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STUDY OF CONCRETE BY DEMOLISHED WASTE AS COARSE AGGREGATE, CHARCOAL AS PARTIAL REPLACEMENT OF CEMENT WITH STEEL AND SISAL FIBERS

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Abstract - *Concrete is an essential material in the construction industry, Aim of this project is to obtain an environmental friendly by using demolished concrete as coarse aggregate and naturally obtained materials. Concrete is a mix of aggregates, binding materials and water. Most of the aggregates are naturally obtained from gravel and river sand. Due to the modern living standards old structures need to pave way for the new modern structures, to save the ecosystem conventional aggregate is replaced fully with demolished waste from the concrete structures. Total Cement manufacturing industry is creating more pollution than the so many countries. By reducing the amount of Cement by using Coal powder in 5%, 10%, 15%and 20% by cement wt, it can decrease total pollution release from cement manufacturing. To increase the tensile strength, to arrest shrinkage, surface cracks and to increase the compressive strength, natural fiber sisal and steel fibers are used in optimal mix at 0.5%,1%,1.5%,2%,2.5% by cement wt. Mechanical Properties of concrete are studied by conducting Compressive, Split Tensile and Flexural tests for 7,14&28days*

Key Words: Demolished concrete, Charcoal powder, Sisal fibers, and Steel fibers.

1. INTRODUCTION

Concrete is a composite mix which consists mostly Coarse and Fine aggregates, nearly 60 to 80% are occupies by the Aggregates. Ongoing rapid Constructions worldwide, consuming lot of natural resources and destroying eco system. So in this project an attempt made to replace constituents of concrete i.e coarse aggregate and cement. The main reason to select these two materials because of these are the main components of the concrete causing more trouble for the environment and ecosystem. For coarse aggregates hills and other rock formations are mined destroying many trees and ecosystem,. And cement manufacturing itself releasing much Co2 emissions in to the environment.

1.1 MATERIALS AND PROPERTIES

Demolished Aggregate **-** Every concrete structure will get old and unserviceable with time, they need to demolished for the safety of the public an attempt made in this project to replace Coarse aggregate fully (100%) with Demolished aggregate.

Charcoal**-**Concrete is the most consumed material next to water, Aggregates are the Body and cement is the heart of it as all we know cement processing units leave so much Co2 Emissions causing Global warming, an attempt made in this project to replace the partially replace some extent of cement with charcoal powder. The reason to select the charcoal powder because of its surface area of charcoal powder is very high. Wood Char coal is grinded to the

powder and sieved through the 90 Microns sieve to bring equal fineness that of Cement.

Fibers- In this project natural (Sisal fiber) and artificial fiber(Steel fibers with hooked ends) are used to increase strength and to arrest the shrinkage cracks in concrete.

Steel fibers –Steel fibers are

Diameter-0.5mm

Length - 30mm

Aspect ratio (l/d)- 60.

Sisal fibers- Sisal fiber is a natural fiber obtained from the Agave plant, agave plant leaves are 2m long and yields fiber. Sisal fiber traditionally used in making twine rope and also dartboards.
Natural fiber they are available locally.

Tensile strength- 385 to 728 Mpa

Diameter - 0.8 to 1.2mm.

2. SCOPE OF THE STUDY:

- The main aim of this study is wholly concentrated on performance of the demolished concrete waste as full replacement of coarse aggregate, the demolished waste materials are collected from the local sources and grinded into 10-20mm.
- To determine the different properties of the coarse aggregate by replacing with 100% demolished concrete waste.
- To study the influence of charcoal dust if replaced with cement, in different proportions of 5%,10%,15% and 20% by wt of cement.
- Addition of steel fibers to the final obtained mix in categories of 0.5%,1%,1.5% and 2%.

3. PHYSICAL PROPERTIES OF THE MATERIALS

Table 3.1 physical Properties of Cement

S. No	Property	Values
1	Normal Consistency	28%
3	Specific gravity	3.19
4	Fineness of cement	3.45%

Table 3.2 Physical Properties of Charcoal Powder

S. No	Property	Values
1	Specific gravity	2.2
2	Fineness of charcoal powder	4.0%

Table 3.3 Physical Properties of Coarse Aggregate

S.No	physical property	Value (20mm)
1	Specific gravity	2.76
2	Water absorption	1.56%
2	Fineness Modulus of coarse aggregate	6.28

Table 3.4 Physical Properties of Demolished Coarse Aggregate

S.No	physical property	Values (20mm)
1	Specific gravity	2.65
2	Water absorption	1.96%
3	Fineness Modulus of D.M aggregate	7.31

Table 3.5 Physical Properties of Fine Aggregate

S.No	Property	Value obtained
1	Specific gravity	2.6
2	Fineness Modulus of fine aggregate	3.01
3	Grading Zone	II

Methodology:

1. In M25 concrete mix Coarse aggregate is fully replaced with Demolished aggregate(D.A), and compared with Coarse aggregate concrete(C.A)
2. Cement replaced with charcoal in 5%, 10%, 15% & 20% in both C.A and D.A concrete mixes and compared.
3. Fibers are added to optimum percentage of charcoal mixes C.A charcoal and D.A charcoal and compared.

Mix Notations:

1. **C.A …..……………….. C.A**
2. **D.A …..……………….. D.A**
3. **C.A+95%OPC+5%C.C……M_1**
4. **C.A+90%OPC+10%C.C….M_2**
5. **C.A+85%OPC+15%C.C….M_3**
6. **C.A+80%OPC+20%C.C….M_4**
7. **D.A+95%OPC+5%C.C…...N_1**
8. **D.A+90%OPC+10%C.C….N_2**
9. **D.A+85%OPC+15%C.C….N_3**
10. **D.A+80%OPC+20%C.C….N_4**

Steel fibers:

11. **M_2 + 0.5%S.F ………….O_1**
12. **M_2 + 1%S.F ……...….O_2**
13. **M_2 + 1.5%S.F ………….O_3**
14. **M_2 + 2%S.F …………O_4**
15. **M_2 + 2.5%S.F ………….O_5**
16. **N_2 + 0.5%S.F ………..….P_1**
17. **N_2 + 1%S.F ………….P_2**
18. **N_2 + 1.5%S.F ………….P_3**
19. **N_2 + 2%S.F ………....P_4**
20. **N_2 + 2.5%S.F ………….P_5**

Sisal fibers

21. **M_2 + 0.5%S.S.F ………….Q_1**
22. **M_2 + 1%S.S.F ……...….Q_2**
23. **M_2 + 1.5%S.S.F ………….Q_3**
24. **M_2 + 2%S.S.F …………Q_4**
25. **M_2 + 2.5%S.S.F ………….Q_5**
26. **N_2 + 0.5%S.S.F ………..….R_1**

27. N_2 + 1%S.S.F …………R_2
28. N_2 + 1.5%S.S.F …………R_3
29. N_2 + 2%S.S.F …………R_4
30. N_2 + 2.5%S.S.F …………R_5

C.A – Coarse Aggregate
D.A – Demolished Aggregate
C.C – Charcoal
S.F – Steel fibers
S.S.F – Sisal fibers

Table 3.7 Comparison of Mechanical properties of Normal aggregate & demolished aggregate concrete mix @ 28 days:

Properties after 28days	Compressive strength(N/mm²)	Split tensile strength (N/mm²)	Flexural strength(N/mm²)
N.A	31.9	3.33	3.8
D.A	24.5	2.69	2.98

Graph 3.1 Comparing C.A and D.A

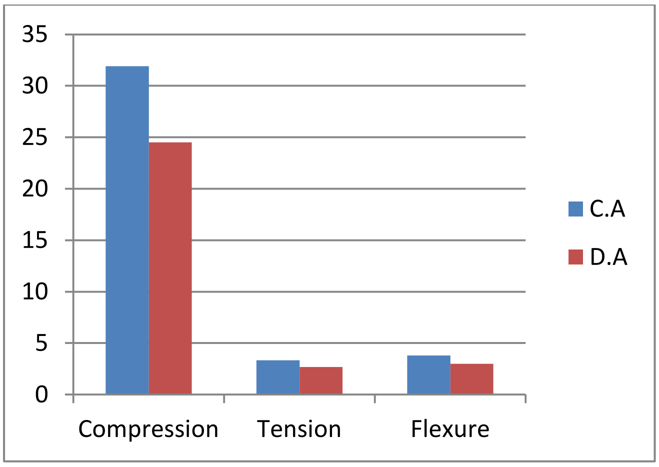


Table 3.7 Mechanical properties of C.A + OPC+ Charcoal @28Days

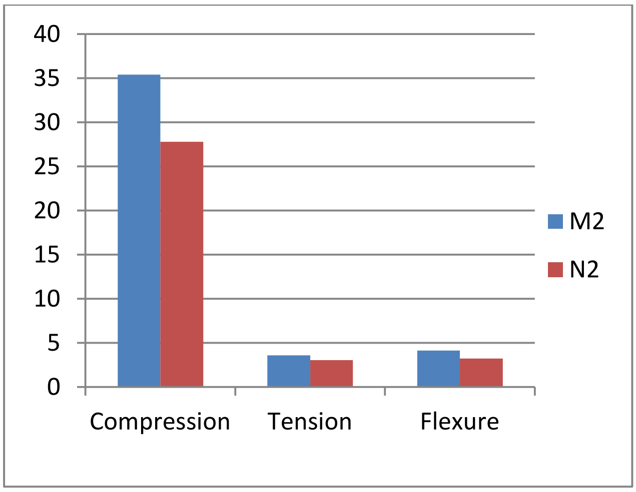
Values @28days(N/mm²)	Compressive strength	Split tensile strength	Flexural strength
M_1	33.2	3.41	3.55
M_2	**35.4**	**3.59**	**4.14**
M_3	32.56	3.51	4.1
M_4	28.65	3.36	3.89

Table 3.8 Mechanical properties of D.A + OPC+ Charcoal @28Days

Values @28days (N/mm²)	Compressive strength	Split tensile strength	Flexural strength
N_1	25.6	2.69	2.98
N_2	**27.8**	**3.06**	**3.23**
N_3	25.1	2.72	2.84
N_4	21.2	2.52	2.45

Table 3.9 Optimum values obtained at M_2 and N_2

Values @28days(N/mm²)	Compressive strength	Split tensile strength	Flexural strength
M_2	35.4	3.59	4.142
N_2	27.8	3.06	3.23



Graph 3.3 Comparing M2 & N2

Table 3.10 Steel Fibers Added to optimum mix M_2:

Values @28days(N/mm²)	Compressive strength	Split tensile strength	Flexural strength
O_1	36.17	3.65	4.19
O_2	37.4	3.78	4.24
O_3	39.05	3.87	4.32
O_4	41.8	3.95	4.45
O_5	38.51	3.76	4.18

Table 3.11 Steel Fibers Added to optimum mix N_2

Values @28days(N/mm²)	Compressive strength	Split tensile strength	Flexural strength
P_1	28.2	3.14	3.39
P_2	29.4	3.29	3.67
P_3	31.05	3.37	3.85
P_4	33.8	3.48	4.05
P_5	29.95	2.95	3.89

Table 3.12 Optimum Values Obtained in Mix O4 & P4

Values @28days(N/mm²)	Compressive strength	Split tensile strength	Flexural strength
O_4	41.8	3.95	4.45
P_4	33.8	3.48	4.05

Graph 3.4 Comparing O_4 & P_4

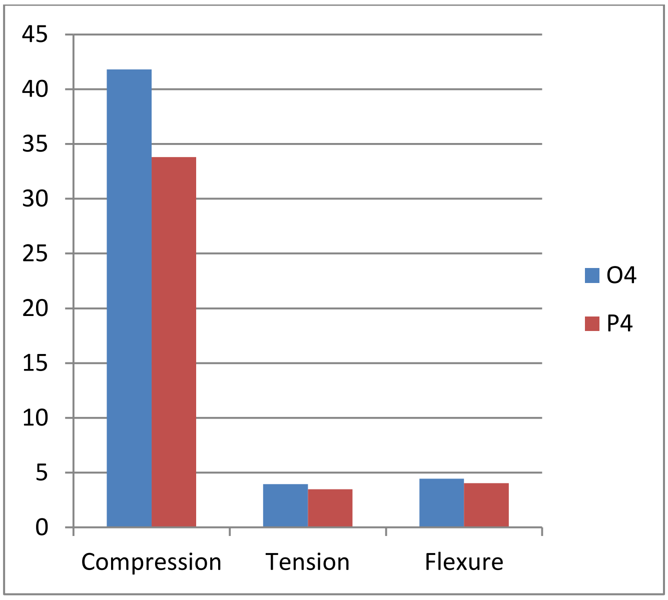


Table 3.13 Sisal Fibers Added to optimum mix M_2

Values @28days(N/mm²)	Compressive strength	Split tensile strength	Flexural strength
Q_1	35.9	3.64	4.15
Q_2	36.75	3.75	4.19
Q_3	38.6	3.82	4.25
Q_4	37.8	3.69	4.21
Q_5	34.4	3.59	4.09

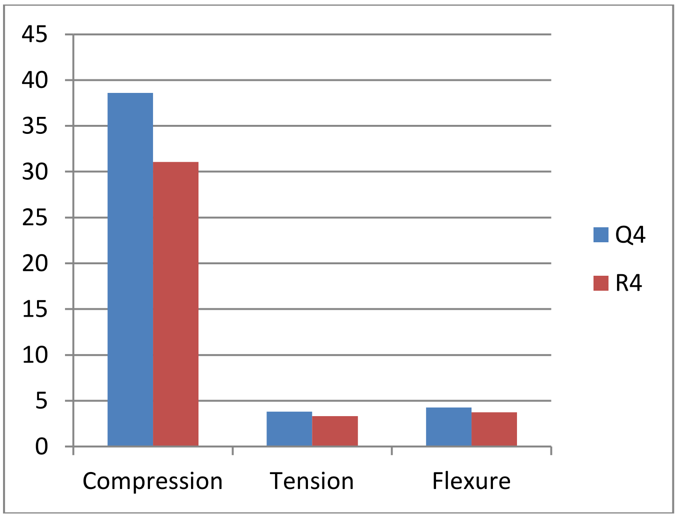
Table 3.14 Sisal Fibers Added to optimum mix N_2:

Values @28days(N /mm²)	Compressive strength	Split tensile strength	Flexural strength
Q_3	38.6	3.82	4.25
P_3	31.05	3.31	3.72

Table 3.15 Optimum Values Obtained in Mix Q_3& R_3

Values @28days(N/mm²)	Compressive strength	Split tensile strength	Flexural strength
R_1	28.2	3.14	3.31
R_2	29.7	3.22	3.48
R_3	31.05	3.31	3.72
R_4	30.1	3.18	3.49
R_5	28.2	2.98	3.3

Graph 3.5 Comparing Q3 & R_3



4. CONCLUSIONS

The following conclusions were drawn from the Experimental results.

When compared to M concrete mix M2 has increased max compressive strength by 11%, split tensile strength by 6.5% and flexural strength by 9%. When compared to N concrete mix N2 has increased max compressive strength by 13.5%, split tensile strength by 4% and flexural strength by 8.3%.

Addition of Steel fibers we get optimum at 2% in M2 mix, it increased compressive strength by 16%, Split tensile strength by 13.5%, Flexural strength by 9%. With addition of Sisal fibers we get optimum at 1.5% in M2 concrete mix, it increased compressive strength by 9%, Split tensile strength by 6.4%, Flexural strength by 3.5%.

Addition of steel fibers we get optimum at 2% in N2 concrete mix, it increased compressive strength by 22%, split tensile strength by 13%, flexural strength by 19%. With addition of Sisal fibers we get optimum At 1.5% in N2 concrete mix, it increased compressive strength by 11.5% only, Split tensile strength by 8%, Flexural strength by 13%.

From the results, It is recommended to use Demolished aggregate, Where lot of demolished aggregate i s available at site. Only used for Small and less important structures.

Ex: Ground floorings of parking lots, External ground floorings at home premises.steel fibers gave almost double the strength than the Sisal fibers, but in economical point of view sisal fibers are cheap and locally available.

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