polymer matrix reinforced with fibres. Composite is a combination of two or more material which is different in the form. Fibre reinforced composites can have different arrangement of fibres within the polymers. The function of polymer in the composites is to transfer stress between reinforcing fibres and to protect the fibres from mechanical and environmental damage. In modern construction, Fibre reinforced polymer are widely used [1].

Ferro-cement is the composite of Ferro (Iron) and cement (cement mortar). In which small thin wire meshes are placed thoroughly structural element and wire meshes are filled with a cement mortar. Ferro-cement technique used in all fields of civil construction work including water and soil retaining structures, building components, space structures of large size, bridges, domes, dams, boats, conduits, bunkers, water treatment plants and sewage water treatment plants [2].

In RCC member observed that, they do not effective in post-cracking stage However, retrofitting techniques are very useful for strengthening of existing structures. FRP, CFRP, GFRP, Sisal Fiber, Jute Fiber are some materials used in retrofitting techniques also recently research on Ferro-cement Jacketing has been laid by the some researcher, but retrofitting techniques are effective for existing structures they cannot overcome the inherent weakness of concrete and not utilized for purposed structures. However there is also way to utilize the WWM (Welded Wire Mesh) in body of concrete due to its high tensile strength and because of encased of WWM with concrete they form a new type of good composite material.

2. MATERIAL PROPERTIS

2.1. Cement

Ordinary Portland Cement (OPC) of 53 grade cement is used in experimental work. All properties cement are tested by referring IS 12269:1987.

2.2. Coarse Aggregate

Locally available coarse aggregate were used in this work. Aggregates passing through 20mm IS sieve to 16mm IS sieve and tested as per IS 383:1970.

2.3. Fine Aggregate

The fine aggregate used for experimental program was locally procured and confirming to zone II. Fine aggregate passing through IS sieve 4.75mm to IS 150micron.

2.4. Water

The tap water available in the campus was tested for suitability.

2.5. Admixture

"CONPLAST P211" admixture was used in experimental work for workability of concrete.

2.5. Welded Wire Mesh

Welded Wire Mesh are made in mild steel material. It is two type 1) Oblong Wire Mesh, 2) Square Wire Mesh. In experimental work, chose square wire mesh having size is 31mmX31mm. Tensile strength of WWM tested on universal testing machine. Result shown below:

Table -2.5: Tensile Strength of Welded Wire Mesh

Sample No.	Tensile Strength
1	471.57 N/mm^2
2	493.42 N/mm^2
3	477.25 N/mm^2

3. MIX DESIGN

The Concrete mix M30 was designed as per IS 10262:2009.

Table -3: Mix Design Proportion.

Cement	Coarse Aggregate	Fine aggregate
1.00	2.29	3.80

4. DETAILS OF BEAM DESIGN SPECIEMNS

Sizes of beam specimens are 150mm width, 200mm depth and 1200mm length. In experimental work, five types of beam specimens are casted. Such as Longitudinal Reinforcement, Fully Nominal Reinforcement, under reinforcement, Balance Reinforcement, Partially over reinforcement. As per wrapping pattern of WWM they are divide in three group i.e. control beam specimens, Beam encased with WWM in stripes wrapping and Beam encased with WWM in fully wrapping. Designation of beam specimens shows below:

Table -4.1 Types and Designation of Beam specimens

Group 1 Control Beam Specimens	**Group 2 Beam encased U-shape WWM with Stripes wrapping**	**Group 3 Beam encased U-shape WWM with Fully wrapping**
R/RC/LR	R/RC/LR/USW	R/RC/LR/UFW
R/RC/FNR	R/RC/FNR/USW	R/RC/FNR/UFW
R/RC/UR	R/RC/UR/USW	R/RC/UR/UFW
R/RC/BR	R/RC/BR/USW	R/RC/BR/UFW
R/RC/POR	R/RC/ POR/USW	R/RC/ POR/UFW

To identify beam specimens from the following designation, R: Rectangular, RC: Reinforced Concrete, LR: Longitudinal Reinforcement, FNR: Fully Nominal Reinforcement, UR: Under Reinforcement, BR: Balanced Reinforcement, POR: Partially over Reinforcement, USW: U shaped Stripes wrapping, UFW: U shaped fully wrapping.

Table -4.2 RCC Beam Reinforcement schedule

Types Of Beam Specimens	**Bottom Reinforcement**	**Top Reinforcement**	**Stirrups**
R/RC/LR	2 # 8	2 # 8	-
R/RC/FNR	2 # 8	2 # 8	6mm @ 125mm C/C
R/RC/UR	2 # 10 1 # 12	2 # 8	6mm @ 125mm C/C
R/RC/BR	2 #12 2 # 10	2 # 8	6mm @ 125mm C/C
R/RC/POR	2 # 10 1# 16	2 # 8	6mm @ 125mm C/C

5. EXPERIMENTAL PROGRAM

The Casted beam specimens are was tested under two point loading system. Beam specimens is tested under 1200KN capacity of universal testing machine. The load was increased and decreased stages up to final failure of the specimen and at each stage of loading, the deflection was noted at the mid span of the specimens using Dial-gauge.

Fig -1: Experimental Program

6. RESULTS AND DISCUSION

6.1 Load vs Deflection

All beam specimens are tested under two point loading system and every 5KN load note deflection. The first crack and ultimate load recorded with their corresponding deflection. Drawn the load vs Deflection graph. Comparison graph of all beam specimens are showed below:

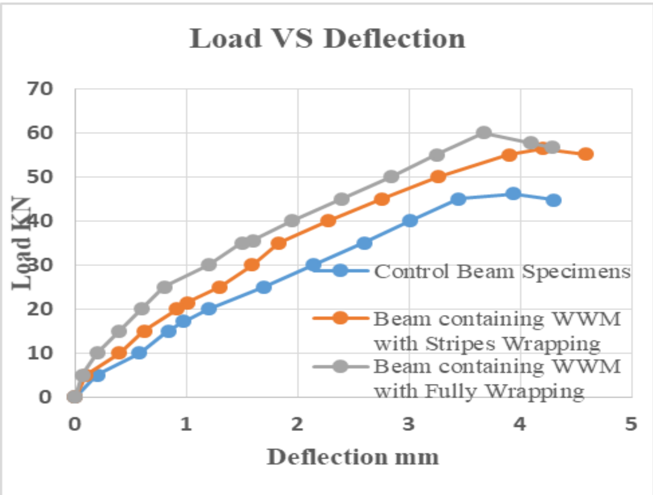

Chart -6.1.1: Longitudinal Reinforcement

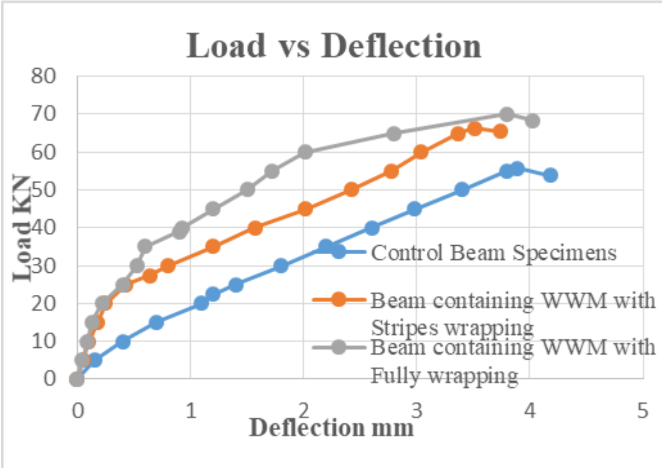

Chart -6.1.2: Fully Nominal Reinforcement

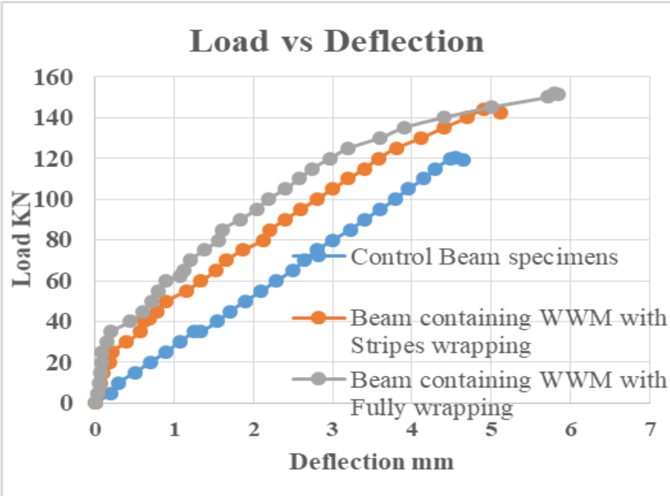

Chart -6.1.3: Under Reinforcement

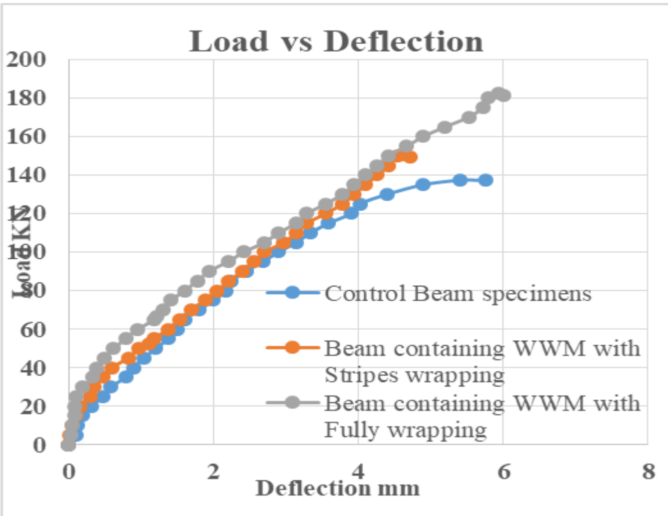

Chart -6.1.4: Balanced Reinforcement

Chart -6.1.5: Partially Over Reinforcement

It is observed that, load vs deflection graphs of control beam specimens, beam containing WWM with stripes wrapping and beam containing WWM with fully wrapping beam specimens are linearly increase up to first crack failure of specimens. After that graphs showed different deflections behavior in post cracking stage. Also it is observed that due to WWM encasement there is increasing in first crack and ultimate load as compare to control beam specimen as well as behavior of beams containing WWM with stripes wrapping and fully wrapping beam specimens contribute more load in same deflection as compare to control beam specimen.

6.2 Flexure and Shear strength

Flexure strength of RCC beam specimens is computation as per IS 516:1959 and shear strength of concrete is computation as per IS 456:2000.

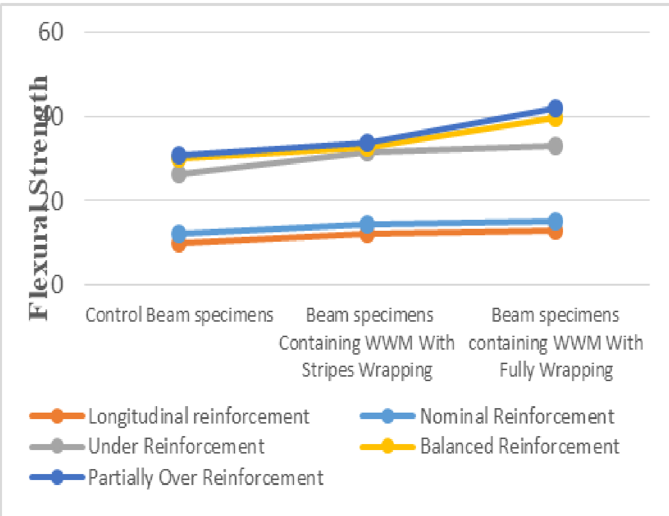

Chart -6.2.1: Flexural Strength

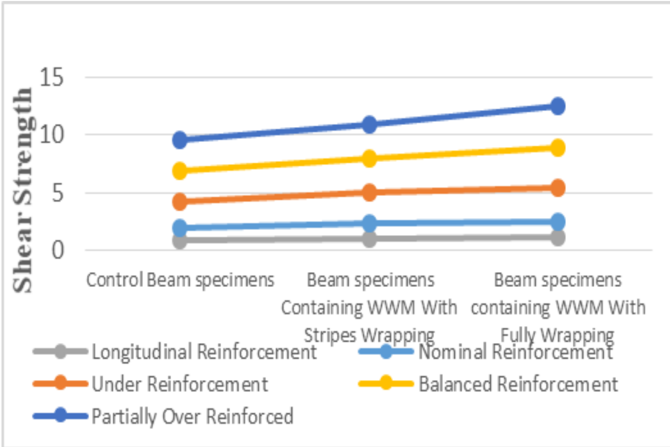

Chart -6.2.2: Shear Strength

The graphs are plotted to shows the beam having of flexural strength and shear strength in control beam specimens, beam specimens contains WWM with stripes wrapping and beam specimens contains WWM with fully wrapping.

The graph showed, there is increase in flexural strength by WWM stripes over control beam specimens varied from 10% to 22%. Also graph showed, there is increase in flexural strength by WWM fully wrapping over control beam specimens varied from 24% to 36%.

The graph showed, there is increase in shear strength by WWM stripes over control beam specimens varied from 10% to 23%. Also graph showed, there is increase in flexural strength by WWM fully wrapping over control beam specimens varied from 26% to 36%.

7. CONCLUSIONS

A detailed study has been carried out to observe the behavior of RCC Rectangular beam encased with Welded Wire Mesh under flexure and Shear. Hence following conclusion are considered based on test results and observations.

1. The test results it was observed that load vs Deflection graph of all categories beam specimens linearly behavior up to first crack load and after that graph showed different deflection behavior in post cracking stage.
2. In also load vs deflection graph the contribution in load resist by stripes and fully wrapping observed considerably in only longitudinal reinforcement and nominal reinforcement beam categories than remaining other categories.
3. There is increase in average ultimate flexural strength by 16.2% and 25% by beam containing WWM with stripes wrapping and WWM fully wrapping with respect to control beam specimens.

4. There is increase in average shear strength by 16.4% and 30.2% by beam containing WWM with stripes wrapping and WWM fully wrapping with respect to control beam specimens.

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