EXPERIMENTAL ASSESSMENT OF GREEN CONCRETE FOR STRUCTURAL USE

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ABSTRACT: In recent years, the application of green concrete has become popular in many countries. Green concrete can also be developed using various production processes that are not detrimental to the environment. The use of recycled or waste materials can be considered sustainable as they can lower costs and raw materials as well as reduce landfills. In this project work replacing the material cement, coarse aggregate, fine aggregate replace as fly ash, rice husk ash, m-sand, quarry dust, recycled aggregates. Methodology for project is physical test for the materials used mix design for M_{20} grade concrete, mechanical property for hardened concrete. The physical property tests are specific gravity, bulk density, fineness modulus, water absorption, soundness, consistency are studied for the above specified materials. Mix design for M_{20} grade concrete and various percentage of replacing the fly ash, rice husk ash, m-sand, quarry dust and recycled aggregates mix ratio also calculate. Mechanical property like compressive strength, spilt tensile, flexural strength, Young's modulus are to be done.

Keywords: *Fly ash ,Quarry dust ,Recycled aggregates ,Mechanical property ,*

1.Introduction

The concrete is made with concrete wastes which are eco-friendly so called as Green concrete. The other name for green concrete is resource saving structures with reduced environmental impact for e.g. Energy saving, CO_2 emissions, waste water. Green concrete is a revolutionary topic in the history of concrete industry. This was first invented in Denmark in the year 1998.

Most people associate GREEN concrete with concrete that is colored with pigment. However, it is also referred which has not yet hardened. But in the context of this topic, green concrete is taken to mean environmentally friendly concrete. This means concrete that uses less energy in its production & produces less carbon dioxide than normal concrete is green concrete. Engineers and architects have choices of the material and products they use to design projects - when it comes to a building frame the choice is typically between concrete, steel and wood. Material choice depends on several factors including first cost, life cycle cost and performance for a specific application. Due to growing interest in sustainable development, engineers and architects are motivated more than ever before to choose materials that are more sustainable. However, such choice is not as straight forward as selecting an energy star rated appliance or a vehicle providing high fuel mileage. Engineers and architects can compare materials and choose one that is more sustainable or specify a construction material in such a way as to minimize environmental impact. Recent focus on climate change and the impact of greenhouse gas emissions on our environment has caused many to focus on CO_2 emissions as the most critical environmental impact indicator. Life Cycle Assessment (LCA) is the parameter.

2.Experimental Details

Experiments were conducted to study the physical and mechanical properties of materials used in concrete such as cement, fly ash(FA),rice husk ash(RHA), sand, m-sand, quarry dust, aggregates (NCA and RCA).

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Table 1 Physical Properties

Properties	Cement	FA	RHA	Sand	m-sand	Quarry dust	Aggregate (NCA)	Recycled aggregate (RCA)
Specific gravity	3.12	2.18	2.15	2.56	2.65	2.56	2.7	2.25
Fineness modulus	8%	7%	5%	3.16	4.45	4.35	4.71	3.81
Bulk density	-	-	-	1.47	1.71	1.64	1.58	2.15
Water absorption	-	-	-	-	-	-	0.3%	0.7%

2.1. Mix Proportions and Procedure

Five concrete mixes were generated in order to assess the strength of the concrete by partially replacing the cement, fine and coarse aggregate with the green materials such as fly ash(FA), rice husk ash(RHA), m-sand(MS), quarry dust(QD), recycled aggregate(RCA) with certain proportions such as 10%, 20% & 25%.

Table 2 Mix Proportions

Content (kg/m^3)

Mix No	Cement	Fly Ash	Rice Husk Ash	Sand	M-sand	Quarry dust	Aggregate	Recycled Aggregate	Water
C	426	0	0	691.2	0	0	1143.07	0	191.7
M1	340.8	42.6	42.6	691.2	0	0	1143.07	0	153.36
M2	255.6	85.2	85.2	691.2	0	0	1143.07	0	115.02
M3	426	0	0	414.8	138.2	138.2	1143.07	0	191.7
M4	426	0	0	345.6	172.8	172.8	1143.07	0	191.7
M5	426	0	0	691.2	0	0	914.47	228.6	191.7

2.3.Curing Process

Curing of concrete plays a major role in developing the microstructure and pore structure of concrete. Curing of concrete means maintaining moisture inside the body of concrete during the early

ages and beyond in order to develop the desired properties in terms of strength & durability. In this study, the specimens were demoulded 24 hr after casting. After demoulding, the specimens were immersed in water for 7,14,28 & 56 days.

3. Experimental Procedure

3.1*Compressive Strength Test*

The compressive strength test was carried out as per IS 516 -1968 (Methods of Tests for Strength of Concrete) on 150mm x 150mm of cube specimens to find the strength of the developed concrete mix. Compressive strength of cube was found at the age of 28 days & 56 days. Totally 5 mix proportion of specimens were tested. Compression Testing Machine of capacity 1000kN was used for the test. Test was continued and the failure load was noted.

3.2 Splitting tensile strength Test

The split tensile strength test was carried out as per IS 516 -1968 (Methods of Tests for Strength of Concrete) on 150mm diameter of cylindrical specimens to find the strength of the developed concrete mix. Split Tensile Strength of cylinder was found at the age of 28 days & 56 days. Totally 5 mix proportion of specimens were tested. Compression Testing Machine of capacity 1000kN was used for the test. Test was continued and the failure load was noted. The magnitudes of the tensile stress are given by $2P/\pi DL$, were P is the applied load, D and L are the diameter and length of the cylinder respectively.

3.3 Modulus of Elasticity

Modulus of elasticity (E) was tested on 15 X 30 cm cylinders (6 samples) at the age of 28 days according to SRPS ISO 6784 and the test results are shown.

4. Results and Discussion

4.1. Compressive Strength

The 7, 28 & 56 days compressive strengths of the different mix proportions are shown in the table.3. As shown in the table, the concrete with the partial replacement showed higher compressive strengths compared to those of the other proportions.

Table 3.Compressive Strength

Mix Designation	Avg Compressive Strength (7 days)	Avg Compressive Strength (14 days)	Avg Compressive Strength (28 days)
CONTROL	26.16	32.7	39.24
C-80 FA-10 RHA-10	15.11	18.89	22.67
C-60 FA- 20 RHA-20	11.04	13.81	16.57
S-60 MS-20 QD-20	22.67	28.34	34.01
S-50 MS-25 QD-25	24.41	30.52	36.62
NCA-80 RCA-20	27.32	34.15	40.98

4.2 Splitting Tensile Strength

The 7, 28 & 56 days Split Tensile strengths of the different mix proportions are shown in the table.3. As shown in the table, the specimen with 25% partial replacement of fine aggregate with m-sand & quarry dust showed higher Split Tensile strength compared to those of the other proportions while the lowest split tensile strength value being 20% partial replacement of cement with fly ash & rice husk ash.

Table 4 Splitting Tensile Strength

Mix Designation	Avg Split Tensile Strength 7 days (N/mm²)	Avg Split Tensile Strength 14 days (N/mm²)	Avg Split Tensile Strength 28 days (N/mm²)
Control	1.84	2.73	3.11
M1	0.76	1.64	2.01
M2	0.25	1.13	1.47
M3	1.31	2.19	2.55
M4	1.90	2.78	3.17
M5	1.43	2.31	2.69

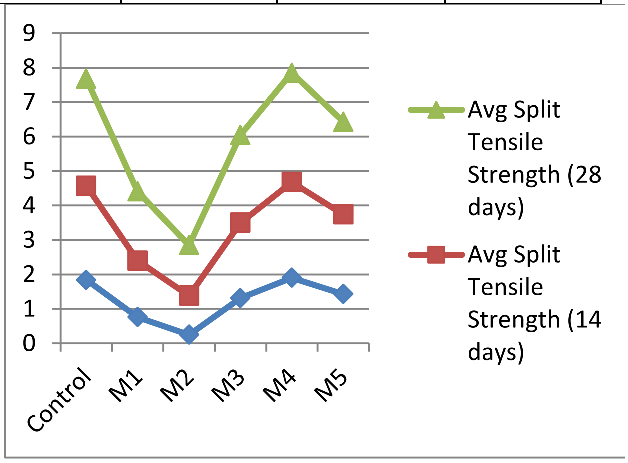

Figure 2

4.3 Modulus Of Elasticity

By comparing all the mixes as given in Table 5, the specimen with 25% partial replacement of fine aggregate with m-sand & quarry dust has the highest value of modulus of elasticity while the specimens with 10% partial replacement of cement with fly ash & rice husk ash has the lowest.

Figure 3 Young's Modulus Test

Table 5 Modulus of Elasticity

Mix Designation	Mix Proportion	Modulus of Elasticity (GPa)
M	CONTROL	23.28
M1	10%FA & RHA	11.57
M2	20%FA & RHA	13.61
M3	20%MS & QD	18.34
M4	25%MS & QD	24.48
M5	20% RCA	15.10

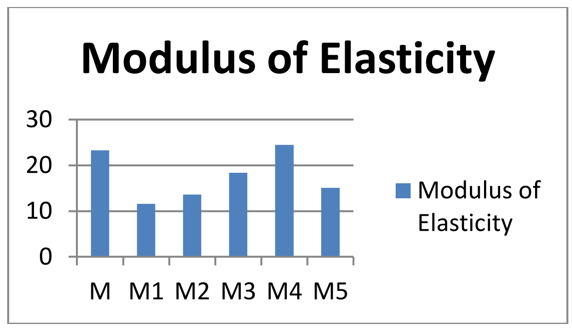

Figure 4

4.4 Results For Flexure Beams

The results for the flexure beams were determined by comparing the ultimate load taken by each specimen with the conventional beam as shown in the table 6. The ultimate load of 72KN was carried by the M5 mix designation 20% partial replacement of coarse aggregate with the recycled aggregate.

Table 6 Ultimate load

Specimen	Ultimate Load At 28 Days (KN)
CONTROL	60
10%FA & RHA	58
20%FA & RHA	56
20%MS & QD	62
25%MS & QD	64
20% RCA	72

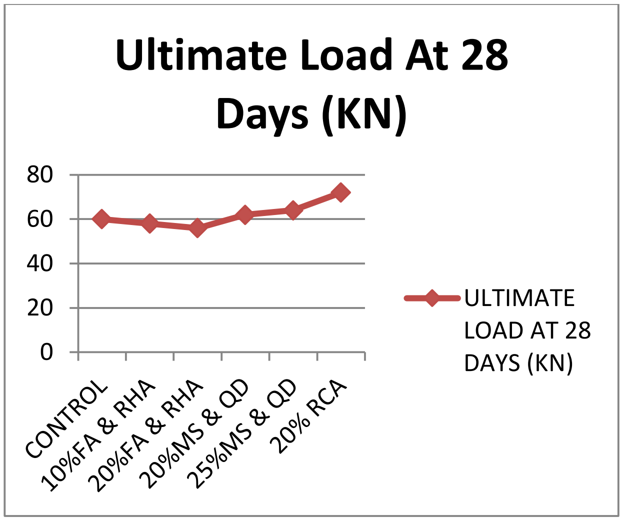

Figure 5

5. Conclusion

The following conclusions are arrived based on the laboratory investigation carried out for various percentages of replacements for different mixes.

- The maximum increase in compressive strength was obtained at 20% replacement of recycled aggregate.
- Concrete acquires maximum increase in split tensile strength at 25% m-sand & quarry dust replacement of fine aggregate in M20 grade.
- The modulus of elasticity value increases for 25% m-sand & quarry dust replacement of fine aggregate in M20 grade.
- 72KN was the maximum ultimate load obtained by 20% partial replacement of recycled aggregate with coarse aggregate.

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