Optimum Usage of QRD in Replacement to Natural Sand for Fiber Reinforced Self Compacting Concrete (FRSCC).

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Abstract : Concrete plays a vital role in the construction industry and on the other hand River sand, one of the essential material used in the concrete, has become expensive and also ascarce material. Due to increase in its usage depletion of sand deposits is occurring.Quarry Rock Dust (QRD), a by-product from crushing process during quarryingactivities is one of the substitute materials for the natural river sand.In general, concrete is strong in compression & weak in tensional property. In thisresearch, to increase the tensile property of Concrete, Glass Fibers are added withdosage of 1kg per m3 of concrete. In this investigation, an attempt is made to introducethe QRD in a percentage variation and to quantify the optimum usage of QRD inreplacement to Natural Sand for Fiber Reinforced Self Compacting Concrete (FRSCC).Compressive Strength & Split Tensile Strength Tests were conducted to study theMechanical Properties of FRSCC for the replacement of Natural Sand with QRD. It isobserved that; at 40% replacement of Natural Sand with QRD, Target Strength isachieved.

IndexTerms **- Concrete, QRD, fiber concrete.**

I. INTRODUCTION

Concrete occupies unique position among the modern construction materials, Concrete is a material used in building construction, consisting of a hard, chemically inert particulate substance, known as a aggregate (usually made for different types of sand and gravel), that is bond by cement and water. Materials are at the heart of the construction industry. They determine the quality of the end product and the technology by which it is manufactured. Performance of civil engineering structures to a great extent depends on the characteristics of the materials used for their construction. Innovation in construction is highly linked with development of advanced construction materials and methods. Concrete is the most basic element of for any kind of construction work. No matter what type of building structure it is, the concrete used should be sturdy and well compacted. The main reasons for compacting any type of concrete are:

1. To ensure attaining maximum density by removal of any entrapped air.
2. To ensure that the concrete used is in full contact with both the steel reinforcement and the form work.
3. Ensuring the above points not only provide additional strength to the structure but also good finish and appearance to the final product. The compacting of any conventional concrete is done through external force using mechanical devices.
4. In order to reduce or nullify the external force for compacting the concrete, Self Compacting Concrete (SCC) is developed.

II. LITERATURE REVIEW

SCC is developed at Japan. Research is still going on this usage. Many researches gavetheir explanations on development of SCC with suitable materials, admixtures etc. Someof the detailed views of the Research papers are produced below:

2.1 THE FUTURE CONCRETE: SELF-COMPACTING CONCRETE

Authors: LIANA IURE Ş and CORNELIU BOB.
Discussion:

- ✓ Fly ash can replace a significant part of the necessary filler when used into a self-compacting concrete composition.
- ✓ The elimination of vibrating equipment improves the environment protectionnear construction and precast sites where concrete is being placed, reducingthe exposure of workers to noise and vibration.
- ✓ SCC is favorably suitable especially in highly reinforced concrete memberslike bridge decks or abutments, tunnel linings or tubing segments, where it is difficult to vibrate the concrete, or even for normal engineering structures.

2.2 Development of Self Compacting Concrete by use of Portland PozzolanaCement, Hydrated Lime and Silica Fume

Authors: Dubey Sanjay Kumar and Chandak Rajeev
Discussion: The slump flow characteristics of mix are between 600 to740 mm.The flows improves due to addition silica fume and lime content. As far as fillingability of mixes is concern, the results of V funnel satisfied the standardrequirement. The blocking ratio in the L box was as per the requirement of SCCmixes as laid by EFNARC guidelines.Self-compacting concrete could be prepared without using viscositymodifying agent as was done in the study. Portland Pozzolana cement can be usedfor development of Self compacting concrete. Different types of SCC havingdifferent compressive strength can be prepared by different combination ofcement, lime and silica fume.

III. . OBJECT & SCOPE OF INVESTIGATION

The specific objectives of the present investigations are as listed below.

To study the Physical Properties of the materials used in our work.

To introduce Quarry Rock Dust (QRD) in percentages and to quantify the optimumusage of QRD in replacement to sand.

To study the effect of QRD and Glass Fibers in SCC.

To study the Mechanical Properties of the obtained SCC & FRSCC

IV. RESEARCH METHODOLOGY

The experimental program was designed to study the Mechanical Properties of Self Compacting Concrete made with concrete of M40 with the Replacement of Fine Aggregate (i.e., Sand) with QRD on Compressive & Split Tensile strength. The program consisted of casting and testing a Total Specimens of 36 cubes (150*150*150mm), 36 cylinders(150mm & 300mm height) were casted in 6 batches for different QRD dosages of 0%, 20%, 40%, 60%, 80% & 100% with respective to the Sand.M40 grade of concrete was selected for this study. NAN-SU MIX DESIGN Method was used for our work. The mix proportions that adopted were 1.46:1.61: 0.39.

4.1 SPECIMENS FOR CASTING:

1. CUBES: The moulds used for the concrete cubes are made up of cast iron with dimensions of 150 mm X 150 mm X 150 mm for Compressive strength studies.
2. CYLINDERS: Cast Iron moulds are used of size 150 mm diameter X 300 mm height for Split Tensile Strength studies.

V. RESULTS AND DISCUSSION

The results obtained from the detailed experimental program conducted on M40 grade Fiber Reinforced SCC with the replacement of Quarry Rock Dust are presented below.Table shows the details about compressive strength, split strength and flexural strength for M40 grade concretes. The optimum replacement dosage of Fine Aggregate(sand) with Quarry Rock Dust is found to be 40% from the experimental study.

SCC FLOW TESTS:
1. SLUMP FLOW - SF
2. T500 SLUMP FLOW - TSF
3. V-FUNNEL - VF
4. V-FUNNEL AT T5 MINUTES. - TVF
5. L-BOX – LB

Table 5.1: TEST RESULTS OF FRESH CONCRETE: WITHOUT FIBER

DESIGNATION	SF	TSF	VF	TVF	LB
Units	mm	Sec	sec	sec	H2/H1
QRD % 0	779	2.2	4.3	6.4	1.0
20	755	3.2	6.1	7.2	0.97
40	724	3.8	6.6	7.4	0.93
60	685	4.2	7.3	8.5	0.92
80	661	4.5	9.6	12.4	0.89
100	629	5.7	12.4	14.4	0.85

Table 5.2: TEST RESULTS OF FRESH CONCRETE: WITH FIBER

DESIGNATION	SF	TSF	VF	TVF	LB
Units	mm	Sec	sec	sec	H2/H1
QRD % 0	769	2.3	4.4	6.2	0.95
20	739	3.4	6.4	7.4	0.92
40	703	4.3	7.1	8.4	0.89
60	667	4.7	8.0	10	0.81
80	637	5.6	10.0	12.4	0.80
100	605	6.2	12.3	16.4	0.73

Table 5.3: Compressive & Split tensile strength results

		Compressive strength (mpa)		Split tensilestrength (mpa)	
S.NO.	DOSAGE OF QRD IN %	Without fiber	with fiber	Without fiber	with fiber
1	0	49.15	49.53	2.95	3.25
2	20	48.23	49.43	2.98	3.36
3	40	47.73	48.40	3.16	3.56
4	60	42.04	45.07	3.52	3.67
5	80	41.91	43.40	2.43	3.34
6	100	42.05	42.33	2.70	2.87

VI. CONCLUSION:

Based on the experimental study on the Fiber Reinforced SCC for M40 grade concrete,the following conclusions are drawn:

1.The Mix Design for Fiber Reinforced SCC using NAN-SU method &"EUROPEAN GUIDELINES FOR SCC" is arrived.
2.Conventional Fine Aggregate i.e., Sand is replaced with Quarry Rock Dust and based on the test results, the optimum dose is found.
3. The Replacement dosage is made at a variation of 20% interval.
4. The optimum replacement of Sand is found to be 40% from the study.
5. SCC flow properties are satisfied with the EUROPEAN GUIDELINES at the Optimum Dose of QRD.
6. The Target Mean Strength is achieved mostly at 40% replacement of Sand with QRD in FRSCC. At this dose, by the use of Glass Fibers, there is a significant increase in the Split Tensile Strength of about 20%; and increase in Compressive Strength is about 3% is observed.
7. Due to presence of Glass Fibers in SCC, Strength results are more predominant compared to normal SCC mix.

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