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EXPERIMENTAL STUDY ON CONCRETE INCORPORATING WITH GRANITE POWDER AND WIRE SCRAP

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Abstract - *The main parameter investigated in this study is the concrete with replacement of sand by waste by-products like granite powder in 15%, 20%, 25% Sand wire scrap in 1%, 1.5%, 2%. Compressive strength test, Split tensile strength test and Flexural strength test for 7, 14 and 28 days curing period were studied. The grade of concrete used in this experiment is M30. Variations in strength parameter of the different ratios were observed by the increase in granite powder and wire scrap percentage. Granite powder increases the compressive strength of the concrete. Wire scrap increases the tensile strength by reducing the micro cracks in concrete.*

Key Words: Granite powder, Wire scrap, Compressive strength, Split tensile strength, Flexural strength.

1. INTRODUCTION

One of the essential component of the concrete is fine aggregate. The most commonly used fine aggregate is river sand. But now a days there is a scarcity in river sand (fine aggregate). So we have to manage the waste generated by effectively utilizing the benefits of wastes (granite powder and wire scrap) by the usage of these waste by-products makes the concrete economical by the partial replacement of the fine aggregate. The wastes of granite powder are generated in India per year were calculated to be around 17.8 million tons. Granite powder is easily available and it causes lung cancer with heavy exposures. Wire scrap is non-biodegradable and its disposal causes land pollution. It can be also effectively used as a filler material in the concrete, partially replacing the fine aggregate which will help in filling up the pores in the concrete. This experiment is aimed at finding out the strength in concrete while partially added the granite powder and wire scrap in certain percentage of mix proportions.

2. METHODOLOGY

1. Studying literature related to granite powder and wire scrap used in concrete.
2. Selection the materials based on their properties and quality (cement, fine aggregate, coarse aggregate, water, granite powder and wire scrap).
3. Calculating the ratio of mix proportions by design mix or nominal mixes for grade of concrete.
4. Select the method of mixing such as hand mixing or machine mixing.
5. Casting of concrete specimen such as cube, cylinder and prism.
6. Curing of concrete by water or some other methods for 7 days, 14 days and 28 days.
7. The specimens are carried out for testing for 7 days, 14 days and 28 days in various testing.

3. MATERIALS AND THEIR PROPERTIES

3.1 MATERIAL USED

1. Cement
2. Coarse aggregate
3. Fine aggregate
4. Granite powder
5. Wire scrap
6. Water

3.2 CEMENT

Cement acts as a binding material in concrete. Ordinary Portland cement confirming to IS: 12269-1987 is used in this experiment. The cement is of 53 grade and the test conducted on cement are

Table- 1: Characteristics of Cement

Serial no.	Characteristics	Values
1.	Specific gravity	3.09
2.	Standard consistency	24%

13.2 COARSE AGGREGATE

Aggregates are composite material. The coarse aggregate used in the nominal size of 20 mm, crushed angular and free from saw dust. The tests conducted on coarse aggregates are

Table- 2: Characteristics of coarse aggregate

Serial no.	Characteristics	Values
1.	Water absorption	2.625%
2.	Specific gravity	2.7
3.	Crushing strength	28.9%

3.3 FINE AGGREGATE

Fine aggregate is consist of natural sand or crushed stone. It is used for particles smaller than 4.75mm sieved. M-sand is used as a fine aggregate in this study. It helps to fill voids between coarse aggregate and acts as a workability agent.

Table-3: Characteristics of Fine aggregate

Serial no.	Characteristics	Values
1.	Specific gravity	2.64

3.4 GRANITE POWDER

Granite powder is a general type of igneous rock. It is a waste material from the granite polishing industry. It has been used in this experimental work. It can be used as a filler material (partial replacement of sand) to reduce the void in concrete.

Fig-1: Granite Powder

Table-4: Characteristics of Granite Powder

Serial no.	Characteristics	Values
1.	Specific gravity	2.43

3.5 WIRE SCRAP

It consist of copper wire and covered with plastic insulation. It control micro cracking due to both the plastic and drying shrinkage. The length of the wire scrap is 1.5 cm and diameter of 1mm. It is used as a fiber reinforcing material in concrete for the following reasons:

1. Corrosion resistant
2. Tough
3. Antibacterial
4. Ductile
5. Alloys easily

Fig-2: Wire Scrap

3.6 WATER

Portable water is used for both concrete mixing and curing. The most recommended water should be free from salts, organic matter, oils, saw dust and other impure materials. The pH value should be lies in between 6 to 8.

4. EXPERIMENTAL INVESTIGATION

4.1 MIX DESIGN

Mix proportioning for a concrete of M30 is as follows:

1. Grade designation : M30
2. Type of cement : OPC 53
3. Min cement content : 320 kg/m^3
4. Maxi nominal size of aggregate : 20mm
5. Maximum water cement ratio : 0.55
6. Workability : 100mm
7. Exposure condition : Severe
8. Degree of supervision : Good
9. Type of aggregate : Crushed
10. Maximum cement content : 465kg/m^3

Test data for materials

a. Cement used : OPC 53 grade
b. Specific gravity of
    1. Cement : 3.09
    2. Coarse aggregate : 2.7
    3. Fine aggregate : 2.6

Mix proportion

Cement	: 465kg/m^3
Water	: 186 liter
Fine aggregate	: 666.12 kg
Coarse aggregate	: 1111.54 kg
Water cement ratio	: 0.40
Ratio	: 1:1.43:2.39

5. TESTING OF FRESH AND HARDENED CONCRETE

5.1 TESTING OF FRESH CONCRETE

1. Slump cone test
2. Compaction factor test

5.1.2 SLUMP CONE TEST

Slump cone test is used to determine the consistency or workability of the fresh concrete. It is the most simple method to determine the concrete quality immediately along with low cost. Water cement ratio = 0.40

Slump value = 300-175= 125mm

Fig-3: Slump cone test

5.1.3 COMPACTION FACTOR TEST

Compaction factor is to calculate the workability of the fresh concrete. Water cement ratio= 0.40

Compaction factor = 0.93

5.2 TESTING OF HARDENED CONCRETE

1. Compressive strength test
2. Split tensile test
3. Flexural strength test

6. RESULTS AND ANALYSIS

6.1 COMPRESSIVE STRENGTH

Compressive strength is one of the important properties of concrete. Size of concrete cubes 150mm x 150mm x 150mm. The compressive strength for the reference concrete was observed as 33.76N/mm^2 which increases to 36.22N/mm^2 with 20% GP & 1.5% WS increases in replacement of fine aggregate.

Compressive strength = Load / Area (N/mm^2)

Fig-4: Compressive test

Table-5: Compressive Strength in concrete

Serial no.	Mix proportion	Compressive strength(N/mm^2)		
		7 Days	14 Days	28 Days
1.	0% GP & 0% WS	25.75	33.76	46.4
2.	15% GP & 1% WS	26.88	35.33	47.11
3.	20% GP & 1.5% WS	28.2	36.22	49.11
4.	25% GP & 2% WS	29.9	33.55	47.78

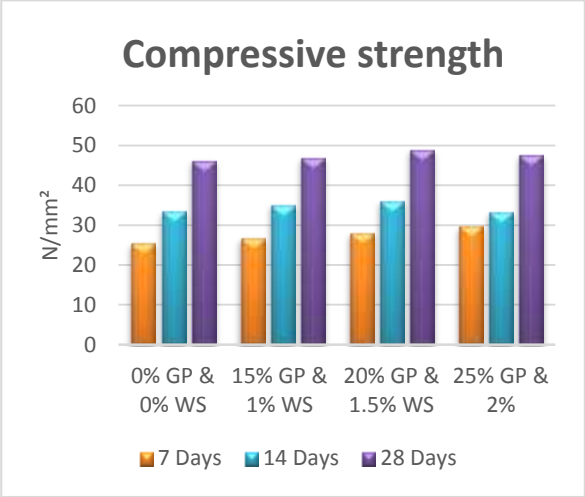

Chart-1: Compressive strength

6.2 TENSILE STRENGTH

To determine the tensile strength of the concrete. Concrete is weak in tension because of brittle nature. Therefore it does not resist the tension completely. So, the concrete develops cracks when the tensile force acts on it more than the tensile strength. Size of concrete cylinders 150mm diameter and 300mm length.

Tensile strength = $2P/\pi DL$ (N/mm^2)

P - Failure load
D - Diameter of the specimen
L – Length of the specimen

Table-6: Tensile strength in concrete

Serial no.	Mix proportion	Tensile strength(N/mm^2)		
		7 Days	14 Days	28 Days
1.	0% GP & 0% WS	1.8	4.03	5.02
2.	15% GP & 1% WS	3.18	4.45	5.31
3.	20% GP & 1.5% WS	3.60	4.66	5.8
4.	25% GP & 2% WS	3.95	4.17	5.38

Fig-5: Tensile strength test

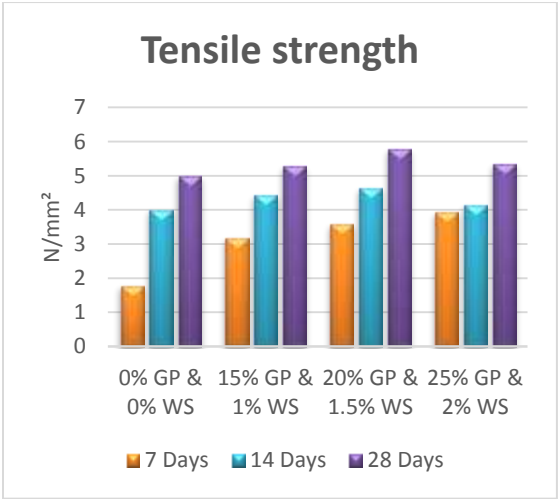

Chart-2: Tensile strength

6.3 FLEXURAL STRENGTH

Flexural strength of concrete is the ability to resist failure during bending. Size of concrete prism 500 x 100 x 100mm. A concrete mix of 1: 1.43: 2.39 with a water cement ratio of 0.40 was used for the investigation.

Flexural strength = $3Pa/bd^2$ (N/mm^2)

P – Load
a – Length of the specimen
b – Breadth of the specimen
d – Depth of the specimen

Fig-6: Flexural strength test

Table-7: Flexural strength in concrete

Serial no.	Mix proportion	Flexural strength(N/mm²)		
		7 Days	14 Days	28 Days
1.	0% GP & 0% WS	6.11	9.6	12.34
2.	15% GP & 1% WS	7.77	10.11	13.2
3.	20% GP & 1.5% WS	8.10	10.68	13.9
4.	25% GP & 2% WS	8.78	8.81	13.30

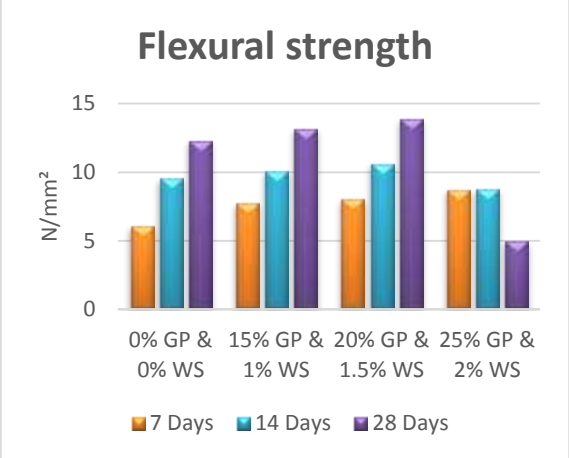

Chart-3: Flexural strength

7. CONCLUSION

The material test and strength were done in laboratory as per codal provisions. From the compressive test result, strength has increased for about 3Mpa greater than conventional concrete at 28 days. The tensile test result has also considerably increased as the partial replacement of granite powder and wire scrap with fine aggregate. Of all the 3 mixtures, granite powder 20% and wire scrap 1.5% has achieved superior results than conventional concrete making it economical as well.

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