FLEXURAL BEHAVIOUR OF RC BEAM WITH WELDED MESH AS SHEAR REINFORCEMENT

Mr.K.Soundhirarajan[1], Mr.T.Sathieshkumar [2], S.Karthikeyan[3]

[1,2]Assistant Professor Gnanamani College of Technology Namakkal
[3]ME Structural Engineering Gnanamani College of Engineering Namakkal

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ABSTRACT- An alternative reinforcement system, Welded mesh is proposed to perform the function of transverse steel in Reinforced Concrete Beams. Welded mesh is made from cold -drawn steel wires arranged in two orthogonal directions and is prefabricated in a production line. Welded mesh reinforcement eliminates some of the detailing problems inherent in traditional rebar in the Reinforced Concrete Construction resulting in easier and faster construction, and better economy and quality control. In this present experimental work on the behavior of Rectangular concrete beams with Shear reinforcement by Welded mesh was carried out. One Control beam with conventional reinforcement with five other beams with vary welded mesh were cast and tested under two point loading. The results were used to study the flexural behavior. It is obtained that the beam with continuous weld mesh and longitudinal bar given the maximum load carrying capacity.

1. INTRODUCTION

Welded wire mesh generally consists of wires arranged in two orthogonal directions and is prefabricated in a production line. Because of its economy, ease, and faster of construction as well as better quality control, Welded mesh has been widely used in buildings that Weld mesh can be a good substitute for the conventional reinforcement and yielded excellent results both in strength and ductility.

Welded Mesh

Our range of welded mesh is supreme in quality, which is produced conforming to IS: 1566-1982 with long and cross wire spacing varying from 25 mm to 150 mm with 2 mm to 6 mm wire diameter. The intersections are rigidly welded and each of them has the capacity to withstand the shear stress up to 210 N\mm2 (IS: 4948-1974) on the reference area of the longitudinal wire. Our range is widely used in RCC-building construction. It gives good reinforcement solution for industrialized concrete constructions.

2. MATERIALS PROPERTIES

Fine aggregate

The sand used for experimental program was locally procured and conforming to zone II. The sand was first sieved through 4.75 mm sieve to remove any particles greater than 4.75 mm. The fine aggregates were tested as per Indian Standard Specification IS: 383-1970.

Coarse aggregate

Locally available coarse aggregates were used in this work. Aggregates passing through 20mm sieve and retained on 16mm sieve were sieved and tested as per Indian Standard Specifications IS: 383-1970.

Cement

The cement used in this experimental investigation was 43 grade OPC manufactured by Chettinad cements.

Water

The tap water available in the campus was tested for its suitability. Necessary properties such as pH value, chloride content, total hardness and total dissolved solids were evaluated

2.2 MIX PROPORTION

The concrete mix was designed as per IS 10262:1982 for M20 grade of concrete.

Unit	Water	Cement	FA	CA
Kg/m^3	192	383	691	1140
Ratio	0.5	1	1.8	2.97

Mix design

2.3 DESCRIPTION OF SPECIMEN

The current experimental program includes six beam specimens, the description of specimens are designated as follows,

SP 1: The Specimen is fully stirrup with welded mesh.

SP 2: From both the supports L/4 length of the specimen welded mesh as well as L/2 of the specimen conventional stirrups.

SP 3: From both the supports L/4 length of the specimen welded mesh and L/2 of specimen no stirrups.

SP 4: From both the supports L/3 length of the specimen welded mesh and L/3 of specimen conventional stirrups.

SP 5: From both the supports L/3 length of the specimen welded mesh and no stirrups for remaining length.

SP 6: Fully Conventional stirrups.

2.4 COMPRESSIVE STRENGTH

Compression test on concrete cubes has been carried out confirming to IS 516-1999. All the concrete cube specimens were tested in a 2000KN capacity compression testing machine.

S.No	Type Of Sample	Comp. Load (KN)	Comp. Strength (N/mm^2)
1	SP1	760	33.78
2	SP2	940	41.78
3	SP3	760	33.78

Compressive strength

2.5 TEST SPECIMEN

All beams were tested in reaction type loading frame. The span of the beams kept as 2000 mm with simply supported end condition and was tested under two point loading applied at one third spans through a stiff beam. Deflections of the beam were measured by three LVDTs placed at the mid span, one third span and one fourth span

2.6 Load Deflection Behaviour

Load Vs deflection plot has been drawn for all test specimens from the experimental data. The behaviour of test specimens is compared the plots. The first crack and failure load were recorded along with corresponding displacements and strains.All the observations recorded during the flexural test on beam apecimen

3. RESULTS AND DISCUSSIONS

SP 1 specimen has the highest load carrying capacity among the group. The beam specimen SP 5 performed in a poor manner with low load carrying capacity. The remaining beams can be grouped under the same class as their load carrying capacity or ultimate load is nearly same. Hence for better flexural performance fully weld mesh stirrups throughout the beam span can be suggested.

Volumetric ratio of specimen SP 1 is less than that of control specimen it has higher ultimate load and the Specimens SP 3 and SP 5 having low volumetric ratio compared to other specimens. For Specimen SP 5 Volumetric ratio is less and also the load carrying capacity of the specimen also less.

3.1 DISCUSSION

3.1.1 Load Vs Deflection

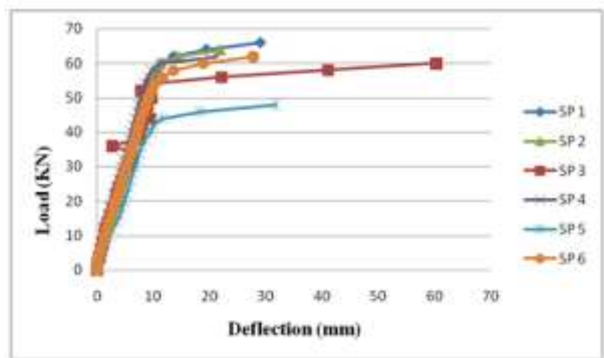

Fig Load Vs Deflection Curve at L/2 for Specimen SP 1 to SP 6

it is observed that mid span deflection of the specimens SP 1,SP 2,SP 4 and SP 6 are having more or less same deflections. Specimens SP 3 and SP 5 are having high deflections compared to that of other specimens.

Specimen SP 3 having high deflection at the mid span, it is due to the absence of shear reinforcement at the mid span section, it is less stiffer than thath of other beam specimens.

Specimen SP 5 is also having high deflection and compared to the specimen SP 5 it is observed that the flexural strength of the specimen SP5 is lower than the specimen SP 3.

The initial crack load for the beam specimens SP 3 and SP 5 is respectively 12 KN and 10 KN, it indicates that the initial crack load of these specimens are lower than that of other specimens.

But all the beam specimens are of having same failure mode.

3.1.2 STRAIN BEHAVIOUR

The strain value at compression face decreases while increasing the load and at the tensile face strain value increases as increasing the load for the entire specimen.

Stress strain curve for specimen SP 1, SP 2 , SP 3, SP 4 SP 5, SP 6 plotted and shown below

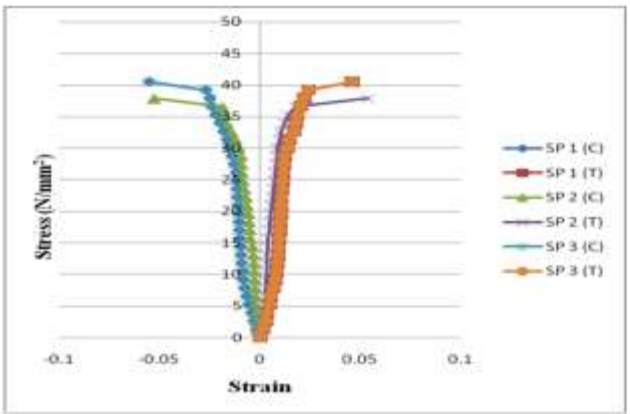

Fig Stress – Strain Curve for Specimens SP 1, SP 2 and SP 3

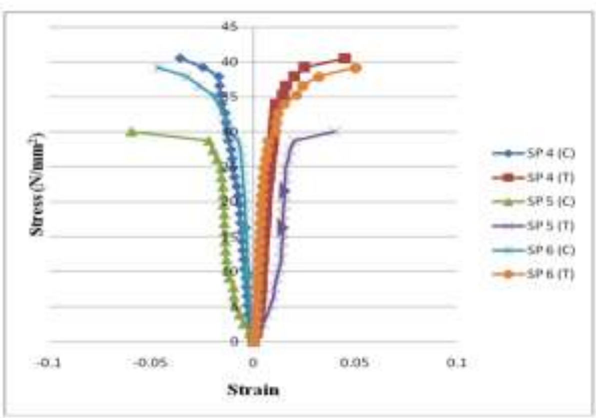

Fig Stress – Strain Curve for Specimens SP 4, SP 5 and SP 6

3.2 CRACKING BEHAVIOUR

3.2.1 FLEXURAL FAILURE OF BEAMS

In the under reinforced section beam, the member approaches failure due to gradual reduction of compression zone, exhibiting and cracks, which develop at the soffit and progress towards the compression face.

All five specimens have suffered extensive flexural cracking near to midspan. The failure mode is shown in Figure

Flexural Failure of specimen

The Modes of failure of all beams are as follows,

- All Reinforced cocnrete beams failed in flexure zone.
- After the first crack load, the reinforcement started yielding and more number of cracks have formed in the flexure zone and extended towards the point loads with increment in loads.
- At the ultimate load, the failure of all concrete beam with welded mesh occurred with crushing of concrete in compression zone.
- In the Specimens SP 3 and SP 5 more number of cracks formed in flexure zone. This is due to the absence of shear reinforcement in the flexure zone at the mid span.
- Specimens SP 2 and SP 5 having less number of cracks formed in flexure zone. It indicates that the combination of weld mesh shear reinforcement with conventional stirrups provide mariginally high strength and cracking reistance.

4. CONCLUSION

From this experimental work, the following conclusions are arrived,

1. The flexural strength of beam increases nominally and remains unaffected compared to that of control specimen for the fully welded mesh shear reinforcement provided throughout the length of the specimen.
2. Even though Shear Reinforcement was replaced with welded mesh there is no appreciable change in flexural load carrying capacity.

3. The load carrying capacity reduces in the case of specimen provided with very small volume of welded mesh shear reinforcement at the supports only.
4. In the mode of failure and crack pattern of the conventional RCC Beam specimen with welded mesh specimen are similar.
5. Failure mode and load carrying capacity depends on the volumetric ratio of welded mesh provided.
6. When the shear stirrups are completely replaced with welded mesh, when the welded mesh distribute throughout the span, behaviour of beam is better than other beam. Load Vs deflection behaviour of this beam also better than other beams.
7. Stress – Strain behaviour indicates that except for the beam without any shear reinforcement at midspan, all other specimens behaviour are of same manner.
8. Out of the six specimens tested the specimens with the provision of fully welded mesh of grid configuration 50.8 x 50.8 mm exhibits better performance.
9. Since there is reduction in cost, the use if welded mesh is found to be an suitable alternative to conventional shear stirrups.

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