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Experimental Study on Concrete with Partial Replacement of Fine Aggregate by Crushed Fourth Class Bricks with Addition of Glass Fibre

Akshay A Biradar Madhu V Deshmukh Mallikarjun B Patil Neelambika N D
Under The Guidance of
Asst. Prof. Laxmikant Doddamani
Department of Civil Engineering
Appa Institute of Engineering & Technology
Gulbarga, Karnataka

Abstract: **World is growing day by day and so the construction industry is going very fast. The difficulty to get building materials in market is increasing day by day, especially the concrete ingredients. We thought to replace one of ingredient with readily available source and cheap in cost. Hence we thought to use the waste crushed fourth class bricks to replace sand in concrete partially. The strength and durability of sand mixed concrete depends on multiple factors where as we tried to use waste crushed fourth class bricks to increase the durability and strength of concrete. We thought to analyze deeply to demonstrate the usage of waste crushed fourth class bricks in this project. We would like to demonstrate the strength and durability of mixed concrete which can be made with low cost waste crushed fourth class bricks as sand and glass fibre.**

Keywords: Crushed fourth class brick, Glass fibre, Split Tensile Strength, Flexural Strength.

I . INTRODUCTION

Concrete is widely used in domestic, commercial, recreational, rural and educational construction. Communities around the world rely on concrete as a safe, strong and simple building material. It is used in all types of construction; from domestic work to multi-storey office blocks and shopping complexes. Despite the common usage of concrete, few people are aware of the considerations involved in designing strong, durable, high quality concrete. Concrete Basics aims to provide a clear, concise explanation of all aspects of making quality concrete; from the Materials and Properties involved through Planning, Preparation, Finishing and Curing. Concrete Basics addresses the needs of unskilled and semi-skilled persons undertaking general concreting projects including home and handyman projects.

Since the natural resources are vanishing due to extensive use of them day by day, It is necessary to find alternative for the natural resources used in concrete. Fine Aggregate is becoming scarce and hence it's cost is increasing day by day. There is need of finding an alternative for fine aggregate used in concrete and crushed fourth class brick is one such alternative which can take the place of Fine Aggregate in Concrete. Concrete is weak in tension and flexure, most commonly it is reinforced using steel reinforcing bars. Considerable efforts have been made worldwide to add various types of fibres to concrete so to make it more strong, durable and economical. Synthetic fibre such as Glass fibre has certain physical and mechanical characteristics that can be utilized effectively in the development of reinforced concrete material in most cases.

This Paper presents study and behavior of concrete with partial replacement of fine aggregate by crushed waste fourth class bricks with addition of glass fibre. A total of 90 specimens were casted in which 30 Cubes of size 150X150X150(mm), 30 Cylinders (300mm depth and 150 mm diameter) and 30 Prisms of size 500X150X150(mm).

II . MATERIALS

Cement: Ordinary Portland cement (43 grade) of Coromandel king brand manufactured from a single batch was used throughout the project

Table-1: Properties of cement

Sl. No	Properties	Results
1.	Specific gravity	3.1
2.	Normal consistency	30%
3.	Initial setting time	31 min
4.	Final setting time	480 min

Fine Aggregate: The aggregates are well graded that pass 4.75mm sieve and are salt free. It is selected from locally available river beds and is free from deleterious matter.

Table-2: Properties of fine aggregate

Properties	Results
Specific gravity	2.7
Bulk density (compacted condition)	1914 Kg/m^3
Fineness modulus	2.8 %

Coarse Aggregate: Crushed Coarse aggregates of 20mm downsize obtained from locally available plants were used.

Table-3: Properties of Coarse aggregate

Specific gravity	2.87
Fineness Modulus	3.98%

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Bulk Density	1615 kg/m^3
Flakiness Index	15.21%
Crushing Strength	13.96%
Abrasion value	8.7%
Impact Strength	9.16%
Elongation Index	28.26%

Crushed Fourth Class Bricks: The waste fourth class bricks were obtained from local brick manufacturing unit, crushed and then sieved through 4.75mm and retained on 150 micron IS -Standard sieves.

Table-4: Properties of crushed fourth class bricks

Propeties	Results
Specific gravity	2.08
Water absorption	14.72%

Glass Fibre: The glass Fibre is obtained from Buddha Building Technology, Thane. Length of fibre is 12 mm.

III . MIX PROPORTION

Five mixture proportions were made with M30 grade. First were conventional concrete mix (normal concrete) and the next proportions mix is with replacing 5%, 10%, 15% and 20% of Fine Aggregate with crushed fourth class brick and keeping 1% of glass fibre constant. Mix proportions are given in table as per Indian standard specification IS: 10262-2007 to obtain 7 and 28 days compressive strength, split tensile strength and flexural strength. Hand mixing was done for the concrete mixers.

IV . PREPARATION OF SPECIMEN

Hand mixing is done, slump test was conducted for each mix to assess the workability. Concrete cubes (150x150x150mm) for determining compressive strength, Cylinder(150mm diameter, 300mm depth) for determining split tensile strength beams (100mmx100mmx500mm) for determining flexural strength using standard moulds were prepared. Specimens were demoulded after 24 hours of casting and were kept in a curing tank for water curing for next 7days and 28 days. The specimens to be tested were taken from the curing tank on 7th and 28th day of curing for compressive strength, split tensile strength and flexural strength.

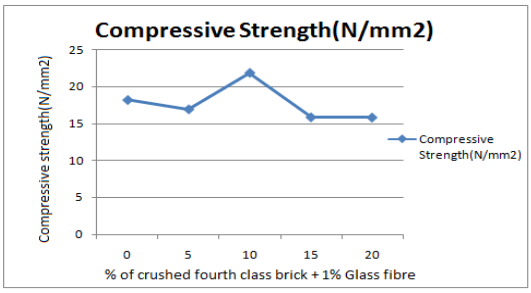
V. TESTING OF SPECIMEN

The Compressive and Split Tensile strength were obtained by testing the Cubes and Cylinders in Compressive Testing Machine which has capacity of 2000KN and the Flexural strength were obtained by testing Prisms on Flexural Testing Machine which has a two point loading system and the data collected is tabulated and the graphs are drawn as below.

VI. RESULTS & DISCUSSION

Table-5: Results of Compressive strength of cubes

% of crushed fourth class brick	%Glass fibre	7 Days (N/mm^2)	28 Days (N/mm^2)
0	0	18.2	30.07
5	1	16.94	31.69
10	1	21.86	31.86
15	1	15.87	35.93
20	1	15.83	35.31



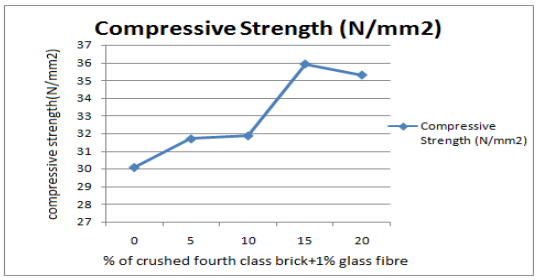


Table-6: Result of Split tensile strength of Cylinder

% of crushed fourth class brick	% of Glass fibre	7 Days (N/mm^2)	28 Days (N/mm^2)
0	0	1.35	2.37
5	1	1.46	2.52
10	1	1.57	2.53
15	1	1.72	2.57
20	1	1.55	2.52

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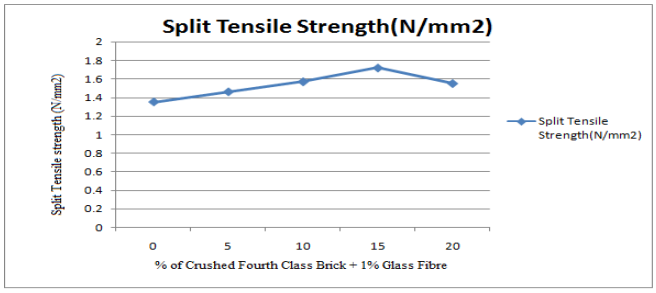


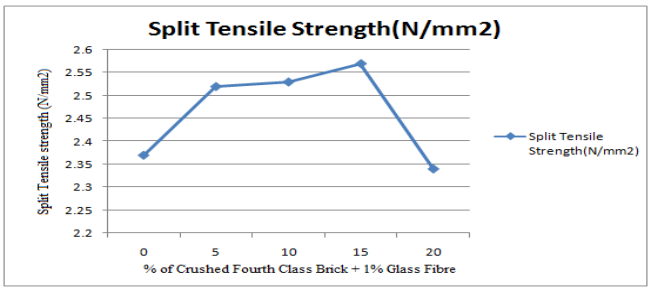
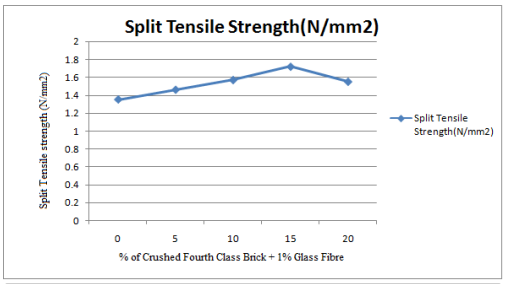
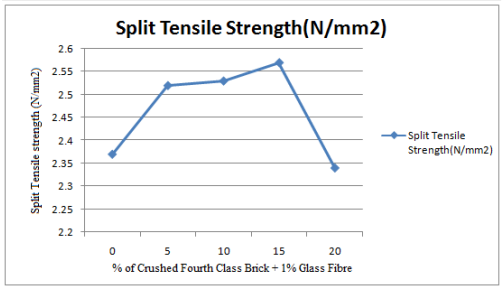


Table 7: Results of Flexural strength of prism

% of crushed fourth class brick	% of Glass fibre	7 Days (N/mm^2)	28 Days (N/mm^2)
0	0	1.35	2.37
5	1	1.46	2.52
10	1	1.57	2.53
15	1	1.72	2.57
20	1	1.55	2.52





Mixing of Concrete

Casted specimen

Demoulding and Curing

Testing of specimen

VII . CONCLUSIONS

- The average compressive strength of the conventional concrete at 28 days is 30.07 N/mm^2.
- The average Split tensile strength of the conventional concrete at 28days is 2.37 N/mm^2.
- The average Flexural strength of the conventional concrete at 28 days is 3.25 N/mm^2.
- Results show that 15% replacement of FA by CFCB along with 1% GF gives more strength i.e. 35.93N/mm^2 compressive strength, 2.57 N/mm^2 split tensile strength and 5.16 N/mm^2 flexural strength compared to 30.07 N/mm^2 Compressive strength, 2.37 N/mm^2 split tensile strength and 3.25 N/mm^2 flexural strength of conventional concrete.
- There is 7.78 % increase in split tensile strength and 37.02 % increase in flexural strength for 15% replacement of FA by CFCB
- Crushed fourth class bricks used as replacement of normal sand with glass Fibre gives high durability, and increases the life span of structure.

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