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DURABILITY ASPECTS OF M25 CONCRETE WITH ADDITION OF CARBONFIBERS

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Abstract - *In present experimental work, M25 grade of concrete can be designed according to is 10262:2019 with four different proportions of carbon fibers are added in the proportions of 0%, 0.5%, 1.0 %, and 1.5% respectively with concrete ingredients by the weight of cement. For strength parameters compressive, spilt tensile strength are calculated for 7, 14, 28 days and tested for hardened concrete.*
For durability study, acid and alkaline tests are conducted and compared to the optimum values of carbon fiber based concrete by addition 5% of H_2SO_4 & NaOH as acid and alkaline Solutions respectively to curing water and tabulate the results .

Key Words: *Carbon fibres, Compressive Strength, Split Tensile Strength, optimum values, Durability.*

1. INTRODUCTION

Concrete is one of the most commonly used building materials. It is a composite material made from several readily available constituents (cement, fine aggregate, coarse aggregate and water). Concrete is prime material for structures and used for various other applications. Admixtures are the substances which are added in concrete in addition to enhance its performance. To overcome the deficiencies of concrete, fibres are added to enhance the performance of concrete. This reduces the micro cracks and increases the strength of concrete. Material tests are conducted to all the materials used in concrete according to the IS Codes. The mix design is M25 and the mix design is designed from IS10262:2019 and various tests are conducted for fresh concrete such as slum cone test and compaction factor test for all types of mixes to find the workability of concrete.

1.1 OBJECTIVES OF THE STUDY:

➢To increase the strength by using carbon fibres.
➢To encourage the introduction of new materials in the concrete
➢To check durability for carbon fibres based concrete

1.2 HISTORY OF CARBON FIBER

Carbon fiber is predominantly produced from polyacrylonitrile (pan). Carbon fibers reinforced polymer, carbon fibers reinforced plastic, or carbon fibers reinforced thermoplastic (CFPR, CRP, CFRTP, or often simply carbon fibers, carbon composite or even carbon), is an extremely strong and light fibers-reinforced plastic which contains carbon fibers . The spelling 'fibers' is usually outside the USA. CFRPS can be expensive to produce but are commonly used wherever high strength- to-weight ratio and stiffness (rigidity) are required, such as aerospace, superstructure of ships, automotive, civil engineering, sports equipment, and an increasing number of consumer and technical applications.

Table: 1.1 Physical Properties of Carbon Fiber

PROPERTY	VALUE
Aspect ratio	150
Length	18mm
Density	350g/lit
Color	Black
Carbon content	95%
Elongation	1.8%
Electric resistivity	$1.6x10^{-3}\ \Omega$
Tensile strength	430mpa
Tensile modulus	230gpa

2. DURABILITY

It is the ability of a physical product to remain functional, without requiring excessive maintenance or repair, when faced with the challenges of normal operation over its design life time. Thereare several measures of durability in use, including years of life, hours of use, and number of operational cycles. In economics, goods with a long usable life are referred to as durable goods.

3. STRENGTH PARAMETERS

Carbon fiber is added in the proportion of 0, 0.5, 0.1, 1.5 percentages by the weight of cement and find out the

compressive and split tensile strength @7, 14, 28 days respectively and tabulate the results.

Table: 3.1 Comparison of Compressive Strength

Type of mix	7 Days (N/mm^2)	14 Days (N/mm^2)	28 Days (N/mm^2)
N	20.3	26.3	31.7
$C.F_{0.5}$	21.84	28.63	35.42
$C.F_{1.0}$	**23.38**	**30.17**	**36.96**
$C.F_{1.5}$	19.81	26.6	33.39

Table: 3.2 Comparison of Split Tensile Strength

Type of mix	7 Days (N/mm^2)	14 Days (N/mm^2)	28 Days (N/mm^2)
N	1.62	2.14	2.83
$C.F_{0.5}$	1.83	2.37	2.92
$C.F_{1.0}$	**2.32**	**3.52**	**4.02**
$C.F_{1.5}$	1.8	2.43	3.23

By observing the values, we get the optimum carbon fibers with 1% weight of cement. So, taking this proportion we find the durability aspects by curing the carbon fiber reinforced concrete with 1.0% by the weight of the cement specimens in 5% acid & alkalinity-based solution @ 7 , 14 and 28 days .

4. DURABILITY PROPERTIES

4.1 ACID ATTACK (H2SO4)

The concrete specimens of **$C.F_{1.0}$** concrete are casted and curing is done with addition of sulphuric acid (H_2SO_4) by 5% weight of curing water and then find out the compressive and split tensile strength to check the durability in acid condition.

Table: 4.1 acid attack specimens (sulfuric acid)

Type	7 Days (N/mm^2)	14 Days (N/mm^2)	28 Days (N/mm^2)
Compressive strength	14.23	21.08	27.83
Split Tensile Strength	1.27	1.19	2.59

4.2 ALKALINITY ATTACK (NaOH)

The concrete specimens of **$C.F_{1.0}$** concrete are casted and curing is done with addition of Sodium hydroxide (NaOH) by 5% weight of curing water and then find out the compressive and split tensile strength to check the durability in alkaline condition.

Table: 4.2 alkaline attack specimens (sodium hydroxide)

Type	7 Days (N/mm^2)	14 Days (N/mm^2)	28 Days (N/mm^2)
Compressive strength	18.47	25.38	32.26
Split Tensile Strength	1.49	2.08	3.15

Table: 4.3 Comparison of Compressive and Split Strength of Acid and Alkalinity Attack Specimens

Type	Compressive strength	Split Tensile Strength
Compressive strength	27.83	2.59
Split Tensile Strength	32.26	3.95

5. FINAL RESULTS AND GRAPHS

By observing the values, we get the best resistance at alkaline condition when compared to acid condition. The final comparison of compressive and split tensile strengths of nominal, carbon fiber based concrete, acid attacked, alkaline attacked specimens are given below in tabular form and as well as graphs.

5.1 Comparison of Compressive Strength Of N, C.F 1.0 , Acid and Alkalinity Attack Specimens

Type	7 Days (N/mm^2)	14 Days (N/mm^2)	28 Days (N/mm^2)
N	20.3	26.3	31.7
$C.F_{1.0}$	23.38	30.17	36.96
Acid Specimens	14.23	21.08	27.83
Alkaline specimens	18.47	25.38	32.26

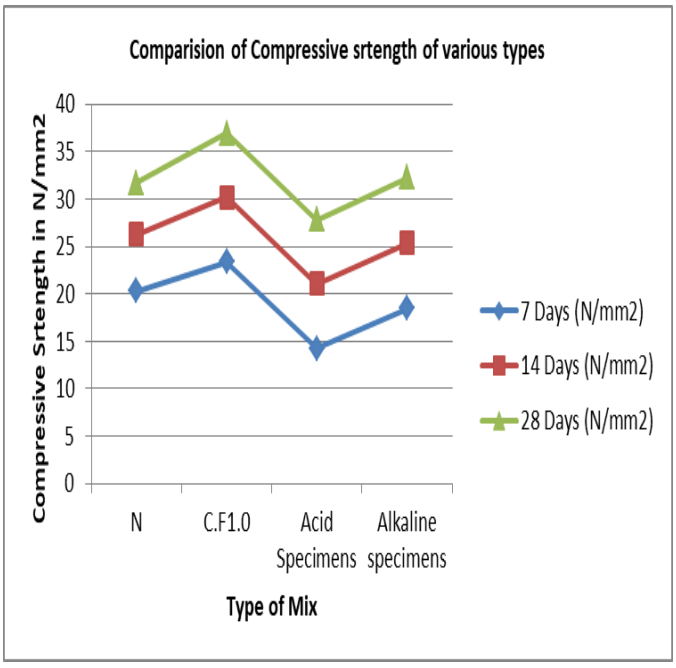


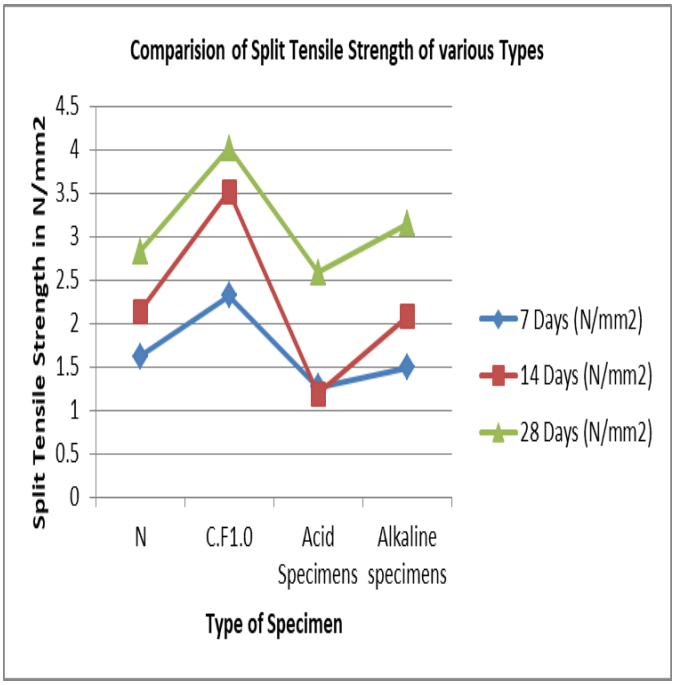
Chart -5.1: compressive strength of various specimens

5.2 Comparison of Split Tensile Strength of N, C.F 1.0, Acid and Alkalinity Attack Specimens

Type	7 Days (N/mm^2)	14 Days (N/mm^2)	28 Days (N/mm^2)
N	1.62	2.14	2.83
$C.F_{1.0}$	2.32	3.52	4.02

Acid Specimens	1.27	1.19	2.59
Alkaline specimens	1.49	2.08	3.15

Chart -5.1: Split Tensile strength of various specimens



6. CONCLUSIONS

• By addition of cement with carbon fibers there is an increase of mechanical properties of up to 1% and there after decreasing pattern is observed.
• The workability property was not of much difference when compared to nominal concrete.
• The carbon fibers based concrete has an increase of compressive strength of about 16.59 % when compared to nominal concrete.
• The carbon fibers concrete has an increase of split tensile strength of about 42.04 % when compared to nominal concrete.
• The acid attack in concrete has an decrease of compressive strength of about 13.90 % when compared to nominal concrete.
• The acid attack in concrete has an decrease of split tensile strength of about 9.26 % when compared to nominal concrete.
• The alkalinity attack in concrete has an decrease of compressive strength of about 1.76 % when compared to nominal concrete.
• The alkalinity attack in concrete has an decrease of split tensile strength of about 11.30 % when compared to nominal concrete.
• The carbon fibers based concrete has a decrease of compressive strength of about 32.80 % when compared to acid attack.
• The carbon fibers concrete has an decrease of split tensile strength of about 55.21 % when compared to acid attack.
• The carbon fibers based concrete has an decrease of compressive strength of about 14.56 % when compared to alkalinity attack.
• The carbon fibers concrete has a decrease of split tensile strength of about 27.61 % when compared to alkalinity attack.
• The alkalinity attack in concrete has an increase of compressive strength of about 15.91 % when compared to acid attack.
• The alkalinity attack in concrete has an increase of split tensile strength of about 21.62 % when compared to acid attack.
• By concluding this project as "acid attack is more when compared to alkalinity attack"

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•Foes pg., Gourley cs, hiker c (1988) rock weathering in engineering time. Q j end gel 21:33–57 .durability can be defined as the resistance of geomaterials to deterioration caused by physical, chemical, and biological agents acting in a specific environment.

BIOGRAPHIES

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