DRAW OUT OPTIMUM CONTENT OF MANUFACTURED SAND IN SCC

Bhaskar B[1], Dr.Mallikarjuna Reddy V[2]

[1]M.Tech Student, Department of Civil Engineering, GRIET, Hyderabad, India.
[2]Professor& HoD of Department of Civil Engineering, GRIET, Hyderabad, India.

Abstract:-

Manufactured Sand is a crushed aggregate which is popularly known as M-Sand. It consist of more fine particles. This experimental work is conducted on SCC. SCC is consist of large amount fine aggregate than compare to coarse aggregate. SCC requires more fine particles which includes cementitious material and fine aggregate. M-Sand responsible for high workability due to its higher fine particles. By utilizing the M-sand in place of the river sand, it reduce the imbalance in the eco-system. To get economical and eco-friendly mix River Sand is partially replaced by Manufactured sand (M-sand) by 0%, 20%, 40%, 60%, 80%& 100%. From these optimum percentage of replacement is established which is satisfy the requirements of SCC fresh properties and strength.

Keywords:- Self compacting Concrete, M-sand.

I. INTRODUCTION

Concrete standing at first place in construction material and day by day changes coming in concrete, in that way a special type concrete was developed in Japan in 1982. i.e., Self Compacting Concrete. It compacted under its own weight, there is no need of any compaction. It is also known as self consolidation concrete. It comprised by large amount of fine particles which includes binder and Fine aggregate. SCC having more fine aggregate content than coarse aggregate content where as Traditional mix contains more coarse aggregate than fine aggregate. A special code named as EFNARC guidelines are provided for SCC requirements and test procedures.

Along with the usage of concrete Natural sand usage also increasing. Due to the day by day increasing in usage of Natural sand, river bed are losing their functioning. It causes drastic changes in nature, like floods and ground water level goes down etc. Manufacture sand introduced to replaces the river sand. It is more angular and cubical in shape, so it exhibits good interlocking capacity. There is no silt content in M-sand. It contains high amount of fines content which contribute filler content for SCC and giving better workability without any segregation. Increasing in M-sand content compressive and bond Strength both are increasing [1]. M-sand improve mechanical properties up to 20% when compared to conventional one [2]. Compressive strength and split tensile strengths are increasing with increasing M-sand content where as Flexural strength is always going constant [3].

Scope of Work:-

- To reduce the extraction of river sand and saving river bed.
- To get economical concrete with better performance.
- To reduce the problems with vibration

II. MATERIALS USED

In SCC mix production Cement, GGBS, Fine aggregate (Natural sand and M-sand), Coarse aggregate, Water and Super plasticizer are used.

A. Cement

Ordinary Portland Cement of 53grade with Specific gravity 3.12 and 8% fineness is used for this work. Normal consistency of cement is 28%, initial setting time is 37minutes and Final setting time is 450minutes. It confirmed to requirements of IS:12269-1987.

B. GGBS:-

Ground Granular Blast Furnace Slag (GGBS) is the waste material of Steel plant. Present using GGBS collected from JSW Steel plant (Location: Nandyal). Specific gravity of GGBS is 2.8.

C. Fine Aggregate

Natural sand of Zone-II medium size and M-sand is used as Fine aggregate for the present work. Their properties are as shown in Table.1.

D. Coarse Aggregate

Maximum 12mm size Crushed aggregate is used for the preparation of SCC. Properties of Coarse aggregates are as shown in Table.1

Table.1 Properties of M-sand, Coarse Aggregates & River Sand

Property	M-sand	C.A	River Sand
Bulk Density (g/m^3)	1580	1502	1560
Specific Gravity	2.83	2.6	2.71
Surface water (%)	0.5	0.5	0.5
Water Adsorption (%)	5	0.2	0.4

All test on aggregates are conducted as per IS:2386(Part-3)-1963.

E. Super Plasticizer (S.P)

MasterEase 3709 with Specific gravity as1.12 is used as super plasticizer for this experimental work. It is a product of BASF company. This plasticizer consist of Viscosity Modifying Agents (VMA) and plasticizer. VMA reduces the friction between particles and give high workability. It is available in liquid form and brown in colour.

F. Water

For mixing and curing of concrete water should be free from impurities like oils, salts and acids etc. pH value should not be less than 6. It fulfil the requirements of IS:456-2000.

III. MIX DESIGN

Final mix Design:- Final mix design is obtain from Nan-Su method of mix design which is a trial and error method. Final mix design and the typical ranges of material is as shown in Table.2.

Table.2 Final mix design and typical Range

S.No.	Material	For M40 grade SCC (Kg/m^3)	Typical range by EFNARC (Kg/m^3)
1	Cement	370	380-600
2	GGBS	110	
3	Coarse Aggregate	807	750-1000
4	Fine Aggregate	920 (53% of Total aggregate)	48 to 55% of Total aggregate

S.P =1% of Total Cementitious material
Water to total binder ratio =0.3

Specimen Data:-

A total of 75 Specimen used in which 72 are 100mm size cubes and 3 are 150mm size cube. 150mm cubes are used to find out the conversion factor and that factor is used to get Compressive Strength from 100mm cube Strength.

Material for various mixes:-

Total six mixes with various compositions of Natural River Sand (NS) and M-Sand (MS) used for this work. Mix-1, Mix-2, Mix-3, Mix-4, Mix-5 & Mix-6 are the mixes with 0%, 20%, 40%, 60%, 80% &100% replacement of Natural Sand by M-Sand respectively. Material data for each mix is tabulated in Table.3

Table.3 Material Data for various mixes

Mix	Variation	Cement (Kg/m^3)	GGBS (Kg/m^3)	Sand (Kg/m^3)	M-sand (Kg/m^3)	C.A (Kg/m^3)	S.P (lit/m^3)	Water (lit/m^3)
Mix-1	100%NS+0%MS	370	110	920	0	807	4.8	144
Mix-2	80%NS+20%MS	370	110	786	184	807	4.8	144
Mix-3	60%NS+40%MS	370	110	552	368	807	4.8	144
Mix-4	40%NS+60%MS	370	110	368	552	807	4.8	144
Mix-5	20%NS+80%MS	370	110	184	786	807	4.8	144
Mix-6	0%NS+100%MS	370	110	0	920	807	4.8	144

IV. EXPERIMENTAL RESULTS

Mainly this experimental work is to get good Quality of SCC of M40 grade. It should satisfy all the workability requirements as well as get the strength near to the target mean strength.

Workability Requirements

Filling Ability

It is the property of fresh concrete which is to fill the all spaces when placing it under its own weight. V-Funnel test is used for test the Filling Ability. Test conducted as per EFNARC guidelines.

Flow Ability

Flow Ability is the fresh concrete property when it is unconfined by formwork and/or reinforcement. Slump flow test is used for determine Flowability and the test procedure done according to EFNARC.

Passing Ability

The ability of fresh concrete to flow through tight openings such as spaces between steel reinforcing bars without segregation or blocking.

Table.4 Workability test data for SCC mixes varying M-sand Content

Property	Mix-1	Mix-2	Mix-3	Mix-4	Mix-5	Mix-6	Range
Slump (mm)	685	675	667	660	650	640	520-900
V-Funnel (sec)	10	12	13	15	16	18	<27sec
L-Box (ratio)	0.9	0.87	0.85	0.83	0.81	0.79	≥0.75

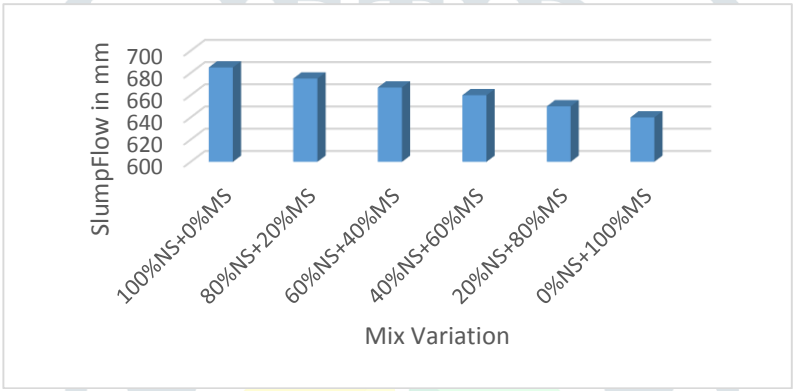

Fig.1 Slump flow values for various mixes

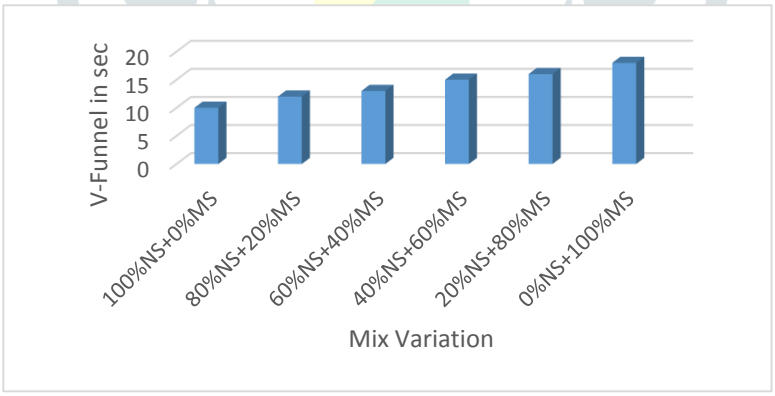

Fig.2 V-funnel data for various mixes

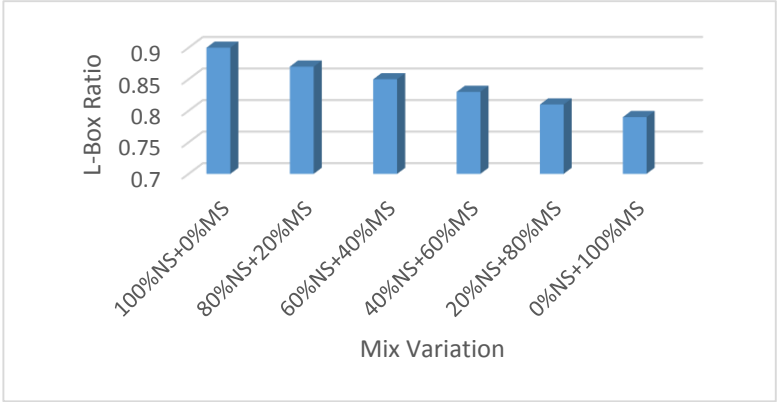

Fig.3 L-box test data for various mixes

Workability decreasing with increasing in M-Sand content. But it improving the segregation resistance.

Compressive Strength:-

Strength test on concrete is conducted as per IS:516-1959. After 28days curing Specimen is tested by using CTM and got Compressive load and Load per area gives Compressive Strength of concrete.

Compressive Strength=Compressive load/Applied Area

Test data for 150mm cube
Area of Cross section=150*150mm^2
Compressive load=1100 kN
Compressive Strength=48.8 MPa

Test data for 150mm cube
Area of Cross section=150*150mm^2
Compressive load=540 kN
Compressive Strength=54 MPa

Conversion Factor = (150mm cube Strength)/(100mm cube Strength)

Conversion Factor = 48.8/54 = 0.9 .

Compressive strength of concrete is strength of 150mm cube. It is calculated from 100mm cube by multiplying 100mm cube strength by conversion factor 0.9. Resulting Compressive strength data is as shown in the Table.5.

Table.5 Compressive Strength of concrete

Mix	Variation	Compressive Strength	Variation in Strength (%)
Mix-1	100%NS+0%MS	49.5	0
Mix-2	80%NS+20%MS	51.48	4
Mix-3	60%NS+40%MS	53.955	9
Mix-4	40%NS+60%MS	55.935	13
Mix-5	20%NS+80%MS	57.915	17
Mix-6	0%NS+100%MS	59.895	22

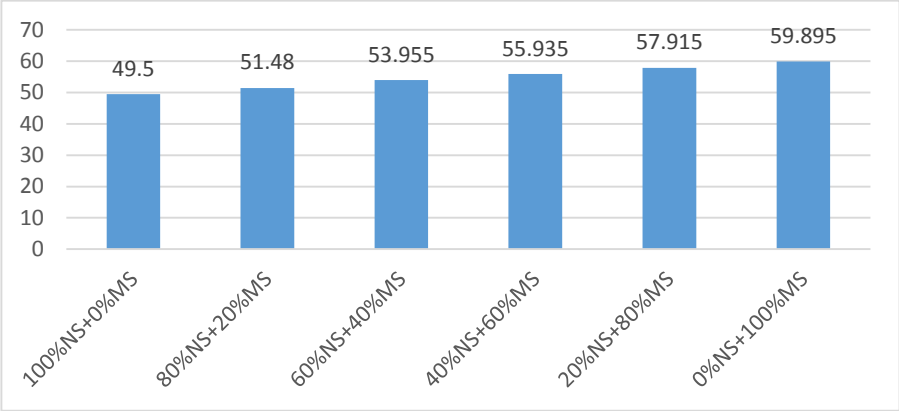

Fig.1 Compressive Strength of concrete

Due to interlocking capacity of M-Sand 100% replacement is giving more Strength. Up to 22% strength increased when compared with 0% M-Sand mix.

Conclusion:-

Based on the experimental investigation the below results are draw out.

1. The flow test data on various mixes with partial replacements by M-sand for natural sand satisfied by EFNARC guidelines. Flow values decreased but segregation resistance increased.
2. To get strength of mix, 100mm cube strength multiplied by Conversion Factor (0.9) for this experimental work.
3. As percentage replacement of River sand by M-sand increases Compressive Strength of Concrete also increasing due to its interlocking capacity.
4. According to its workability and strength results 100% M-sand mix is preferable than other mixes with fixed water cement ratio.

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List of codes:-

[1] IS12269:1987 Specification For 53 Grade Ordinary Port Land Cement
[2] IS 2386-3 (1963)_ Methods of test for aggregates for concrete, Part 3
[3] IS 12269 : 2013 Ordinary Portland Cement, 53 Grade — Specification
[4] IS : 516 - 1959 Methods Of Tests For Strength Of Concrete
[5] The European Guidelines for Self-Compacting Concrete (EFNARC Guidelines)