Experimental Study of Self-Compacting Concrete

Kunal Songra[1] Vishal Gupta[2] Rajendra Singh Dangi[3]
[1]Cadd Expert [2]M.Tech. Scholar [3]Assistant Professor
[2,3]Department of Civil Engineering
[1]Indian Technocrats Ltd [2]RKDF, Bhopal [3]Laxmi Narian College of Technology

Abstract— Thrown in situ cementing is the most every now and again utilized materials innovation worldwide with its creation in auxiliary edges. In India, this innovation overwhelms the business sector however is tested by other aggressive generation routines. The feedback concerns issues with respect to example short section compasses (restricted adaptability for future repair), long generation times, unfortunate workplace and indoor air issues. A hefty portion of these hindrances are because of the way that by custom normal second rate concrete is utilized as a part of development field. Broad concrete materials research on SCC has uncovered chances to counter the feedback of cast in situ concrete, however the innovations are not yet used in vast degree. The examination venture goes for researching the capability of SCC for aggressive creation, basic plan and capacity of auxiliary edges of cast in-situ concrete. For quite a while, the issue of the strength of concrete structures has been a noteworthy issue postured to builds. To make strong concrete structures, adequate compaction is required. Compaction for traditional concrete is finished by vibrating. Over vibration can without much of a stretch reason isolation. In customary concrete, it is hard to guarantee uniform material quality and great thickness in vigorously strengthened areas. On the off chance that steel is not legitimately encompassed by concrete it prompts auxiliary and toughness issues. This is the issue primarily with intensely strengthened segments where a high clog of support is seen. For this situation, it turns out to be to a great degree hard to reduced the concrete. At that point what should be possible to abstain from honeycombing?. The response to the issue might be a sort of concrete which can get compacted into each side of structure work and hole between steel, absolutely by method for its own weight and without the requirement for compaction. The SCC idea was required to defeat these challenges. The SCC idea can be expressed as the concrete that meets unique execution and consistency necessities that can't generally be gotten by utilizing routine fixings, typical blending strategy and curing hones. The SCC is a built material comprising of bond, totals, water and admixtures with a few new constituents like colloidal silica, pozzolanic materials, substance admixtures to deal with particular necessities ,, for example, high-flowability, compressive quality, high workability, improved resistances to synthetic or mechanical hassles, lower porousness, sturdiness, resistance against isolation, and probability under thick fortification conditions. The properties, for example, ease and high imperviousness to isolation empowers the position of concrete without vibrations and with decreased work, clamor and a great deal less wear and tear of hardware. Utilization of SCC conquers the issue of concrete position in intensely strengthened areas and it abbreviates development period. Self compacting concrete is becoming quickly, particularly in the precast business sector where its focal points are quickly comprehended and used. Superplasticiser improves deformability and with the decrease of water, additionally powder isolation resistance is expanded. High deformability and high isolation resistance is acquired by constraining the measure of coarse total. On the other hand, the high measurements of super-plasticizer utilized for diminishment of the water content and for better workability, the high powder content as "ointment" for the coarse totals, and also the consistency specialists. Article demonstrates how self compacting concrete is valuable in making fast and solid concrete. How self compacting can enhance the sturdiness, quality and pace of development, what is the genuine capability of SCC tending to specialized/down to earth and temperate issues.

Key words: Self Compacting, Concrete, Red Mud

I. INTRODUCTION

Self-compacting concrete(SCC), or self-consolidating concrete that is the most common term in North America, is described world wide as one of the most important development steps in concrete materials technology during the last decades. SCC is based on new types of highly efficient water-reducing admixtures (super plasticizers) combined with high powder contents, e.g. limestone, fly ash, ground fillers or other mineral addition. Alternatively, a viscosity-modifying agent (VMA) can be added to the concrete mix when no or limited filler amount is used. The main advantage of SCC is that the traditionally needed compaction work can be eliminated. This opportunity means that several potential benefits may be exploited. These benefits cover various important areas, e.g. improved structural design, increased production efficiency and improved building function. However in India utilization of SCC is still strongly limited due to lack of awareness and the higher costs associated with its production. The obstacles for increased implementation of SCC include both technical and non-technical issues. Concerning the latter, direct economical aspects, e.g. direct materials costs, still is the dominating influence on the choice of concrete in many house-building projects. Probably, if a more total- economy related or a more work-environment perspective is adopted in combination with further technical development of SCC, the utilization of SCC will be influenced in a positive way.

II. SELF-COMPACTING CONCRETE BY USING RED MUD

Red mud is one of the major solid wastes coming from Bayer process of alumina production. At present about 3 million tons of red mud is generated annually, which is not being disposed of recycled satisfactorily. The conventional method of disposal of red mud in ponds has often adverse environmental impact and during monsoon, the wastes may be carried by runoff to the surface waters course and a result of leaching may cause contamination of ground water; further disposal of large quantities of red mud dumped,

poses increasing problems of storage occupying a lot of space.

Inspite of the fact that the aluminium production plant produces a great quantity of red mud, such plants are producing aluminium at an increasing rate of 1% per annum since last decade. Red mud is predominantly, a finely powdered mud. It adversely effects the air, land and water environment of surrounding area. With this reference it is desired and greatly needed to utilize the red mud in some way, or recycled, which otherwise is dumped in huge amounts anywhere in nearby vicinity of the plant

III. METHODOLOGY

The main aim of this experiment is to find out the effect of addition of red mud, which is a waste product from the aluminum industries, and foundry waste sand, which is a waste product from foundry, on the properties of self-compacting concrete containing three admixture. In this experimentation combinations of admixtures which is taken (Superplastizer + VMA). The flow characteristics and strength characteristics of self-compacting concrete produced from different waste material and different percentage of that material are found. The different percentage of red mud used in experimental are 0%, 1%, 2%, 3%, 4%, 5%, 6%, 7% and 8%. In the experimentation PPC was used. Locally available sand and coarse aggregate were used. The specific gravity of sand was found to be 2.55 and was Zone II sand. The specific gravity of coarse aggregates used was found to be 2.61. The coarse aggregate were 12mm and down size. Red mud is one of the major solid wastes coming from Bayer process of alumina production. At present about 3 million tons of red mud is generated annually, which is not being disposed of recycled satisfactorily. The conventional method of disposal of red mud in ponds has often adverse environmental impact and during monsoon, the wastes may be carried by runoff to the surface waters course and a result of leaching may cause contamination of ground water; further disposal of large quantities of red mud dumped, poses increasing problems of storage occupying a lot of space and which is collected locally. The mix proportion adopted in the experimentation was 1:1:0.5with a water/binder ratio 0.3. The flyash /cement ratio used was 1:3.5. The fly ash used in the experimentation is pozzocrete 60 was obtained from DIRK INDIA PRIVATE LTD.

IV. EXPERIMENTAL PROCEDURE

The cement, sand and coarse aggregates were weighed according to the mix proportion 1:1:0.5. The flash and cement proportion used in the experimentation was 1:3:5. To this dry mix the required quantity of red mud (1%, 2%, 3%, 4%, 5%, 6%, 7%, and 8%) was added and homogenously mixed. To this dry mix the required quantity of water was added and thoroughly mixed. To this the superplasticizer was added at the rate of 700ml/100Kg of cementitious material and mixed intimately. Now the viscosity modifying agent (VMA) was added at the rate of 100ml/100Kg of cementitious material. The entire mix was thoroughly mixed once again. At this stage, almost the concrete was in a flow able state. Now, the flow characteristics experiments for self-compacting concrete like Slump flow test, Oriment test, V-funnel test, L-box test and U-box test were conducted. After conducting the flow characteristic experiments the concrete mix was poured in the moulds required for the strength assessment. After pouring the concrete into the moulds, no compaction was given either through vibrated or through hand compaction. Even the concrete did not require any finishing operation. After 24 hours of casting, the specimens were demoulded and were transferred to the curing tank wherein they were allowed to cure for 28 days.

For compressive strength assessment, cubes of size 150mmX150mmX150mm were prepared. For tensile strength assessment, cylinders of diameter 150mm and length 300mm were prepared.

After 28 days of curing the specimens were tested for their respectively strengths.

V. TEST RESULTS OF SELF COMPACTING CONCRETE CONTAINING THE COMBINATION OF ADMIXTURES (SP+VMA)

A. Flow Test Results

The tables give the flow test results of effect of addition of red mud in various percentages on the properties of self-compacting concrete containing an admixtures combination of (SP+VMA)

Percentage of red mud	**Slump flow (mm)**	**Slump test (sec)**	**V-funnel flow time sec**	**U-box filling height H_1-H_2 (mm)**	**L-box**		
					Blocking ratio H_2/H_1	**(T_{20}) sec**	**(T40) sec**
0	680	4.9	33.10	0	0.812	9.24	15.8
1	700	4.7	24.61	0	0.88	6.3	10.2
2	720	4.3	18.70	0	0.96	3.8	6.5
3	710	4.6	32.80	5	0.85	4.6	8.8
4	680	5.3	34.60	5	0.83	5.2	9.2
5	650	5.8	36.80	10	0.78	5.5	11.2
6	630	8.6	42.00	10	0.6	6.3	13.4
7	590	12.4	52.80	15	0.39	7.2	15.6
8	560	13.2	66.54	20	0.16	9.4	25.2

Table 1: Flow Test Result

B. Compressive Strength test results of self-compacting concrete containing the combination of admixtures (SP+VMA) with various percentages of red mud

Percentage addition of red mud	**Compressive strength (Mpa)**
0(Ref)	40.72
1	41.50
2	44.61
3	42.89
4	40.47

5	37.31
6	35.67
7	34.45
8	33.43

Table 2: Compressive Strength Test

C. Tensile strength test results of self-compacting concrete containing the combination of admixtures (SP+VMA) with various percentages of red mud

Percentage addition of red mud	**Tensile strength (Mpa)**
0	3.50
1	4.15
2	4.71
3	3.64
4	3.71
5	3.20
6	2.91
7	2.64
8	2.22

Table 3: Tensile Strength Test

D. Flexural strength test results of self-compacting concrete containing the combination of admixtures (SP+VMA) with various percentages of red mud

Percentage addition of red mud	**Flexural strength (Mpa)**
0	5.12
1	5.36
2	5.53
3	5.5
4	5.26
5	5.25
6	4.92
7	4.83
8	4.4

Table 4.4 Flexural Strength Test

VI. Conclusion

Different case study/experiments were done to justify SCC as a standard concrete and can be used for speedy and durable construction. It has been observed that on comparing SCC with conventional concrete it provides eco friendly concrete and reduces energy cost. Initial cost of SCC is 10-15% higher than conventional concrete due to which it is not opted by most of the consumers. With the experiments we concluded that the end cost of total construction by using SCC is less than the conventional concrete. In the same manner it is necessary to reduce initial cost of SCC to enable it as day to day concrete. To achieve the same, case studies & experimental work is accomplished using, different types of wastage materials. Replacing 0-8% cement with red mud, it has been observed that to reduce the cost of SCC combination of admixture such as (SP+VMA), optimum value of red mud was at 2%. Maximum compressive strength of SCC is obtained by adding 2% red mud which is waste material from Alumina industry. The flow test result of 2% addition of red mud, slump flow (720mm), V-funnel flow time (18.70 sec), U-box filling height (0mm) & L-box 0.96. These flow test value fulfill the suggested criteria given by European Guideline.

References

[1] Brite Euram SCC (2000), Rational production and improved working environment through using self compacting concrete, Brite-EuRam project BRPR-CT96-0366.
[2] Bui, V., Akkaya, Y. ans Shah, S. (2002), Rheological model for self-consolidating concrete, ACI Material Journal No 6, Farmington Hills: American Concrete Institute, pp 549-559.
[3] Byfors, J. (1999), SCC is an important step towards industrialisation of the building industry, Proceedings of the First International RILEM Symposium on Self-compacting Concrete, Stockholm: RILEM Publications S.A.R.L, pp. 15-21.
[4] EFNARC (2002). "Specifications and guidelines for self-compacting concrete." EFNARC, U K (www.efnarc.org), pp. 1-32.
[5] ErgoAir (2002), Hand-Arm vibration technical information, Las Vegas: ErgoAir Inc.
[6] ERMCO (2006), European ready-mixed concrete industry statistics year 2005, Brussels: European Ready-mixed Concrete Organisation.
[7] ERMCO BIBM, CEMBUREAU, EFCA and EFNARC (2005), The European Guidelines for self-compacting concrete-specification, production and use, Warrington: SCC European project group.
[8] Eurocode 2 (2005). Design of concrete structures, part 1: General rules and rules for buildings, prEn 1992-1.
[9] Fujiwara H, "Fundamental Study on the Self-Compacting Property of High- Fluidity Concrete", Proceeding of the Japan Concrete Institute, Vol. 14, No.1, June 1992, pp. 27-32.
[10] Hayakawa M, et al. "Development and application of super workable concrete", RILEM International Workshop on Special Concretes: Workability and Mixing, Paisley, 1993.
[11] HEINE, HANS, J. "Saving Dollars through Sand Reclamation- Part 1, "Foundry Management and Technology. 111:5 (May, 198), pp.22-25.

