EXPERIMENTAL STUDY OF FIBRE REINFORCED CONCRETE WITH RECYCLED AGGREGATES

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ABSTRACT

Recycling them is the most effective method for dealing with the increasing volume of waste for preservation of the environment. This paper is focused on the experimental program aimed at verifying selected material properties of fibre reinforced concrete in which the natural stone aggregates is partially replaced by recycled aggregates concrete. The combination of recycled construction and demolition waste, steel fibres and binder creates an unusual fibre reinforced concrete; new composite, which offers a wide field of possible use in construction industry. The experimental program and shows results on these composite - mechanical and physical characteristics – density, compressive strength and flexural tensile strength and modulus of elasticity of fibre reinforced concrete. Based on a large series of acquired experimental results on different characteristics of the tested material, it can be judged on the behaviour of this composite, which is sufficient enough to be used in ground structures as intended.

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 fibers in the concrete mix. Construction and Demolition waste (C&D) constitutes a major portion of total solid waste production in the world, and for the present most of it is used in landfills. The most effective way to reduce the waste problem in construction is agreed in implementing reuse, recycling and reduced the use of a construction material in construction activities. Those **―3R‖** are the positive influence on **E**conomy, **E**cology and **E**nergy. Application of recycled materials in the building industry is important for sustainable development and keeping of primary sources of each country. Recycling and re- use of building rubble presents interesting possibilities for economizing on waste disposal sites and conserving natural resources. As a recycled material, one can consider not only the construction and demolition waste but also the waste coming from the industrial production and extraction of primary materials.

The restrictions in improvement of recycling principles are requiring certain criteria C&DW as crushed concrete are mineral inorganic materials with inert behaviour, without dangerous properties and without significant physical, chemical or biological change. The idea to add fibres to a concrete mixture with recycled aggregate may change material properties of such concrete, improve behaviour, bring about new types of applications and enables saving sources of natural aggregate . This project work aims to reduce the demand for primary aggregates by using crushed C&DW as an alternative with Steel fibres.

LITERATURE REVIEW

OBJECTIVES OF THE STUDY

Present study aims to

- To examine an enhancement in strength characteristics of steel fibre reinforced concrete specimen with Recycled aggregates.
- To study the behavior of RA on different percentage addition in concrete.

LITERATURE SURVEY

K.Nagamam' et al. (2008) the investigation on the contribution of steel fibres on the splitting tensile strength of high strength steel fibre reinforced concrete. Crimped steel fibre used having diameter O.45mm and length 36mm giving an aspect ratio of 80. Splitting tensile strength tests were conducted using l50mmx300mm cylindrical specimen. The addition of steel fibers by 2.50% volume fraction results in increases of 55.9% in the splitting tensile strength compared with un reinforced mix.

G.J Xiong et.al(2010) has investigated about the behaviors of hybrid fibre reinforced concrete with externally bonded hybrid carbon fibre, glass fibre sheets and he has concluded it has increased flexural performance of beam by 38%. Then strengthening cost also lesser than the conventional FRP method.

S.Eswari, et al. (2015) focused on the polyolefin steel hybrid fibre reinforced system. In this system, steel fibre which is stronger and stiffer improves the first crack strength ultimate strength, While the polyolefin fibre which is more flexible and ductile leads to improved toughness and strain capacity in the post-cracking zone. A total of 27 specimens were tested. Increasing the fibre content from 2 to 5% increases the modulus of rupture. The increases in modulus of rupture were found to be 72.52% with 5% hybrid fibre content. The increase in ultimate load was found to be 72.42% with 5% hybrid fibre content when compared to the plain concrete. The increase in ultimate and service load deflection was found to be 137.50 % and 186.49% respectively with 5%hybrid fibre content when compared to the plain concrete. The hybrid fibre reinforced concrete specimen exhibit reduced crack width was found to be 80% compared to that of plain concrete. The hybrid fibre reinforcement appreciably enhances the ductility of concrete specimen. The increase in ductility was found to be 98% and 83%in terms of energy and deflection.

METHODOLOGY

The general method used for conducting tests on the strength aspect is by casting concrete specimens and conducting the tests as per the IS456-2000 codal provisions. The specimens will be tested afler 7days, 14 days and 28days.

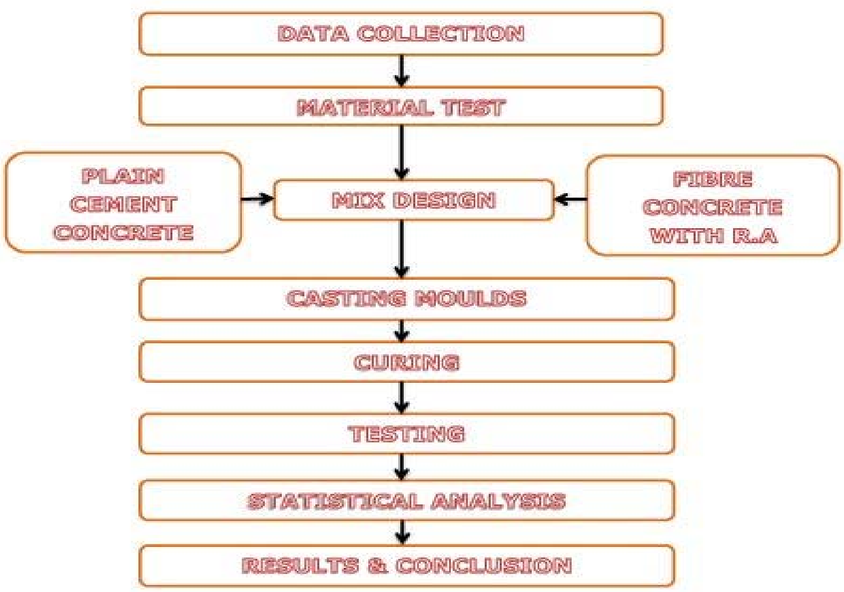


Fig 1: Methodology

3.2 COMPRESSIVE STRENGTH

The cube size of 150x150x150mm, the control concrete strength to be compared with fibre reinforced concrete strength. Followed as per IS 516-1959.

3.3 FLEXURAL STRENGTH

The concrete beams of size 150x150x700mm are to be cast and tested for comparing the flexural strength of conventional concrete with those adding with various percentages of Recycled aggregates with constant percentage of steel fibers. Two points loading can be employed for determination of flexural strength of the concrete. Tested as per IS 516-1959.

3.4 SELECTION OF MATERIAL REQUIREMENTS

3.4.1 Cement

Ordinary Portland cement of grade (43) is used for the present investigation and tested as per IS 4031-1988.

3.4.2 Fine Aggregate

River sand with fraction passing through 4.5mm sieve and retained on 60micron sieve is used and will be tested as per IS2386 (part l)—1963. The fineness. Modulus of sand is 3.12 with specific gravity of 2.51.

3.4.3 Coarse Aggregate

The size of 20mm Coarse aggregate has been selected for the study. The physical properties will be tested as per IS23 86 (part l)—1963. The fineness modulus of coarse aggregate is 5.95 with specific gravity of 2.81.

3.4.4 Recycled Aggregate

The size of 20mm to 12.5mm retained recycled aggregate has been selected for the study. The physical properties will be tested as per IS23 86 (part l)—1963. The fineness modulus of coarse aggregate is 5.95 with specific gravity of 2.81.

3.4.5 Water

Portable tap water available in the laboratory with pH value of 7.0 and Confirming to the requirements of IS456-2000 is used for making concrete and curing the specimen. For the present work the following steel and glass fibres are chosen. And Physical and mechanical Properties are shown in below.

3.4.6 Steel Fibres

Mechanical and Physical Properties of steel fibres

Name : MSH 41050—BN
Length 60mm
Diameter : 0.8mm
Aspect Ratio : . L/D = 75
Tensile Strength 1100 N/mm:
Anchorage : Hooked End

COMPRESSIVE STRENGTH TEST

The test was conducted as per IS 516-1959. The specimens were kept in water for 7days,14days, and 28 days and surface dry conditions were obtained by wiping water on the surface. The load was applied without shock and increased continuously at a rate of approximately 140 kg/sq cm/min until the resistance of the specimen to the increasing load breaks down and no greater load can be sustained. The maximum load applied to the specimen was then recorded and the Appearance of the concrete for any unusual features in the type of failure was noted. Average of three values was taken as the representative of the batch, The compression test setup is shown in Figure.

Fig :During Testing And Crack Formation On Specimen

TABULATION & RESULTS

Table: 7 Days Compressive Strength Test on Cube for Conventional Concrete and R.A Concrete

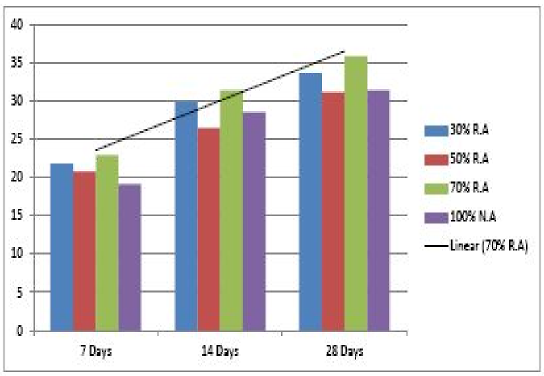
SL NO	DATE OF CASTING	NO OF CUBE	DATE OF TESTING	LOAD IN KN	7th DAY STRENGTH IN N/mm^2	7th DAY AVG STRENTH IN N/mm^2	AREA
1	25-Feb-16	M30-1	4-Mar-16	425	18.88	19.11	22500mm^2
2		M30-2		430	19.11		
3		M30-3		435	19.33		

SL NO	DATE OF CASTING	NO OF CUBE AND % OF R.A	DATE OF TESTING	LOAD IN KN	7th DAY STRENGTH IN N/mm^2	7th DAY AVG STRENTH IN N/mm^2	AREA
1	11-Mar-16	M30-1(30%)	19-Mar-16	495	22.00	21.77	22500mm^2
2		M30-2(30%)		485	21.75		
3		M30-3(50%)		475	21.11	20.78	
4		M30-4(50%)		460	20.44		
5		M30-5(70%)		520	23.11	22.88	
6		M30-6(70%)		510	22.60		

Table : 14days and 28days Test fo R.A. Concrete

SL NO	DATE OF CASTING	NO OF CUBE AND % OF R.A	DATE OF TESTING	LOAD IN KN	14th DAY STRENGTH IN N/mm^2	14th DAY AVG STRENTH IN N/mm^2	AREA
1		M30-1(30%)		680	30.22		
2		M30-2(30%)		660	29.33	29.77	
3	8-Mar-16	M30-3(50%)	23-Mar-16	590	26.22	26.44	22500mm^2
4		M30-4(50%)		600	26.67		
5		M30-5(70%)		710	31.56	31.30	
6		M30-6(70%)		700	31.11		

SL NO	DATE OF CASTING	NO OF CUBE AND % OF R.A	DATE OF TESTING	LOAD IN KN	28th DAY STRENGTH IN N/mm^2	28th DAY AVG STRENTH IN N/mm^2	AREA
1		M30-1(30%)		790	35.11	33.55	
2		M30-2(30%)		720	32.00		
3	5-Mar-16	M30-3(50%)	1-Apr-16	700	31.11	31.11	22500m^2
4		M30-4(50%)		700	31.11		
5		M30-5(70%)		800	35.55	35.77	
6		M30-6(70%)		810	36.00		



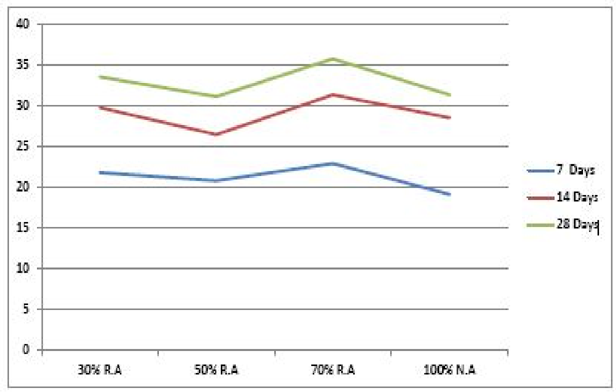
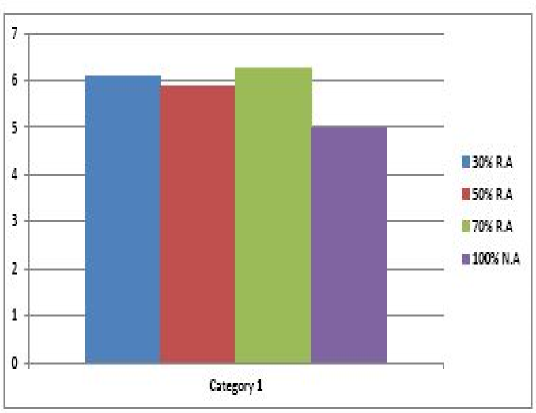


Fig : Compressive Strength Comparison of 7 days, 14 days, 28 days on both R.A & N.A

Table : 28Days Test For R.A Concrete:

SL NO	DATE OF CASTING	NO OF BEAMS	DATE OF TESTING	LOAD IN KN	28th DAY STRENGTH IN N/mm^2	28th DAY AVG STRENGTH IN N/mm^2
1		M30-1(30%)		29.60	6.13	6.11
2		M30-2(30%)		28.40	6.09	
3		M30-3(50%)		29.40	6.09	5.86
4	25-Feb-16	M30-1(50%)	23-Mar-16	27.20	5.64	
5		M30-1(70%)		29.80	6.18	6.27
6		M30-1(70%)		30.70	6.36	



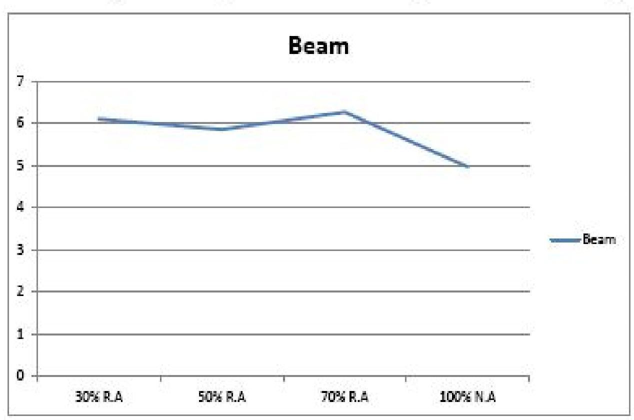


Fig : 28 days Beam Flexural strength comparison

CONCLUSION

Based on a large series of acquired experimental results on different characteristics of the tested material, it can be judged on the behaviour of this composite. The following conclusion may be drawn from the present investigation:

C&D waste material can be recycled and experimented to testify that utilization of recycled concrete with fibres in every-day life is possible and moreover it is useful without plasticizer and other admixtures. However, the use of recycled aggregate is possible only for that with acceptable grading in the range of 0/32 mm on account of a technology simplification. Suitable technology of construction material recycling could be considered an easy alternative for future applications. The recycling of this waste will reduce environmental damages caused by incorrect disposal, extend the useful life of landfills and preserve finite natural resources.

Steel fibres are applicable for fibre reinforced concrete and improve the properties of concrete. Several areas of application have been recognized however full-scale use of such fibre concrete is still hindered by the high cost, which is inacceptable for investors. The examples of application of such fibre concrete, which would help to meaningfully utilize the demolition waste, are so far based on numerical simulations and developed laboratory models. The main purpose of this research was to investigate the addition of construction waste (masonry and concrete) material in concrete production and establish the effects of steel fibres on mechanical properties of new concretes. In terms of this research were used standard test methods for determination of mechanical properties as initial bulk densities, compressive strengths and flexural strengths. Results are presented from the laboratory test results showing how recycled crushed aggregate can be recycled and experiment testify that utilization of concrete with fibres in every-day life is possible and more it is useful without plasticizer and other admixtures.

The recycling of C&D waste material in building production contributes to sustainable development in the construction sector and so helps to protect the environment. The viable technology of the construction material recycling could be considered an easy reference for future applications. A sprayed, pumpable or normal brickconcrete with fibres are suitable in highway construction, namely layers of pavement, slope stabilization, in hydraulic engineering for the strengthening of dam crests and in structural engineering for layers of floors in commercial halls. In general are appropriate for structures where restriction of cracking is required. Studies are continuing with the aim of obtaining more information about concretes made with C&DW mateials and reinforced with fibres and modeling situation construction with this composite. This will show more definitive trend of the effect of the level of replacement primary aggregates on the properties.

And hence we consider and recommend 70% recycled aggregates with 1% steel fibre can use in concrete.

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