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AN EXPERIMENTAL STUDY ON FLEXURAL BEHAVIOUR OF LIGHT WEIGHT CONCRETE IN REINFORCED BEAM

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ABSTRACT

Light weight concrete is made by 20% replacement of OPC by fly ash, 10% replacement of fine aggregate by saw dust and 10% replacement of coarse aggregate by coconut shell. The density and compressive strength test performed on the light weight concrete is found to be satisfactory to be used as a structural light weight concrete.Six under reinforced beam were casted with similar bottom and top reinforcement and flexural test was carried out. Thus it carries more loads when compared to the straight and U shaped pattern of shear reinforcement. Spiral pattern also carries load similar to the 45° this is because here also the shear reinforcement is provided in the diagonal direction. X type and confined pattern have almost similar and higher load carrying capacity than the other pattern of shear reinforcement because these pattern of stirrups have little more reinforcement than the others. But this not the only reason for the increase in ultimate capacity of the beam, here the confinement of concrete is achieved and also the transfer of shear force is achieved in both the direction thus the reinforcement carry more load without undergoing major failure. It concluded to provide the pattern of shear reinforcement based on the amount shear acting in the section, workmanship and importance of the building.

INTRODUCTION

The most important factor which governs the design of reinforced concrete building is the loading condition to which the building is subjected to act during its life time. Each and every building should be designed against dead load, live load, wind load, snow load and earthquake forces etc. Among these loads dead load plays a major role because it is the load which is constantly acting on the building. Dead load is based on the unit weight of the materials used in the buildings.

Unit weight of plain concrete and reinforced concrete was 24 kN/m^3 and 25kN/m^3. Since the unit weight of concrete is high, it increases the self weight of concrete which in some extent make it as an uneconomical structural material. Attempts have been made to reduce the self weight of concrete and to increase the efficiency of concrete as the structural material.

Density of conventional concrete is 2200 kg/m^3 to 2600 kg/m^3. The concrete whose density is less than the normal concrete, then this type of concrete is known as light weight concrete. In recent years, light weight concrete has become more popular owing to the tremendous advantage it offers over the conventional concrete. When the density of concrete is reduced this in turn leads to reduction of dead load acting in the structure consequently reduced load in the foundation, leading to greater economy in construction. Thus making possible to construct high rise building in soft soil.

Concrete is the widely used number one structural material in the world today. The demand to make this material lighter has been the subject of study that has challenged scientists and engineers alike. The challenge in making a lightweight concrete is decreasing the density while maintaining

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strength and without adversely affecting cost. Introducing new aggregates into the mix design is a common way to lower a concrete's density. Normal concrete contains four components, cement, crushed stone, river sand and water. The crushed stone and sand are the components that are usually replaced with lightweight aggregates. Lightweight concrete is typically made by incorporating natural or synthetic lightweight aggregates or by entraining air into a concrete mixture. Some of the lightweight aggregates used for lightweight concrete productions are pumice, perlite, expanded clay or vermiculite, coal slag, sintered fly ash, rice husk, straw, sawdust, cork granules, wheat husk, oil palm shell, and coconut shell. The coconut shell when dried contains cellulose, lignin, pentosans and ash in varying percentage.

The most widely used fine aggregate for the making of concrete is the natural sand mined from the riverbeds. However, the availability of river sand for the preparation of concrete is becoming scarce due to the excessive non scientific methods of mining from the riverbeds, lowering of water table, sinking of the bridge piers etc. are becoming common treats. The present scenario demands identification of substitute materials for the river sand for making concrete. The choice of substitute materials for sand in concrete depends on several factors such as their availability, physical properties, chemical ingredients etc, Saw dust is one of the by products in burning sawdust not being used for any applications other than filling–up.

Structural lightweight aggregate concrete is an important and versatile material in modern construction. It has many and varied applications including multi-storey building frames and floors, bridges, offshore oil platforms, and prestressed or precast elements of all types. Many architects, engineers, and contractors recognize the inherent economies and advantages offered by this material, as evidenced by the many impressive lightweight concrete structures found today throughout the world. Structural lightweight aggregate concrete solves weight and durability problems in buildings and exposed structures. Lightweight concrete has strengths comparable to normal weight concrete, with weight 25% to 35% lighter.

Structural lightweight concrete offers design flexibility and substantial cost savings by providing: less dead load, improved seismic structural response, longer spans, better fire ratings, and thinner sections, decreased story height, smaller size structural members, less reinforcing steel, and lower foundation costs. Lightweight concrete precast elements offer reduced transportation and placement costs.

Table .1 Fineness test

S.No	Observation	Trail-1	Trail-2	Trail-3
1	Weight of sample taken(g)	100	100	100
2	Weight of material retained (g)	1.0	0.9	1.1
3	Percentage of fineness	1.0	0.9	1.1

Fineness modulus of cement = 1

Table2 Chemical Composition of OPC

Constituents	Contents(%)
Silicon dioxide SiO_2	20.52
Aluminium oxide Al_2O_3	5.57
Ferric oxide, Fe_2O_3	3.46
Calcium Oxide, CaO	63.77
Sulphur trioxide, SO_3	2.91
Sodium oxide,Na_2O	0.19
Magnesium oxide, MgO	0.86
Potassium oxide, K_2O	0.95
Loss of ignition	2.78

Table3 Physical properties of Class F fly ash

Specific gravity	2.30
Fineness modulus (passing through 45micron sieve)	7.64

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Table.4 Chemical Composition of Class F fly ash

Constituents	Content (%)
Silicon dioxide SiO_2	64.43
Aluminium oxide Al_2O_3	23.67
Ferric oxide, Fe_2O_3	5.40
Calcium Oxide, CaO	1.25
Potassium Oxide , K_2O	0.60
Sodium Oxide, Na_2O	0.40
Magnesium Oxide, MgO	1.54
Sulphur trioxide, SO_3	0.6

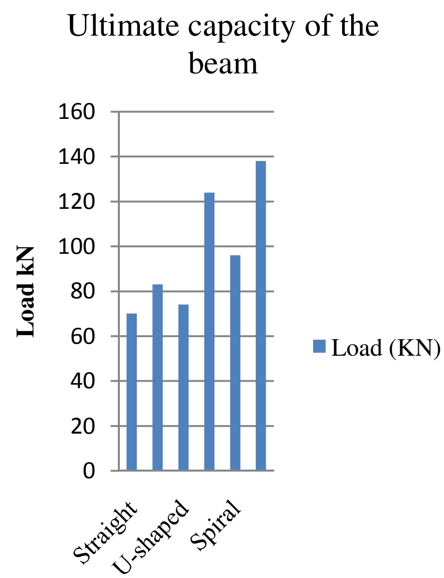

Figure .2 Ultimate capacity of the beam.

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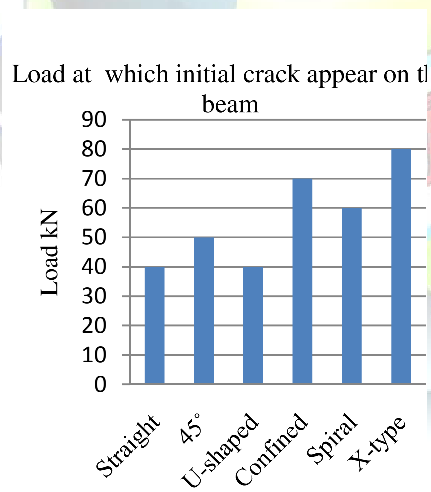

Figure .1 Load at which initial crack appear on the beam

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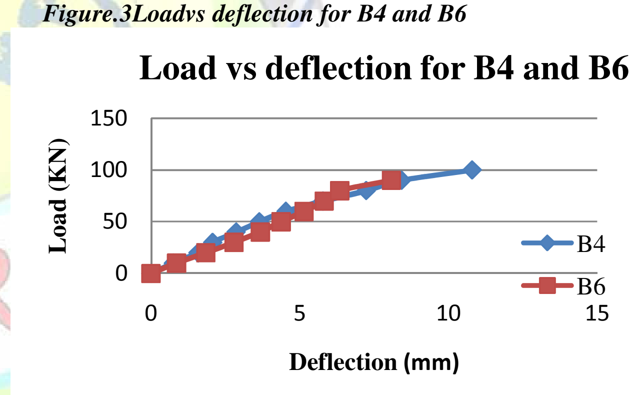
Table.5 Ductility factor of Beam

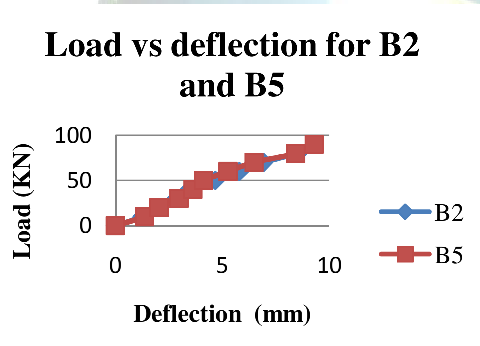
Beam No	Yielding load (KN)	Yielding deflection (mm)	Ultimate load (KN)	Ultimate defection (mm)	Ductility factor
B1	40	4.75	70	7.67	1.61
B2	50	4.67	85	9.03	1.93
B3	40	5.03	75	8.47	1.68
B4	70	5.78	105	11.89	2.06
B5	60	5.26	90	9.28	1.76
B6	80	6.34	120	12.82	2.02

Figure.3Loadvs deflection for B4 and B6



B6

F



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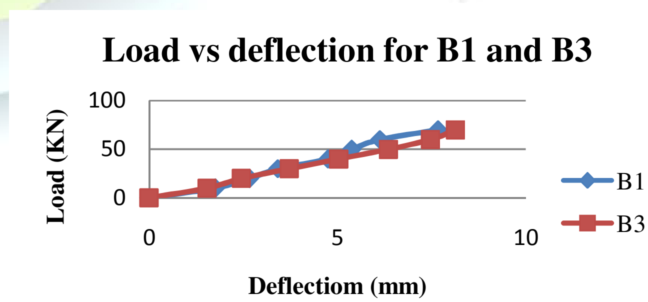
ure 4.4 Load vs deflection curve for B2 and B5



SUMMARY AND CONCLUSIONS

Light weight aggregate concrete is made by 20% replacement of OPC by fly ash, 10% replacement of fine aggregate by saw dust and 10% replacement of coarse aggregate by coconut shell. The density and compressive strength test performed on the light weight aggregate concrete is found to be satisfactory to be used as a structural light weight concrete.

Six under reinforced beam were casted with similar bottom and top reinforcement and flexural test was carried out. The results showed that straight and U shaped pattern of shear reinforced beams have similar wat of transfer of shear force and thus the ultimate moment carrying capacity of the beam resemble each other. 45˚ inclined stirrups are inclined in direction which is in direction of the transfer of shear force. Thus it carries more loads when compared to the straight and U shaped pattern of shear reinforcement. Spiral pattern also carries load similar to the 45˚ this is because here also the shear reinforcement is provided in the diagonal direction.

X type and confined pattern have almost similar and higher load carrying capacity than the other pattern of shear reinforcement because these pattern of stirrups have little more reinforcement than the others. But this not the only reason for the increase in ultimate capacity of the beam, here the confinement of concrete is achieved and also the transfer of shear force is achieved in both the direction thus the reinforcement carry more load without undergoing major failure. It concluded to provide the pattern of shear reinforcement based on the amount shear acting in the section, workmanship and importance of the building

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