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COMPARATIVE STUDY OF SELF COMPACTING CONCRETE WITH LESS CEMENT AND MORE CEMENTITIOUS MATERIALS

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ABSTRACT
Conventional concrete tends to a problem with regard to adequate consolidation in thin sections where in the re bars are located at close internals and densely oriented, where in difficult to use the mechanical vibrator which leads to large volume of entrapped air voids and compromises the strength and durability of concrete. At this junction to resolve the issue, self-compacted concrete is adopted.
Self-consolidation concrete is that concrete that is not only workable at lesser water to binder ratio but also cohesively flow like a viscous fluid without yielding to segregation, rendering compaction of self-weight, ultimately resulting to superior engineering properties.
The main aim of the project is comparative study of self-compacting concrete with less cement and more cementitious material by comparing compressive strength, flexural strength and split tensile strength of conventional concrete (cc) and the corresponding values of self-compacting concrete (scc) by replacing cement with fly ash at 20% and 30% weight of cement for M50 grade of concrete.
The project is based on the partial replacement of cement with fly ash which is a waste product from combustion of powdered coal in thermal plants. Use of fly ash does not only reduce the cost of construction, but also helps to reduce the impact of disposal on environment and also advantageous to use of fly ash in construction of marine structure as it improves resistance to attack of sea water.

I. INTRODUCTION

Contraction work will never be so durable without concrete. All the buildings are to be compacted, by maximum density and contact of concrete with steel framework used. These initiatives are very important for better finishing and appearance of the building. Addition of the mixtures is usually the practice over last few years to improve the sustainability of the environment. The ingredients addition in the concrete is carried out by the researchers and the properties were studied in past. The mix design depends on the type of structure being built, how the concrete will be mixed and delivered, and how it will be placed to form this structure.

SELF COMPACTING CONCRETE:

Self-compacting concrete is a type of concrete, which is not a product of mixing substances having different properties but a combination of several mixes having the same flow characteristics.
Manufacturing of a Self -Compacting Concrete requires three main aspects to be full-filled. They are as follows:
High amount of water reducing substance or super plasticizers is added for obtaining high flowing characteristics.
A type of aggregate mixture is added to gain the desired compactness. Note that the aggregate content is of round shape and proportional in size in order to increase the locking tendency of the concrete.

FLY ASH:

Fly ash is a by-product in coal combustive thermal power plants. Fly ash is synonym with ‘flying ash’ that came into vocabulary with the use of pulverized coal in boiler operations. This flying ash (fly ash) is

separated out of flue gases and entrapped in electrostatic precipitate (ESP) or bag filter. Now a day there is worldwide problem of disposal of this by-product 'Fly ash'.

II. METHODOLOGY

The different methods utilized in this research include the following:

i) **Background Study:**

Literature survey was carried out to review previous studies related to this thesis.

ii) **Collection of Raw Materials:**

All the required materials were collected and delivered to the laboratory. These are; Cement, Fly ash, Fine Aggregate, coarse aggregate.

iii) **Material Tests:**

Tests were conducted on the raw materials to determine their properties and suitability for the experiment.

iv) **Mix Proportioning (Mix Design):**

The concrete mix is designed for M50 and degree of workability is medium. The mix design is carried out according to the IS 10262:2009 for the conventional concrete

v) **Specimen Preparation:**

The concrete cubes of size 100 mm, cylinders of size 200 mm height and 100 mm diameter and beams of size 500 x 100 x 100 mm are casted and used as test specimens to obtain the compressive strength of concrete, split tensile strength of concrete and flexural strength of concrete. The specimens casted in the above manner are compacted on a vibrating table. Tests are conducted at the 1, 3, 7 and 28 days from the date of casting.

vi) **Testing of Specimens:**

Laboratory tests were carried out on the prepared concrete samples. The tests conducted were slump, unit weight and compressive strength tests.

vii) **Data Collection:**

The data collection was mainly based on the tests conducted on the prepared specimens in the laboratory.

viii) **Data Analysis and Evaluation:**

The test results of the samples were compared with the respective control concrete properties and the results were presented using tables, pictures and graphs. Conclusions and recommendations were finally forwarded based on the findings and observations.

MATERIALS:

The raw materials required for the concrete in the present work are;
Cement, Fine Aggregate, Coarse Aggregate, Water, Fly Ash
TESTS CONDUCTED ON MATERIALS:
Cement:
The following tests as per IS 4031:1988 are done to ascertain the physical properties of the cement. Theresults of the tests are compared to the specified values of IS 4031:1988.The various tests conducted on cement are
Fineness of cement, Consistency,
Initial and Final setting time
Specific gravity of cement
Compressive strength of cement

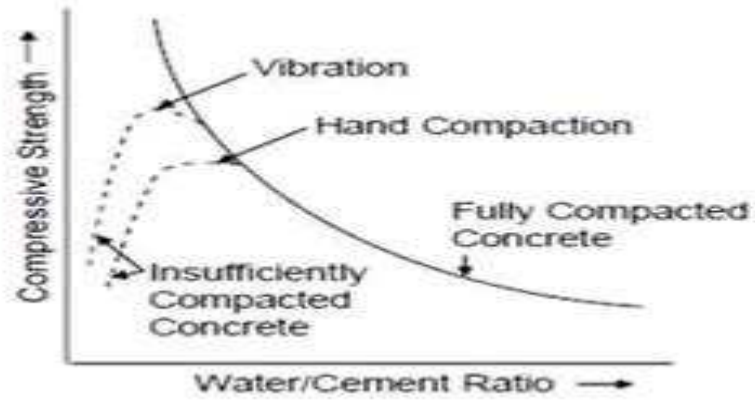
WORK PLAN:

The proceedings of the work plan as per the outlook of the objectives.
Sort out the types of materials required and calculate the quantities of each material required
Collection of above said material that is O.P.C cement, coarse aggregate, fine aggregate, fly ash, potable water, and poly carboxylic based ether etc.
Conductivity tests for materials to check the quality of O.P.C, coarse aggregate, fine aggregate, fly ash etc.
Sort out the schedule for preparation of specimens with control concrete as well as SCC.
As per the above schedule, prepare the specimens with conventional concrete as well as with SCC.

Conduct the tests like slump cone test in control concrete, and slump flow, L-Box, V-Funnel, U-Box tests in SCC which lying for the above said designed mix concrete.
De-mould the above said prepared specimens and demarked the numbers over the specimens and take the weights of each specimen and record the same.
Curing the above said prepared specimens as per the schedule prepared.
Test the above said specimens as per the schedule prepared after taking weight of each specimen and record the same.
Compare the results at different curing periods and proceed for discussion.

TEST ON WORKABILITY OF CONCRETE
Slump cone test, flow table test, U-funnel, L-box, J-box test

WORKABILITY VS STRENGTH OF CONCRETE:



EXPERIMENTAL WORK
Workability test:
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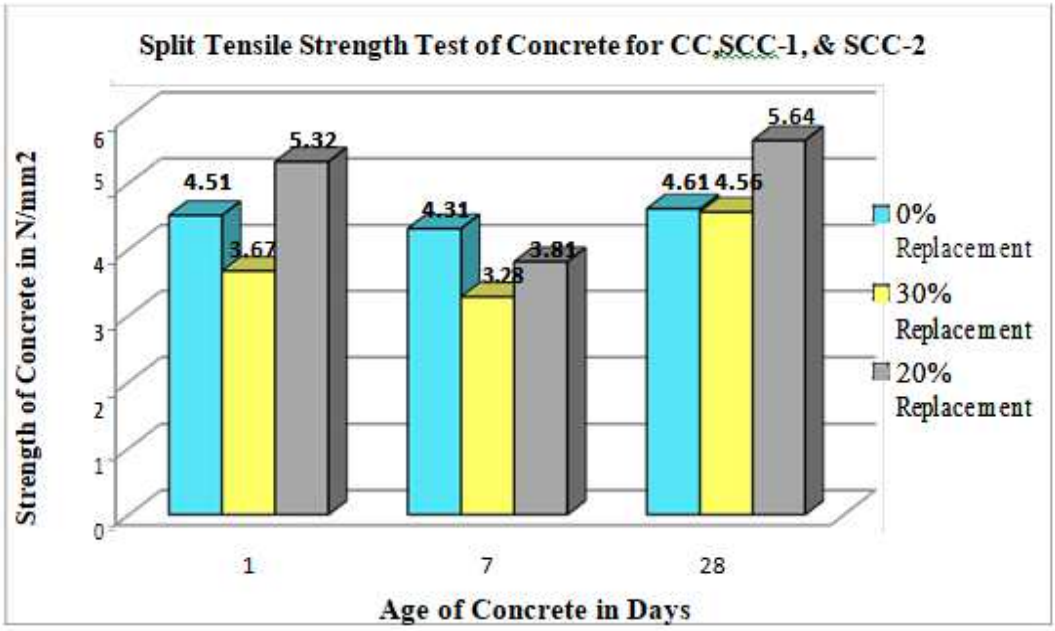
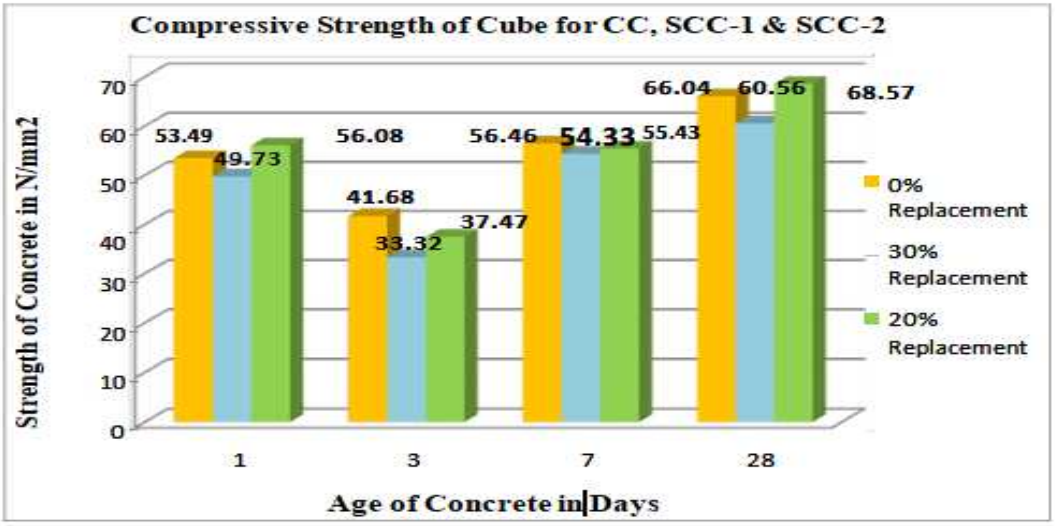
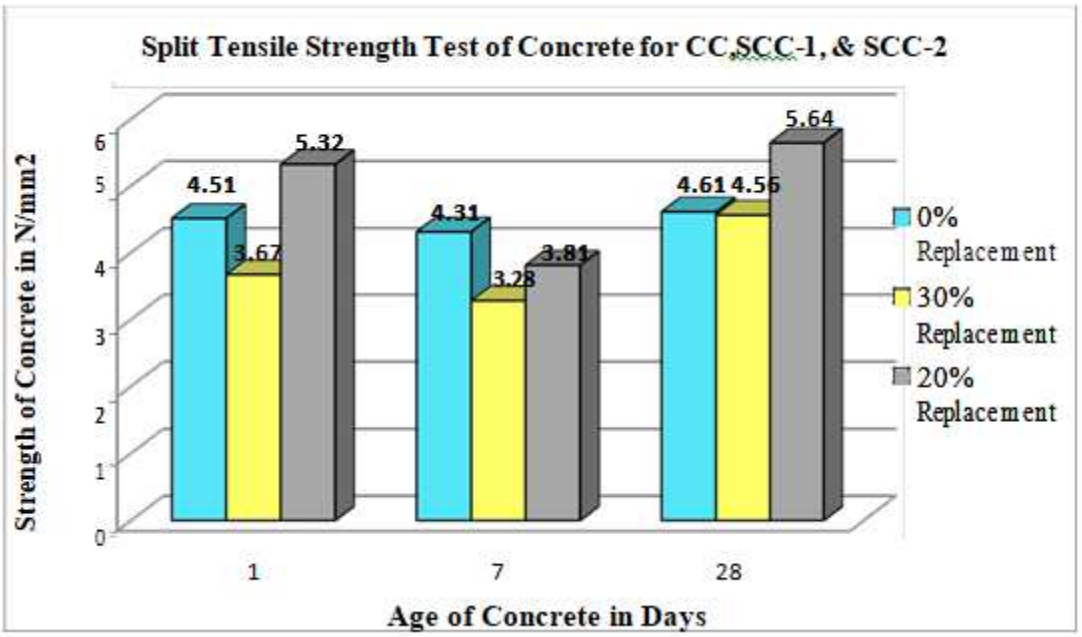
The rate of loading for various concrete specimens is as follows.
5Cm Cube .....35KN/min (0.6 KN/Sec)
1.4x5x (5/60) = 0.58=0.6 KN/Sec
7.06Cm Cube.....70 KN/min (1.2 KN/Sec)
1.40x7.06x (7.06/60)=1.16=1.2KN?Sec
10 Cm Cube.....149 KN/min (2.3KN/Sec)
1.40x10x (10/60)=2.3 KN/Sec
15Cm Cube.....315 KN/min (5.0 KN/Sec)
1.40x15x (15/60) =5.25 KN/Sec

III. EXPERIMENTAL RESULTS & GRAPHS

Age of Concrete	Type of Specimen	Conventional Concrete	SCC Mix-1	SCC Mix-2
Accelerated Curing	Cube	53.49	49.73	56.08
	Beam	6.67	5.73	6.41
	Cylinder	4.51	3.67	5.32
	Cube	41.68	33.32	37.47
3 Days Curing	Beam	------	-------	-------
	Cylinder	------	-------	-------
	Cube	56.64	54.33	55.43
7 Days Curing	Beam	6.24	5.84	6.07
	Cylinder	4.31	3.28	3.81
	Cube	66.04	60.56	68.57
28 days Curing	Beam	6.53	6.13	7.05
	Cylinder	4.61	4.56	5.64







IV. CONCLUSIONS

1. The target mean strength of concrete is 58.25 N/mm2. After conducting various trial tests, M50 grade self-compacting concrete is finally obtained which satisfied all the SCC characteristics such as flow ability, passing ability and segregation resistance given by European standards. As there are no Indian standards for self compacting concrete (SCC) comparison could not be made.
2. From the observations it was found that nearly 2/3 of the compressive strength is gained in 7 days curing which satisfies IS: 456-2000.
3. From the above graphs we observed that, replacement of fly is made good results in self compaction of concrete, workability of concrete is good by adding super plasticizers (polycarboxylic ether) of quantity of 1.2% weight of the cement (i.e., 5.064kg/m3).
4. By comparing Conventional concrete (CC) with SCC Mix-1 & SCC Mix-2, these are got more strength than CC. But as we compare to SCC Mix-1 and SCC Mix-2, SCC Mix-2 got more strength, i.e., 20 % replacement of fly ash in cement.
5. It was also observed that the flexural strength and Split Tensile strength of SCC has attained the permissible values for 7 days and 28 days as per IS: 456-2000.
6. In the above cases the SCC Mixes of 7 day curing strength was bit lesser than CC.
7. Finally we can conclude that the strength of Self-Compacting Concrete is higher than the Conventional Concrete.
8. Therefore probably we should increase the quantity of fly ash in cement but not exceeding more.

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