EXPERIMENTAL STUDY ON FLEXURAL STRENGTH OF STEEL FIBRE CONCRETE

S.Vignesh[1],A.Mohamed Abubakar Sithik Ali[2], D.Prasanya[3],R.Guru Lakshmi[4]

[1234]*Assistant professor civil Engineering, sri vidya college of engineering & Technology, Tamilnadu, India*

Abstract - *The main aim of the project is to determine the strength development of High Strength Concrete containing steel fibres. Compressive strength, Tensile strength and Flexural strength is to be determine to the study the effect of the steel Fibre on the properties of high strength concrete.*

Mix Design was prepared for the grade of M $_{50}$. Two different trial mixers was prepared with the constant water ratio of 0.36 is added based on the required degree of workability compressive strength test conducted for a trial mixers as 14 & 28 days continuous curing . the test result to the trial mix is the effective combination. The result of steel fibre concrete in increasing the strength and longevity of structures.

Key Words: steel fibre, flexural strength, compressive strength, split tensile strength

1.INTRODUCTION

Concrete is considered a brittle material, primarily because of its low tensile capacity and poor fracture toughness. Concrete can be modified to perform in more ductile form by the addition of fibre in the concrete matrix.

In Fibre Reinforced Concrete (FRC), fibre can be effective in arresting cracks at both macro and micro levels. For an optimal response, different type of fibre may be suitably combined to produce Steel Fibre Reinforced Concrete (SFRC).The use of optimized combinations of two or more types of fibre in the same concrete mixture can produce a composite with better engineering properties than that of individual fibre. This includes combining fibre with different shapes, dimension, tensile strength and young's modulus to concrete matrices.

If the fibre are sufficiently strong, sufficiently bonded to material and permit the FRC to carry significant stresses over a relatively large strain capacity in the post cracking stage. The real contribution of the fibre is to increase the toughness of the concrete under any type of loading. Recent investigations have shown that the steel fibre type provide a higher toughness. In a steel system micro fibre provide reinforcement mechanisms at small to medium crack opening while macro-fibre would carry stresses a cross cracks at medium to large crack openings.

Reinforcement of concrete with randomly distributed micro -reinforcements may improve the toughness and ductility of cementitious matrices by preventing the initiation and propagation of cracks. It has been shown recently by various researchers that by using the concept of hybridization with two different fibre incorporated in a cement matrix, the steel composite can offer more attractive engineering properties than the composite with mono fibre system, because the presence of one fibre enables the more efficient utilization of the potential properties of other fibre. Also the addition of fibre can reduce the deflection and improve the post cracking behavior significantly.

1.1 Materials and methods 1

The most commonly available Portland pozzolana cement of 43 grade was selected for the investigation. The cement used was dry, powdery and free from lumps. All possible contact with moisture was avoided while storing cement. Ordinary crushed stone with size 20mm was used as coarse aggregate in concrete mixes. The generally passes all the essential passes all the essential qualities absorbtion value and least porosity. In general, water fit for drinking is suitable for mixing concrete. Impurities in the water may affect concrete setting time, strength, shrinkage or promote corrosion of reinforcement . Hence locally available purified drinking water was used for the work. The steel fibre was collected locally from a small cutting unit in the form of long size 10 mm steel fibre can be used.

1.2 Prepertation of test specimen 2

Various concrete specimens were prepared for m_{50} grade concrete i.e. in the ratio of 1:0.98:1.96 and various percentages of steel fibres i.e. 0.5%,1%,1.5%,2%,2.5% were added and thoroghly mixed using drum mixer. Then water is added is added at water content ratio of 0.36 and mixed continously until uniform mix was obtained. Then the mixture is filled into the moulds which were properly oiled and compacted using table vibrator . cubes of size 150mm x 150mm x150mm were cast for compressive strength test and cylinder of size 150mm diameter and 300mm height were cast for split tensile strength test and beams of size 1000mm x 300mm x

300mm were cast for flexural strength test.

2. CONCRETE 2

Concrete is the most widely used man-made construction material. It is obtained by mixing cement, water and aggregates in required proportions. The mixture when placed in forms and allowed to cure becomes hard like stone. The hardening is caused by chemical action between water and the cement and it continues for a long time, and consequently the concrete grows stronger with age.

Process of manufacture of concrete

The various stages of manufacture of concrete are:

- batching
- mixing
- transporting
- placing
- compacting
- curing
- finishing

Batching

The measurement of materials for making concrete is known as batching. There are 2 methods of batching namely

- volume batching
- weigh batching

Volume batching

It is not a good method for proportioning the material because of the difficulty it offers to measure granular material in terms of volume. Cement is always measured in weight; it is never measured in volume. Generally for each batch mix, one bag of cement is used. The volume of one bag of cement is 35 liters. Gauge boxes are used for measuring fine and coarse aggregate.

Weigh batching

Weigh batching is the correct method of measuring the materials. For important concrete, invariably, weigh batching system should be adopted. Use of weight system in batching facilitates accuracy, flexibility and simplicity.

MEASUREMENT OF WATER

When weigh batching is adopted, the measurement of water must be adopted accurately. It is usual to have the water measured in a horizontal tank or vertical tank fitted to the mixer.

Mixing

There are 2 methods of mixing

- Hand mixing
- Machine mixing

Hand mixing:

Hand mixing is practiced for small scale unimportant concrete works.

Machine mixing:

Mixing of concrete is almost invariably carried out by machine, for reinforced concrete work. Machine mixing is not only efficient, but also economical, when the quantity of concrete to be produced is large. Many types of mixes are available they are batch mixers and continuous mixers. Concrete mixers are often used for mixing of concrete.

Transporting concrete

Concrete can be transported by a variety of methods and equipments. The methods adopted for transportation of concrete are:

Mortar pan
Wheel barrow
Transit mixer
Concrete pumps

Concrete pumps

Pumping of concrete is universally accepted as one of the main methods of concrete transportation and placing.

The modern concrete pump is sophiscated, reliable and robust machine. in the past a simple two stroke mechanical pump consisted of a receiving hopper an inlet and outlet valve, a piston and a cylinder. The pump was powered by a diesel engine. The pumping action start with the suction stroke drawing concrete into the cylinder as the piston moves backward. .. Placing concrete

It is not enough that a concrete mix correctly designed, batched, mixed and transported. It is of at most importance that the concrete must be placed in systematic manner to yield optimum result.

Form work

Form work can be designed and constructed so as to remain sufficiently rigid during placing and compaction of concrete. The joints are plugged to prevent the loss of slurry from concrete.

Stripping time

Formwork should not be removed until the concrete has developed a strength of at least the twice the stress to which concrete may be subjected at the time of removal of formwork.

Compaction of concrete

It is the process adopted for expelling the entrapped air from the concrete. In the process of mixing, transporting and placing of concrete. Air is likely to get entrapped in the concrete.

The following methods are adopted for compacting the concrete.

- Hand compaction
  - Rodding 2) Ramming 3) Tamping
- Compaction by vibrations
  - internal vibrator
  - formwork vibrator
  - table vibrator
  - surface vibrator
- Compaction by pressure and jolting

Curing

Curing methods may be divided broadly into 4 categories

water curing
membrane curing
application of heat
miscellaneous

Water curing

This is by far the best method of curing as it satisfies all the requirements of curing namely promotion of hydration, elimination of shrinkage and absorption of heat of hydration.

Water curing can be done in following ways:

1. Immersion
2. Ponding
3. spraying
4. wet covering

Finishing

Finishing operation is the last operation in making concrete. Surface finishes may be grouped as:

Formwork finishes
Surface treatments
Applied finishes

Formwork finishes

Concrete obeys the shape of formwork that is centering work. By judiciously assembling the formwork either in plane surface or in undulated fashion or having the joints in a particular V shaped manner to get regular fine , pleasing surface finish can be given to concrete.

Surface treatment

This is one of the widely used methods for surface finishing

Applied finish

The term applied finish is used to denote the application of rendering to the external Concrete

The Mix proportion is shows below

For M_{50} Grade concrete

Cement	Fine aggregate	Coarse Aggregate	W/c ratio
1	0.98	1.96	0.3

8. RESULTS AND DISCUSSION

COMPRESSIVE STRENGTH

Tests were conducted on compressive strength after 7,28 days of curing. The results of compressive strength for 0.5 to 2% volume of steel fiber are given in

Table: Compressive Strength test

Fibre content (%)	7 days		28 days	
	Load in KN	Average Compressive strength N/mm²	Load in KN	Average Compressive strength N/mm²
0	134.70	5.98	244	10.35
0.5%	140.50	6.24	297	13.20
1%	169.10	7.84	354	15.73
1.5%	176.43	7.84	436	19.37
2%	211.50	9.40	501	22.26

SPLIT TENSILE STRENGTH

Tests were conducted on Splitting Tensile Strength 7, 28days of curing. The results of Splitting Tensile Strength for 0.5 to 2% volume of steel fibers are given in

Table No.8.2 Splitting tensile strength test result (M50)

Fibre content (%)	7 days		28 days	
	Load in KN	Average tensile strength N/mm2	Load in KN	Average tensile strength N/mm2
0	38	0.53	48	0.67
0.5%	44.90	0.63	54	0.76
1%	61	0.86	77	1.08
1.5%	70.80	1.00	89.20	1.26
2%	85.8	1.20	111.5	1.57

FLEXURAL STRENGTH

Tests were conducted on flexural strength after 7,28 days of curing. The results of Flexural Strength for 0.5 to 2% volume of steel fibers are given in

Flexural strength test result (M_{50})

Fibre content (%)	7 days		28 days	
	Load in KN	Average Modulus of Rupture N/mm2	Load in KN	Average Modulus of Rupture N/mm2
0	5.20	2.60	0	5.20
0.5%	6.60	3.30	0.5%	6.60
1%	8.80	4.40	1%	8.80
1.5%	11.70	5.85	1.5%	11.70
2%	14.90	7.45	2%	14.90

3. CONCLUSIONS

An important focus of our vision should now be on increasing the strength and longevity of various structures. The life of all bridges, pavements and other concrete structures should double in the next century as our country's major financial resources are invested in the construction sector. Carefully selecting materials to optimize and control their properties and use of more performance based specifications will result in advances in the durability of concrete.

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BIOGRAPHIES

S.vignesh
BE civil Engineering
ME Structural Engineering
Working as a assistanr professor in sri vidya engineering college, tamilnadu,

A.Mohamed Abubakar Sithik Ali
BE civil Engineering
ME Environmental Engineering
Working as a assistant professor in sri vidya Engineering college

D.Prasanya
BE civil Engineering
ME Structural Engineering
Working as a assistant professor in sri vidya Engineering college

R.Guru Lakshmi
BE civil Engineering
ME Structural Engineering
Working as a assistant professor in sri vidya Engineering college