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Experimental Investigation of Steel Fibre Reinforced Self Compacting Concrete using ECOSAND

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Abstract: *The project mainly aims at studying the mechanical and durability characteristics of the self-compacting steel fibre reinforced concrete with recycled aggregate as coarse aggregate and ecosand as fine aggregate replacement by conducting compressive strength test, consistency test, split tensile strength test, flexural strength test, water absorption test. The project also deals with the comparison of properties of the proposed self-compacting concrete with mentioned replacements with that of existing conventional concrete. For this experiment, M40 grade concrete is used and steel fibre is incorporated and ecosand is used. Conventional concrete tends to present a problem with regard to adequate consolidation in thin sections or areas of congested reinforcement, which leads to a large volume of entrapped air voids and compromises the strength and durability of the concrete.*

Keywords: Self Compacting Concrete, Steel Fibers, Ecosand

I. INTRODUCTION

Concrete is a versatile widely used construction material. Ever since concrete has been accepted as a material for construction, have been trying to improve its quality and enhance its performance. Recent changes in construction industry demand improved durability of structures. There is a methodological shift in the concrete design from a strength-based concept to a performance-based design. At present stage there is a large emphasis on performance aspect of concrete. One such thought has lead to the development of self compacting concrete (SCC). The present investigation is aimed at developing a self-compacting concrete with the addition of steel fibres and using ecosand as replacement. SCC characteristics such as flowability, passing ability and segregation resistance have been verified using slump flow, L box and V funnel tests.

1.1 Objectives

- To study the feasibility of utilization of Recycled aggregate as coarse aggregate and Ecosand as fine aggregate and incorporating steel fibres in the self-compacting concrete.
- To compare the properties of the proposed self-compacting concrete with mentioned replacements with that of existing conventional concrete.

1.2 Fly Ash

Fly ash is a heterogeneous by-product material produced in the combustion process of coal used in power stations. It is a fine grey coloured powder having spherical glassy particles that rise with the flue gases. As fly ash contains pozzolanic materials components which reach with lime to form cementitious materials. Thus, fly ash is used in concrete, mines, landfills and dams. The chemical composition of fly ash depends upon the type of coal used and the methods used for combustion of coal.

1.3 Chemical Composition of Fly Ash

COMPONENT	BITUMINOUS COAL	SUB BITUMINOUS COAL	LIGNITE COAL
SiO_2 (%)	20-60	40-60	15-45

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Al_2O_3(%)	5-35	20-30	20-25
Fe_2O_3(%)	10-40	4-10	4-15
CaO (%)	1-12	5-30	15-40
LOI (%)	0-15	0-3	0-5

The properties of fly ash are as follows:

- **Fineness:** As per ASTM, the fineness of the fly ash is to be checked in both dry n wet sieving. The fly ash sample is sieved in 45 micron sieve and the percentage of retained on the 45 micron sieve is calculated. Further fineness is also measured by LeChatelier method and Blaine Specific Surface method.
- **Specific Gravity:** The specific gravity of fly ash ranges from a low value of 1.90 for a sub-bituminous ash to a high value of 2.96 for an iron-rich bituminous ash.
- **Size and Shape:** As the fly ash is a very fine material, the particle size ranges in between 10 to 100 micron. The shape of the fly ash is usually spherical glassy shaped.
- **Colour:** The colour of the fly ash depends upon the chemical and mineral constituents. Lime content in the fly ash gives tan and light colours where as brownish colour is imparted by the presence of iron content. A dark grey to black colour is typically attributed to an elevated unburned content.

II. ECOSAND

The Ecosand was obtained from ACC cement factory, Madukarai, Coimbatore .Sample of ecosand is shown in Figure 4. Its physical properties were calculated by conducting various tests are shown in Appendix-1 and chemical properties are given in Table 4.7

2.1 Physical Properties of Ecosand

Constituent	Composition
Fineness modulus	3.1
Specific gravity	2.35
Loose density	1460kg/m^3
Compacted density	1610kg/m^3
Grading zone	IV

2.2 Chemical Composition of Ecosand

Constituent	Composition (%)
Silica (SiO_2)	58-60
Alumina (Al_2O_3)	2-3
Iron	1-3
Magnesium oxide (MgO)	0.4-1
Calcium oxide (CaO)	20-25

III. TEST

Compressive Strength Test

Compressive Strength

Type of specimen	**Compressive strength after 3 days (N/mm^2)**	**Compressive strength after 7 days (N/mm^2)**	**Compressive strength after 28 days (N/mm^2)**
Control concrete Specimen1	12	22.12	28
Without ecosand Specimen 1	17	26.5	30.0
Specimen2 (ecosand)	11.8	19.15	23.72

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Split Tensile Strength Test

Split Tensile strength

Type of specimen	Split tensile strength after 28 days of curing (N/mm_2)
Control concrete specimen1	2.65
Without ecosand specimen1	3.60
Specimen2 (Ecosand)	2.31

IV. CONCLUSION

1. It is found that replacing fine aggregates with ecosand results in decrease in strength may be due to its more water absorption capacity, reducing the water available for hydration.
2. A much more extensive study can be made on the properties and behaviour of concrete with ecosand can be made.
3. More study on concrete with full replacement of ecosand as fine aggregates can be done.
4. The flowability properties in concrete are varying when there is a partial replacement of cement with flyash. It is seen that with the increase in powder content, flowability of concrete is being reduced.
5. It is seen that self compacting concrete incorporated with steel fibres has given great results

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