Study on Shear Behaviour of Prefabricated Cage Reinforced Concrete Beams

K.M.Jiyavudeen1, B.Jose Ravindra Raj2

1Post Graduate Student, Department of Civil Engineering, PRIST UNIVERSITY, Trichy-Thanjavur Highway, Vallam, Thanjavur, INDIA
2Assistant Professor, Department of Civil Engineering, PRIST UNIVERSITY, Trichy-Thanjavur Highway, Vallam, Thanjavur, INDIA

ABSTRACT
Prefabricated Cage effectively enhances the Flexural Strength, Ductility and Deformation characteristics of Prefabricated Cage Reinforced Composite (PCRC) Beams. This Journal gives an Experimental solution for the prediction of Curvature Ductility of PCRC beams. This view of Ductility factor has mostly perfect when compare to the Theoretical form of analysis. The Equation of Ductility is given in the form of Ultimate concrete strain and Yield strength of steel. The Experimental results will provide the good agreement with the Prefabricated cage concrete beams. This paper shows both Strength and Deformation characteristics of PCRC beams.

Keywords---- PCRC Beams; Prefabricated cage; Curvature ductility factor; Equilibrium equations; Strain compatibility method

I. INTRODUCTION
The Structural member have been designed to keep Ductility capacity away from Brittle failure to secure a ductile behaviour mainly for seismic design. The study of ultimate reality of seismic design of moment resisting RC frames is depend on the arrangement of plastic hinges at the critical section in the frame. The formation of plastic hinge endure inelastic deformations without loss in its strength capacity is always proceed in terms of available ductility of that section. The curvature ductility factor can be denoted by the symbol $\mu_\varphi$. Most probably ductility capacity should be declare in the form of $\mu_\varphi$. The moment curvature is created based on gradually enhance the load and it specify first-quarter cycle of the real conduct of the plastic hinge rotation based on the earthquake loading. By the way the curvature ductility factor can be calculated under the consideration of the experimental results of the existing ductility and it can be given by the section subjected to real earthquake loading.

To whatever extent, the experimental evaluation of curvature ductility factor ($\mu_\varphi$) is mainly used in the approximate indication of the adequate earthquake Design of RCC. It is extensively used in the fortelling of damage in the frames beneath earthquake loading. Even if the real response of the frame is depending upon rigourous earthquake is complex one and it undergoes extensive uncertainties, fortell of damage is always denote in the form of ductility demand on particular members.

II. LITERATURE REVIEW
By enhancing the ductility of materials usually guide to a beneficial change in the ductility. When comparing with the other work the ductility of concrete has been improved and is performing it in a steel binders as tied in a compression member and spaced stirrups in beams. (Soliman et al.1967, Shamim A Sheikh 1982, Guney Ozcebe et al.1987, Sharim A Sheikh et al.1994, Mohamed M Ziara et al.1995, Mohamed Saafi et al.1999, Esneyder Montoyo et al.2006). To improve the ductility the tension member is added in the concrete section. The concrete confined in this way is known as the confined concrete or ductile concrete. Prefabricated Cage was proposed by Halil Sezen et al.2006 to reinforce the structural member and its concrete core.

OBJECTIVE
The main objective of this paper is to understand the shear behaviour of Prefabricated Cage Reinforced Composite (PCRC) Beams and to know the cracking shear strength, ultimate shear strength and load carrying capacity of PCRC Beams. The concept of prefabricated cage system (PCS) is mainly used to understand about the prefabricated cage reinforced composite beams (PCRC).
III. EXPERIMENTAL INVESTIGATION

Cement:
Cement is one of the binding material in concrete and it binds the different materials to create a compact mass. Here the cement used is Ordinary Portland Cement (OPC) of grade 53. Most probably OPC is available in three grades such as 33, 43, 53. These three grades having a specific gravity of 3.16.

Fine Aggregates:
The fine aggregate used in this experiment is taken from the IS 383-1970 and it is common to all specimens. It was sieved by 4.75mm sieve and then used.

Coarse Aggregates:
The coarse aggregate is used in this experiment is also taken from the IS 383-1970 and the hard broken Granite stone should be obtained and dug from in and around Coimbatore.

MIX PROPORTION

<table>
<thead>
<tr>
<th>Water</th>
<th>Cement</th>
<th>Fine aggregate</th>
<th>Coarse aggregate</th>
</tr>
</thead>
<tbody>
<tr>
<td>192 liters/m³</td>
<td>479 kg/m³</td>
<td>499 kg/m³</td>
<td>1249 kg/m³</td>
</tr>
<tr>
<td>0.4</td>
<td>1</td>
<td>1.04</td>
<td>2.61</td>
</tr>
</tbody>
</table>

SPECIMEN DETAILS:
Casting Of Beam Specimen
All the materials were correctly measured before mixing. Fine Aggregate and Cement were mixed properly. The coarse Aggregate is added to this mixture. Once again properly mixed Water is added in this stage. The mixing was continue until the concrete is ready for casting.

Beams can be mould with steel packing pieces (precast mortar briquetts having thickness similar to the required thickness of the cover) were placed at two or three points to give proper cover to the prefabricated cage system (PCS). The concrete was set in three layers and each one is suitably compacted. The specimen was cured with wet gunny bags for 28 days and dried in air for one day before testing.

Casting Of Cubes:
The size of cube can be assumed as 150×150×150 mm is used to cast the cubes and it was confirmed to IS 456-2000. For easy demoulding the inner surface have to coated with a thin layer of waste oil. While before applying the oil the inner surface have to be cleaned and free from superfluous moisture and set concrete. Then the concrete was filled in the mould with three layers and each one is uniformly compacted.

The concrete was demould after 24 hours of casting and it was cured in a pond for 28 days. For Every seven days the water was changed in the curing pond and the temperature of the curing pond was not greater than 30°C.

Water:
The water was convenient for carrying and it is used to mix the concrete and curing of the specimens.

Reinforcement Steel:
High strength deformed steel bars were taken from IS 1786-1985. The diameter used here is 10mm and 8mm for reinforcement.

Cold Formed Steel:
The thickness of the cold formed steel is 1.6 mm and it is taken from the code IS 1079-1968 was used to manufacture the Prefabricated Cage System.

Concreting:
In this process, the concreting is made with the proper addition of concrete and finout their allied proportion of concrete with minimum strength and durability as frugality as possible. The mix design for M30 concrete is taken from the code IS 10262-1982. The mix design is as follow as,

IV. RESULT AND DISCUSSION

Fabrication Of PCS Reinforcement:
The PCS reinforcement was produced by the rectangular steel of standard size 2.50 m x 1.25 m and thickness 1.6 mm, 2 mm and 2.5 mm. This reinforcement having dimensions based on the steel strength of rebar reinforcement. PCS reinforcement having longitudinal and transverse rebar reinforcement which are equal to longitudinal and transverse rebar reinforcement.

The required dimension has been made in the cold formed steel sheets using CNC cutting. Then the perforated plates were bent to the required size and connected using welding. To study the shear behaviour of PCRC beams and to compare with ordinary RCC beams two shear span of L/4 and L/2 are adopted. In all the specimens no shear reinforcement was provided in order to ensure the shear failure of beams. However, four numbers of 6mm diameter stirrups are placed at load application and reaction points to avoid local stress concentration.

Test on Cold Formed Steel Sheet:
The two process of manufacturing cold formed sheets are i) cold rolling and ii) pressing. These two are used in building industry ranging form purlins to roof sheeting and floor decking. Zinc coating of performed sheets gives a protection against corrosion in internal environments. The advantages of cold formed steel sheets are,

Cross sectional shape should be formed to close tolerances and these can consistently repeat as long as required.
Cold rolling can be employed to produce desired shape and desired length. All conventional jointing method like riveting, welding, bolting and adhesive shall be employed. High strength to weight ratio can also be achieved. They are light weight making and it is easy for transportation and erection.  

Test piece:  
Width (b) and gauge length (L) of the test piece was 20mm and 80mm respectively. The test specimen were enlarged at the ends made with gradual and without shock. Three specimens has been made from 1.6mm thick plate and it is tested. The properties of cold formed steel sheets from coupon test are presented in the table.

<table>
<thead>
<tr>
<th>Properties of cold formed steel sheet</th>
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<tr>
<td>Plate thickness (mm)</td>
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<td>---------------------</td>
</tr>
<tr>
<td>2.5</td>
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<tr>
<td>2</td>
</tr>
<tr>
<td>1.6</td>
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Compression test was carried out on the cube specimens on 7th day and 28th day and the values are tabulated in table respectively.

<table>
<thead>
<tr>
<th>Table: Average 7th and 28th day compressive strength</th>
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<td>Sl.No.</td>
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V. CONCLUSION

From the Experimental investigation the Prefabricated Cage Reinforced Concrete beams having two different shear spans L/4 and L/2 and the thickness of 1.6, 2 & 2.5 mm have been used. The following are the conclusion of this project.  
(1)The shear strength of PCRC beams should be greater than RCC beams.  
(2)The ultimate shear strength and the ultimate moment of PCRC beams increase with increase of cage steel sheet thickness.  
(3)At about 40% of the ultimate was applied, hairline cracks were noticed in the flexural span.  
(4)After gradual application of loads, 1mm crack were observed in the mid span during 50 % of ultimate load.

REFERENCES

