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EFFECT OF BONE POWDER IN COMPRESSIVE STRENGTH OF SELF COMPACTING CONCRETE

By

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CHAPTER ONE

1. Introduction

1.1 General

Self-Compacting is remarkable and innovative form of Concrete developed in Japan in the year of 1980. By Prof. H. Okamura in the University of Tokyo, Japan. He is mainly responsible for initiating and initial development of this concrete and is now regarded as the Father of SCC. The need for the development of SCC arose from the skilled labor and man power in Japan during 1980's. Though SCC was first developed to overcome the deficiency of the skilled man power, subsequently it is observed that SCC not only reduces the requirement of man power, but it also results in more durable concrete with the excellent user-friendly characteristics and strength [23]. It has a big role to play because of the sustainable benefits in construction both quantitatively and qualitatively. It is now used in many countries such as Middle East, Canada, Sweden, Netherlands, USA, Austria, and Korea etc. The foundation of land mark tower in Abu Dhabi, Sheikh Zayed Bridge, Abu Dhabi, and Palm Island in Dubai are some of the construction uses self-compacting concrete. Here are some of the buildings that uses self-compacting concrete.

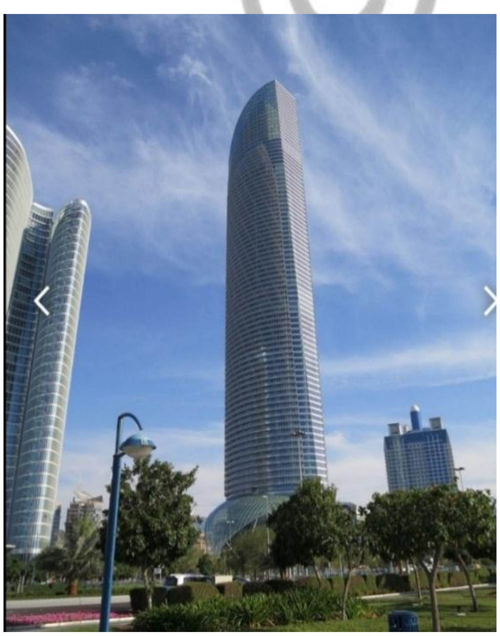

Figure 2.1: Palm Island in Dubai

Figure 2.2: The Land Mark in Abu-Dhabi

Figure 2.3: Arch tower in Abu-Dhabi

SCC flows in its own weight, completely filling formwork and achieving full compaction, even in the presence of congested reinforcement or narrow passage. Due to the materials and fillers density the hardened concrete is dense, homogeneous and has the same engineering properties and durability as ordinary vibrated concrete [1]. The method for achieving self-compact ability involves not only high deformability of paste quantity or mortar quality, but also resistance to segregation between coarse aggregate and mortar when the concrete flows through the confined zone or narrow placing of reinforcing bars. Okamura and Ozawa have employed three major methods to achieve self- compact ability of concrete, the first one is limiting the aggregate size, second is Low water powder ratio and at third they put using of super plasticizer admixtures [2]. The additions are mainly improved and maintain the cohesion and segregation resistance of the concrete. As normal concrete the particle size distribution, shape and water absorption of mineral fillers may affect the water demand /sensitivity and therefore suitability for use in the manufacture of SCC. Fillers specifically ground for this application offer the advantage of improved batch to batch consistency of particle size distribution, giving improved control over water demand and making them particularly suitable for SCC. the filler used is compared with other available materials used in this type of concrete. The filler improves shape and angularities then it reduces inter particle friction; use finer grading to reduce Harshness or coarser grading to reduce viscosity due to coverage area of particles [3].Tests used for assessing the fresh properties of self-compacting concrete enable to characterize the type and mix design of self-compacting concrete. From the tests conducted to characterization of self-compacting concrete slump flow test is the one this test is used to assess the horizontal free flow of SCC in the absence of obstructions. On lifting the slump cone, filled with concrete, the concrete flows. The time T50cm is a secondary indication of flow. It measures the time taken in seconds from the instant the cone is lifted to the instant when horizontal flow reaches diameter of 500mm. The second test is V-Funnel; the flow ability and viscosity of the fresh concrete can be tested with, where by the flow time is measured and segregation resistance of the mix is reasonable if the difference between T_0 and T_5 is less than or equal to 3 sec.

The recommended constituent amount of self-compacting concrete from different researches is as follow.

Table 1.1:Mixture proportion guidelines for self-compacting concrete suggested by Different authors.

`Autor's	Vc /Vagg	Vf /Vagg	Vb /Vs	(Vb + Vf)/Vagg
Okamura	0.64	0.44	0.22	0.64
Yurgui and et al.	0.54	0.46	0.24	0.78
J. Ambrose, S. Rols, and J. Pera	0.44	0.56	0.18	0.78

(from [*new methodology for designing self-compacting concrete,by Aaron W. Saak and et al.*]).

Vc = volume coarse aggregate; Vf = volume fine aggregate; Vagg = volume of total aggregate; Vb = volume of binder (solids); and Vs = volume of total solids (aggregates+ binder) [27].

Self- Compacting Concrete is characterized by filling ability, passing ability and resistance to segregation. Many different methods have been developed to characterize the properties of SCC. No single test is capable of assessing all of the key parameters, and a combination of tests is required to fully characterize an SCC mix.And hence, each mix has been tested by more than one test method for the different workability parameters [5].

Table 1.2:Recommended Limits for Different class of SCC

Sr. No.	Property	Range
1	Slump Flow Diameter	600-800 mm
2	T50cm	2-5 sec
3	V-funnel	6-12 sec
4	L-Box H2/H1	≥ 0.8

Self-compacting concrete itself could be produced in three ways one is Powder-type self-compacting concrete, Viscosity agent-type self-compacting concrete and Combination of both-type self-compacting concrete.

One of the research paper revised over this topic is *"effect of grounded bone powder addition on the mechanical properties of cement mortar" by M. Kotb et al.*

The bone powder (BP) was obtained by crushing animal bones. The supplied bones were cleaned, boiled in water, and dried for several months to remove any organic materials. The cement used was OPC and water-cement ratio required to give a paste of standard consistency was equal to 0.29. Natural clean sand having specific gravity of 2.57, compacted density of 1.79 t/m3 and fineness modulus of 2.49 was used in the fabrication of test specimens. The BP additions were 0, 5, 10, and 15% by weight of cement. The compression and tensile test specimens were tested on a universal hydraulic testing machine of capacity 1000 KN. according to ECCS 203-2003 and SBC 302-2007. The mortar compressive strength was measured at ages of 7, 28, 90, 180, and 270 days. the compressive strength increases as bone powder addition increases up to 5% beyond this, the compressive strength of mortar with 10 and 15 % BP is lower than that of 0 % BP. The compressive strength ratio is about 115.2% with the addition of 5% BP, while it decreased to reach 72% with increasing BP addition to 10% and decreased to 67% with increasing BP addition to 15%. The results presented in the figure are for ages of 7, 28, 90, 180 and 270 days. It is clear that the tensile strength increases at BP of 5%. Beyond this, the tensile strength of mortar with 10 and 15 % BP is lower than that of 0 % BP. BP behaves filler (fills the voids in the matrix) and has not a pozzolanic effect. Thus, the increase in mortar strength due 5% BP addition can be attributed to its physical effect in filling the voids in the matrix [30].

The conclusion made from this research [30] was: -

- The compressive strength and tensile strength of bone cement mortar at ages of 7, 28, 90, 180, and 270 days increases as bone powder ratios increases up to 5% beyond this percent it decreases.
- The mechanical properties of mortars mixes containing 5% of bone powder showed higher performance compared to 0%, 10%, and 15% of bone powder. The increase of strength at 5% bone powder (BP) is mainly due to that. the bone acts as filler or nucleating agent, which accelerates the hydration of cement.
- The abrasion resistance of mortar specimen improved by the addition of bone powder up to 10% at testing age of 7 days. The improvement was continued with the addition of 15 % pone powder at testing age of 28 days.

CHAPTER TWO

Materials and Methodology

2.1 Materials

Commercially available ordinary Portland cement is used (Derba OPC cement) Ethiopian Standard, ES 1176-2:2005 is intended for the determination of the major oxide contents of Portland cement conforming to BS12:1991, within the following compositional ranges.

Table 2.1:The oxide test results of Derba cement [33]

Chemical Compound	Percentage
Lime, CaO	60.02
Silica, SiO_2	22.67
Alumina, Al_2O_3	5.52
Iron Oxide, Fe_2O_3	3.98
Magnesia, MgO	1.81
Sulphur trioxide, SO_3	2.83

Fine aggregates used are found locally from Meki Awash river sand with the maximum size of 4.75mm. And Crushed stone with maximum size of 19mm and 12.5mm use as coarse aggregate. Coarse aggregates used for this research was taken from the Sendafa.

Table 2.2: Gradation limits of natural sand

AASHTO Sieve Size		Mass Retained (g)	% Retained	% Passing	VDOT Specs. (%Passing)	
Standard	mm				Lower	Upper
	6.30	0.0	0.0	100.0		
No. 4	4.75	142.4	8.92	91.1	95	100
No. 8	2.36	213.0	13.35	77.7	80	100
No. 16	1.18	209.3	13.11	64.6	50	85
No. 30	0.60	436.0	27.32	37.3	25	60
No. 50	0.30	419.3	26.27	11.0	5	30
No. 100	0.15	122.2	7.66	3.4	0	10
No. 200	0.075	24.9	1.56	1.8	0	3
	passing 0.075 + C					
	Total	1567.1				

"Fosroc Structuro W420" is used as plasticizing admixture for production of self-compacting concrete. It is [36] a superior high performance concrete hyperplasticiser based on polycarboxylate technology. Structuro W420 is differentiated from conventional superplasticizers in that it is based on a unique carboxylic ether polymer with long lateral chains.

"Mega Air" air entraining admixture which made-up in Ethiopia (CONMIX), is used for further upgrading of self-compact ability of the concrete. Air entraining admixture mainly modify the plastic property of concrete such as Workability, segregation, bleeding and finishing quality. Insufficient compaction could result in an "Entrapped Air" and it is [36] undesirable, though it decreases compressive strength of concrete.

"Mega Flow SP4" is used as high range water reducing and set retarding admixture with standard of ASTM C494, Type B. D and G, BSEN 934-2. The increased addition of retarder had no influence on the initial rheological parameters, but led to the markedly reduced increasing rate of static yield stress with rest time [39].

"**Nano Grout Aid**" this product is a powder product use in the concrete to provide non-shrink properties. This product mainly used for grouting post tensioned cable ducts, bearing plates, anchoring and non-shrinkage concrete. It improves fluidity at reduced mix water content and prolongs workability with reducing segregation and bleeding [38].

The addition of stone powder increase the powder which leads to increased viscosity and improved stability of the fresh concrete and increase durability by filling the voids. It is necessary to use powder materials, which are greatly beneficial for concrete properties and durability. They do not only decrease the SCC materials' cost but also enhance its particle packing density, self-compact ability and stability as well as its durability [12]. This stone powder is collected from stone crusher area which filtered as dust in the crushing machine.

Figure 2.1: Stone Powder

Bone Powder

The bone powder is obtained by directly purchased from Addis Ababa Abattoir Company. In this company the main surplus product is bone. Usage of this surplus is not that vast to cover this all material used. The bone powder is first produced for agroindustry users to be food for the hens and others related uses. But the need for this industry was not as much as the available product in Abattoir Company. This bone powder is produced in three steps, boiled in water to separate of adhering flesh and tissues. Then it will dry for several days and it will be brittle finally it will be crushed with electrical bone crusher found in the Abattoir compound.

2.2 Testing equipment for self-compactibility of SCC

V-funnel

This standard covers the method of funnel testing for average flow-through speed. This test is used to evaluate viscosity and filling ability of SCC [40]. The internal surfaces of V-funnels shall be smoothly finished and their capacity shall be 10 liters. A funnel used have total depth of 60 cm with top area of 50cm x 7.5cm and 7.5cm x 6.5 cm bottom area with nozzle height of 15 cm. 1mm thick plate is used to build up this mold.

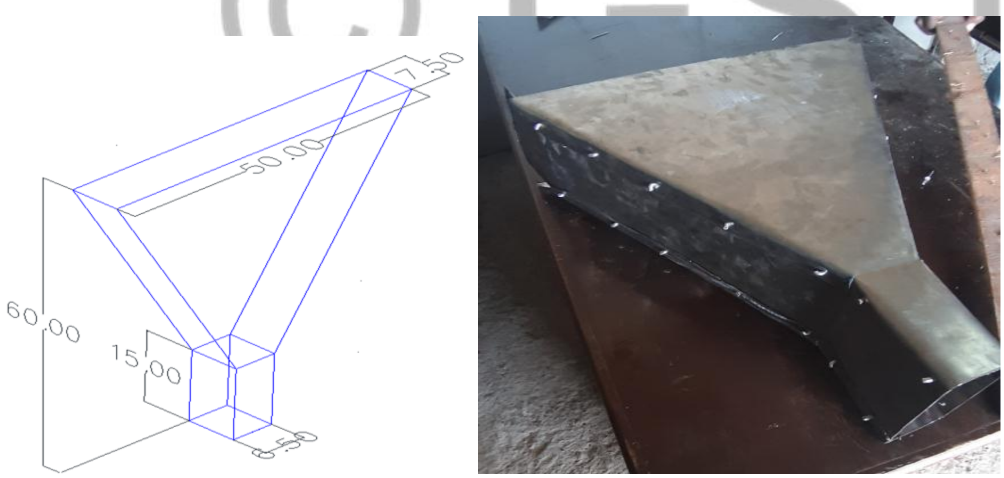

Figure 2. 2: V-Funnel test mold.

L-Box

This is the other equipment used for characterize the fresh property of self-compact ability (filling and passing ability) by measuring time and length. This equipment is also built with the metal sheet of 1mm thickness. It is L shape box with top area 10cm x 20cm and frontal area of 20cm x15cm and height of 60cm with 70cm lay on the ground.

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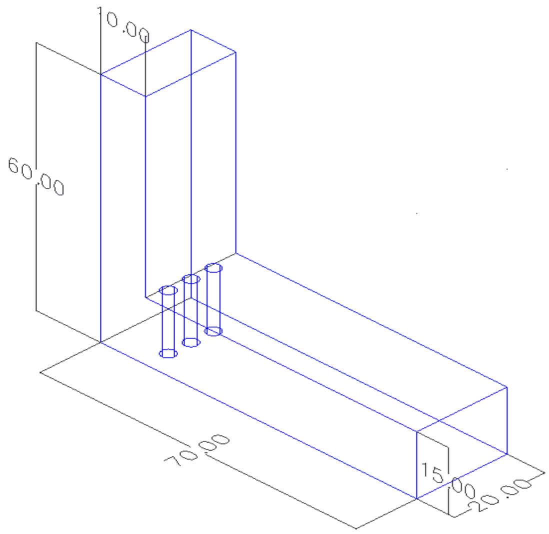

Figure 2.3: L box test mold

Slump cone

The filling ability of SCC is evaluated by measuring the horizontal flow diameter; the larger the slump flow value, the greater is the ability of SCC mix to fill formwork under its own weight [12]. This equipment was available in the site where the experimental work has been done. Its height is 30cm with top and bottom diameter of 10cm and 20cm respectively.

2.3 Methodology

2.3.1 Self compacting concrete

The first step of this research is accomplishment the mix design of self-compacting concrete. regression analysis is performed on the data collected from many published sources to construct a reliable formula between water to cementitious material (w/cm) and compressive strength. The mix design is taken according to the proportion of aggregates, fines, cement and admixture which are recommended in to these published journals and documents. Secondly the soundness of the proposed mix proportion is checked with fresh property checking methods of self-compact ability of concrete mix. then water to cementitious materials ratio will be evaluated by preparing a series of SCC mixes differing water to cementitious ratio. The first step in preparing of self-compacting concrete is fresh characteristics test for the requirements of achieving this type of concrete. Tests made on the research for the fulfillment of triumphing self-compacting concrete are:

Slump Flow Test: -

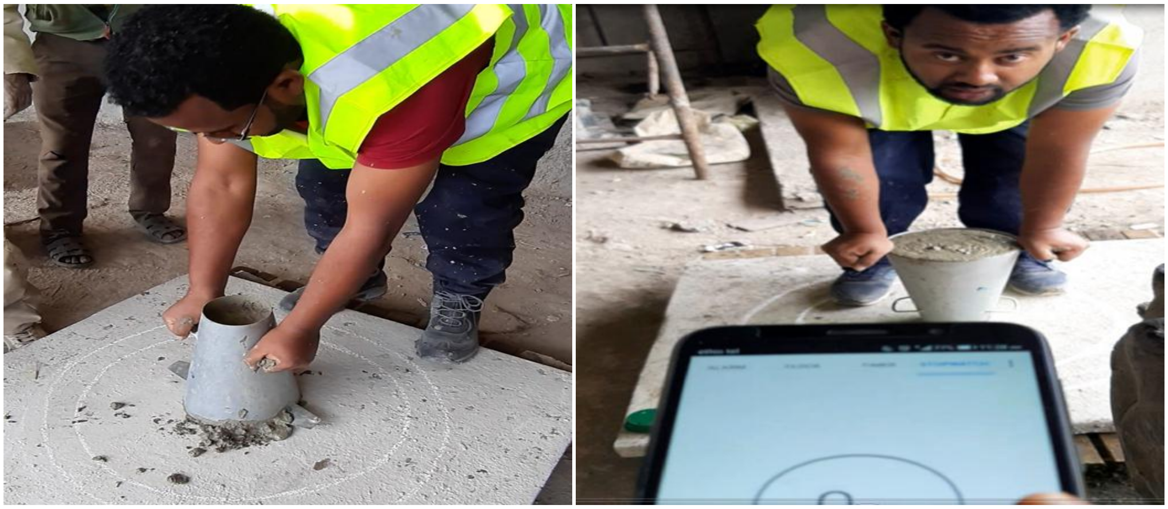

Figure 2.4: Slump flow Test of self-compacting concrete.

This test is taken as ordinary concrete slump test but the measured parameter is not the height of concrete remain undisturbed (the height remaining from 25 cm.) but as shown in the Picture the diameter of flow covered. Slump flow test is used to assess the horizontal free flow of SCC in the absence of obstructions. On lifting the slump cone, filled with concrete, the concrete flows. The average diameter of the concrete circle is a measure for the filling ability of the concrete. The time T5 is a secondary indication of flow. It measures the time taken in seconds from the instant the cone is lifted to the instant when horizontal flow reaches diameter of 500mm [5].

V-Funnel Test at T0 and T5 minutes

The V-funnel test is performed by measuring the time for the concrete to flow out of the funnel under its own weight. Segregation resistance of concrete flow can be evaluated by assessing the homogeneity of concrete flow from the funnel test [12]. T 5min is also measured with V-funnel, which indicates the tendency for segregation, wherein the funnel can be refilled with concrete and left for 5 minutes to settle. If the concrete shows segregation, the flow time will increase significantly. The segregation also can be evaluated from visual observation in the flow of the concrete.

L-box Test

The passing ability is determined using the L- box test as shown in picture, the vertical section of the L-Box is filled with concrete, and then the gate lifted to let the concrete flow into the horizontal section. The height of the concrete at the end of the horizontal section is expressed as a proportion of that remaining in the vertical section (H2/H1) where H1 is the height of the concrete at the L angle or at the get and H2 is the height of concrete at the end of lower box. The ratio of (H2/H1) shall not be ≥ 0.8.

Figure 2.5: L-box test of self-compacting concrete.

Thirdly the hardened state of control self-compacting concrete is tested for to check the mechanical effect of bone powder in SCC. The mechanical tests conducted are as follows.

Compressive Strength: Each mix will be placed in separate cubical mold of size 150 mm x 150 mm x 150 mm and removed after 24 hours. Concrete cubes will be stored in water. Then it will be taken out from the water prior to testing. The compressive strengths to be determined is at 7 and 28 days as per IS 4031.

Flexural Strength:To conduct the flexural strength test as per BS 1881-118, beam samples of size 500 mm×100 mm×100mm are casted and cured in water for 14 and 28 days. For each mix proportion, three samples are made. Freshly mixed concrete filled in the wooden beam mold. All the above data are recorded and listed for interpretation with the statistical representation. Recommendation and conclusions are made based on this result.

CHAPTER THREE
Experiment

3.1 Mix proportioning

Property	Cement	Sand	Coarse aggregate
Bulk Specific Gravity	3.15	2.455	2.881
absorption capacity %	-	3.008	1.485
fineness modulus	-	2.52	-
Unit weight Kg/m^3	1440	1620	1550

Table 3.1:Property of materials used in the mix

Using these values for ACI tables (ACI mix design, Civil 1112) the mix design proportion can be calculated.

Table 3.2: C30 concrete mix proportion according to ACI

INGREDIENTS	Quantity	Unit
CEMENT	389	Kg/m3
SAND	731	Kg/m3
COARSE AGGREGATES	1035	Kg/m3
WATER	175	Kg/m3
Water/Cement	0.45	-

The other constituent used in this research are stone powder for upgrading the powder content and increase viscosity and stability, Nanogrout aid powder for resistance of segregation, and chemical admixtures which are Retarder (High Range Water Reducing Admixture (HRWRA)) and Hyperplasticiser. Air entraining agent is also used. The quantity used for these constituents (without stone powder) is used as per the recommended dosage of the product from the company.

3. *2* Self-compact ability *(1st Step)*

The water to powder ratio was taken 0.50, 0.45, 0.40, 0.35, 0.30, and 0.32 for the mix designated as SCC1, SCC2, SCC3, SCC4, SCC5 and, SCC6 respectively. Those mixes ware done using mechanical mobile mixer with mixing capacity of 0.2m^3 and rotate 10-12 rpm. Fine aggregate, coarse aggregate, cement and powders was mixed for three minutes to this mixer in dry form to get uniform distribution over the batch. Water and high range water reducer are added to the mixer after the dry mix. Finally, the plasticizer is added in to the mix after three minutes of water mixed to the mix and rotated with the same speed for additional four minutes. This mixed concrete is transported to the place where physical tests are done using mini loading and unloading vehicle (Dumper).

3.3 Fresh property tests of pure SCC mixes

Slump flow Test: - After cleaning and cutting the extra filled concrete from the surface of the cone it was raised vertically in two seconds. From this time till the concrete reaches to 50cm diameter and stopped movement the time was recorded. The flow diameter was recorded in the maximum direction and the diameter at right angles to it. The average of two diameters at right angles to each other expressed to the nearest 5mm in.

Table 3.3: mix proportion of SCC with variable W/P ratio

Materials		SCC1	SCC2	SCC3	SCC4	SCC5	SCC6
Cement	Kg	24.74	24.74	24.74	24.74	24.74	24.74
Stone Powder	Kg	1.48	1.48	1.48	1.48	1.48	1.48
Nano grout Aid	Kg	1.48	1.48	1.48	1.48	1.48	1.48
Fine aggregate	Kg	38.63	38.63	38.63	38.63	38.63	38.63
Coarse aggregate	Kg	24.50	24.50	24.50	24.50	24.50	24.50
Water	Lit.	12.37	11.13	9.9	8.66	7.42	8.16
Retarder	Lit.	0.25	0.25	0.25	0.25	0.25	0.25
Hyperplasticiser	Lit.	0.37	0.37	0.37	0.37	0.37	0.37
Water/Cement		0.5	0.45	0.4	0.35	0.30	0.32

V-funnel Test: - The concrete sample was filled onceGently from the charging container to the top edge/rim of the funnel. After cleaning the surface of the funnel, the trap was opened from the bottom within 10 seconds. The time was recorded from its opening till the all the concrete comes out of the funnel and this time is taken as T0. Again, by cleaning the funnel the concrete was filled and waited for five minutes, then with the same procedure the funnel is opened and the time is recorded as T5.

L-box test: -. The concrete was leveled and the apparatus was cleaned. Finally, the concrete was released and the time gap between the instances of opening till the concrete reaches to the far edge of horizontal box (glass) which is 500mm length was recorded. Vertical dimensions from the top edge of horizontal box to the stable concrete top at the gate and opposite side of the gate (glass) are measured and ratio of these two measurements was recorded.

Table 3.4: Mix proportion of SCC with BP

Materials	CSCC	BP3SCC	BP6SCC	BP9SCC	BP12SCC	BP15SCC
Cement (Kg/m3)	450.66	450.66	450.66	450.66	450.66	450.66
Stone Powder (Kg/m3)	34.26	34.26	34.26	34.26	34.26	34.26
Nano grout Aid (Kg/m3)	34.26	34.26	34.26	34.26	34.26	34.26
Fine aggregate (Kg/m3)	974.17	974.17	974.17	974.17	974.17	974.17
Coarse aggregate (Kg/m3)	617.10	617.10	617.10	617.10	617.10	617.10
Water Lit./m3	183.79	189.11	194.43	199.76	205.08	210.64
Retarder Lit./m3	5.79	5.79	5.79	5.79	5.79	5.79
Hyperplasticiser Lit./m3	8.56	8.56	8.56	8.56	8.56	8.56
Water/Powder	0.32	0.32	0.32	0.32	0.32	0.32
BP in Cement %	0	3	6	9	12	15

All fresh physical tests are done again with the same procedure in the above, the change in characteristics have been recorded.

3.4 Harden state testes(2nd Step)

Compressive strength: - The effect of the proposed bone powder has been tested through compressive strength tests performed on three specimens per mix at seven- and twenty-eight-days age of 150 mm cube specimens, cured in water at room temperature.

Flexural strength: - tests also were performed for all mix with three specimens per mix after performing the fresh physical test of SCC. As per BS 1881-118, beam samples of size 500 mm×100 mm×100mm were taken for the tests. Fourteen and twenty-eight days of Strength was measured in this step.

CHAPTER FOUR

Result and discussions

4.1 Self-compact ability test results for pure SCC

Slump test results

Table 4.1: Results of slump of pure SCC

Water Powder ratio	Slump flow test	Result dia. (mm)	T50cm slump flow (sec.)
0.5	SCC1	collapse	<1
0.45	SCC2	845	1.4
0.4	SCC3	770	2.6
0.35	SCC4	735	3
0.3	SCC5	660	6.1
0.32	SCC6	710	3.68

From the results of slump tests, we can say that fresh self-compacting concrete slump is directly affected by the water powder ratio. Flow time to rich 50cm diameter increase highly when the water ratio decreases from 0.35 to 30 it shows that the internal friction is affected highly and the dosage of plasticizer have significant effect in the viscosity of the concrete when water powder ratio is getting lower. The enhancement of viscosity is occurred due to the increasing the amount of paste so that the cohesion will be upgraded. Low powder content SCC typically shows a high yield stress due to the lattice effect and a low viscosity due to typically higher water to powder ratios. In the other hand the higher powder content or lower water to powder ratio, the yield stress is decreased.

L-box test results

As in slump flow shown segregation was observed in the mixes SCC1, SCC2 and SCC3 and the flow scale was less in SCC5 mixture. Mixture SCC6 shows a good result of segregation and it have a flow scale of 0.842.

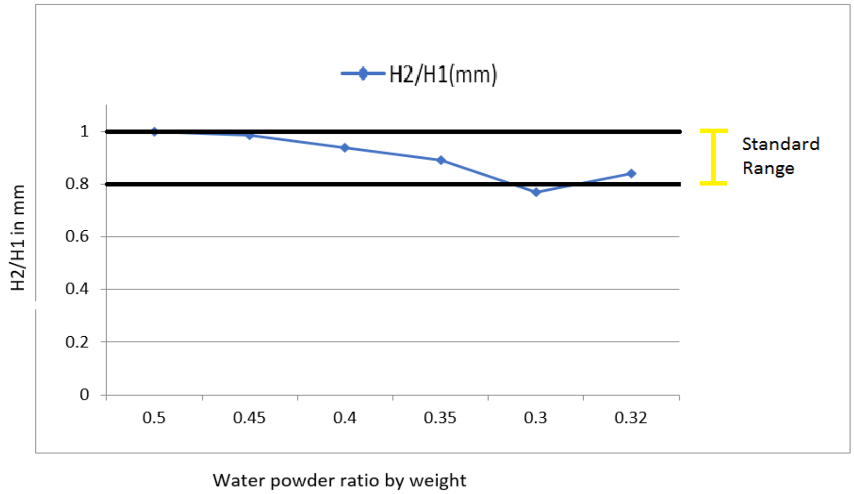

Figure 4.1: T50 L-box passing ability

V-funnel test result

The flow ability of the mixes was to measured and the test is started right after the concrete is filled into the funnel; the result of this flow was affected by concrete properties. High flow time (t0) and low flow time was recorded and it was decreasing while the water powder ratio is decreased. These results can also be associated with low deformability due to a high paste viscosity and with high inter-particle friction.

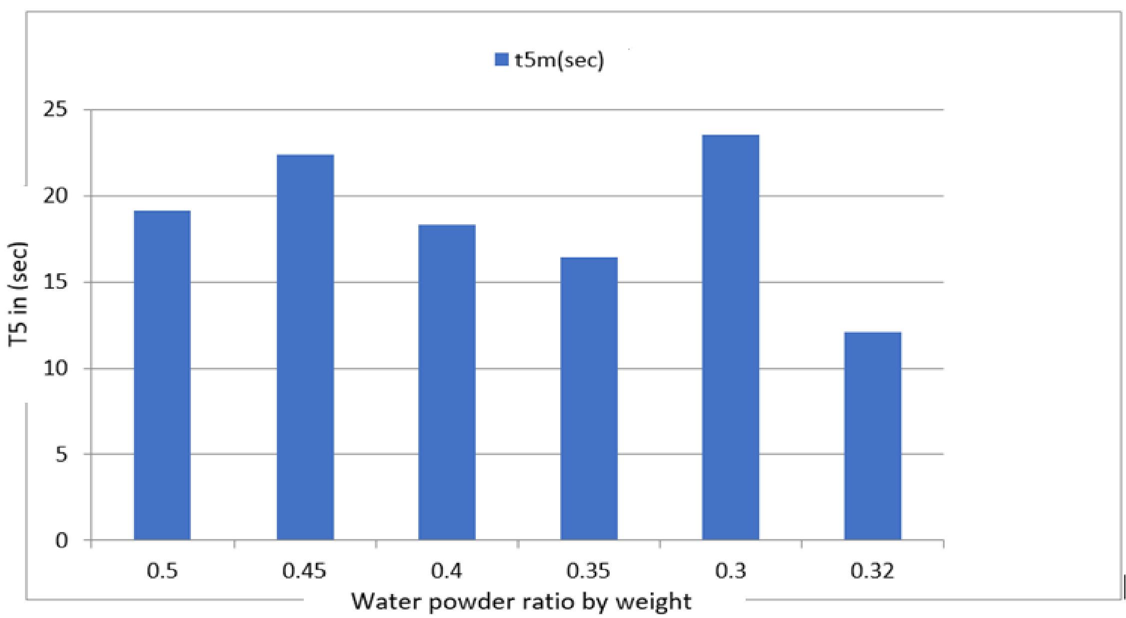

Figure 4. 2: T5 V-funnel passing ability

4.2 Self-compact ability of SCC with bone powder.

The same procedures have been made for testing the effect of bone powder presenting into self-compacting concrete. Viscosity and the stability of mixture are directly affected by the presence of powder content in self-compacting concrete. It also enhances the rheology characteristics and hence the compressive strength.

Slump cone test result

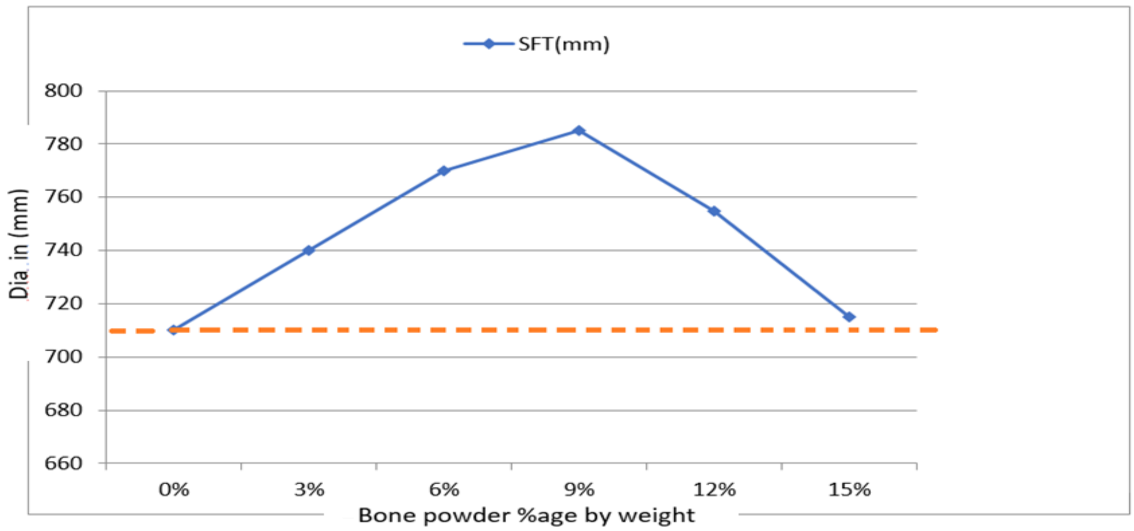

Figure 4. 3: Slump flow of SCC with BP.

From the values shown in the graph above one can conclude that the flowability could be upgraded by adding bone powder.

L-box Test results

Table 4.2: Test results of L-box

Bone Powder	L-Box	H2/H1 (mm)	(L50cm sec)
0%	CSCC	0.84	3.91
3%	BP3SCC	0.85	3.63
6%	BP6SCC	0.88	3.65
9%	BP9SCC	0.89	4.43
12%	BP12SCC	0.87	6.05
15%	BP15SCC	0.85	8.61

The results show that the presence of bone powder didn't affect the passing ability property of the concrete but the flow time was affected by the amount of bone powder added to the mix.

V-funnel

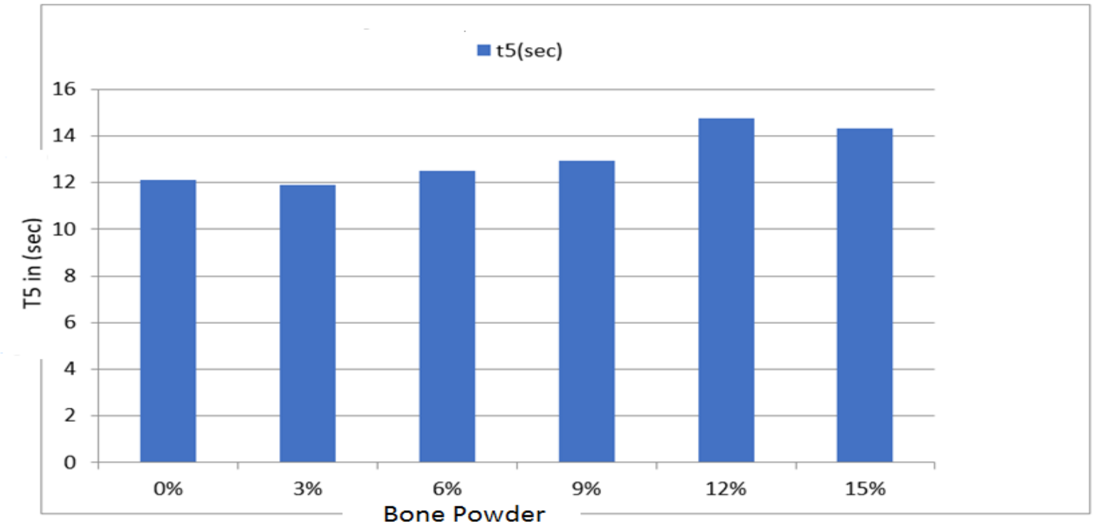

Figure 4.4: T5minutes V-funnel

From the result in V-funnel shows that the powder content enhances the viscosity of the mix because the time taking to flow through the funnel is mostly greater than that of the control SCC. but due to the enhancement of the viscosity due to the addition of powder which is not pozzolanic, segregation was not seen.

3.1 Hardened property test results

Table 4.3: Results of Compressive strength

B.P %	28-days Compressive results			
	1	2	3	Avg.
0	32.04, 30.13, 34.44	31.52, 32.73, 31.96	32.99, 33.40,31.27	32.273
3	33.88, 33.08, 34.17			33.71
6	32.99, 33.93, 31.85			32.923
9	29.13,28.06, 30.24			29.143
12	24.56, 23.86, 23.16			23.86
15	21.46, 20.03, 20.52			20.67

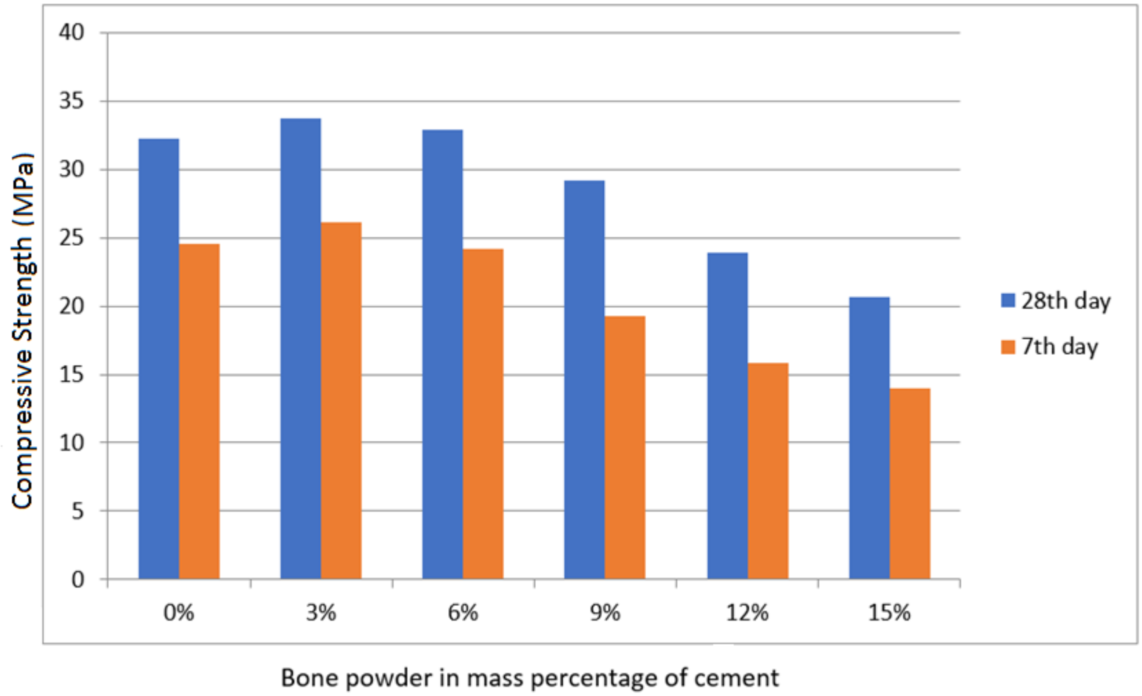

Figure 4.5: - 7 and 28-days Compressive strength.

Table 4.4: Results of Flexural strength

B.P %	28-daysFlexural results		14-daysFlexural results	
	1	Avg.	2	Avg.
0	4.41, 4.26, 4.11	4.26	3.24, 3.14, 3.43	3.27
3	4.7, 4.76, 4.98	4.81	3.42, 3.69, 3.19	3.433
6	4.66, 3.99, 4.78	4.477	3.09, 3.78, 3.26	3.376
9	3.08, 3.14, 3.23	3.15	2.71, 3.28, 2.44	2.81
12	2.83, 2.68, 2.91	2.807	2.32, 2.14, 2.08	2.18
15	2.24, 2.15, 2.32	2.237	2.01, 1.86, 1.74	1.87

CHAPTER FIVE

Conclusion

1. From the fresh and harden test results conducted, it can be concluded that, the mix ingredients in SCC6 can be used for production of self-compacting concrete with a compressive strength of 30 MPa; Where there is a martials which may have equivalent quality and property with the materials used in this research.
2. According to the test result from L-box, the passing ability and filling ability of Self-compacting concrete can be increased up to 6% by the addition of 9% bone powder in the cement quantity.
3. As observed from slump flow (T50cm) and V-funnel (t0) test results Bone powder addition in self-compacting concrete provide adequate stability of the mix and improve the flow ability of the mix.
4. For the case considered in this thesis the addition of bone powder in 3% can increase the compressive and flexural strength up to 4.5% of self-compacting concrete due to the upgrading of fresh physical property and being the additional filler in the mix.
5. Based on the experimental results, the compressive and flexural strength of self-compacting concrete is not significantly affected if cement is replaced by bone powder up to 6%. But replacement beyond this percentage decrease these strengths in a high range.
6. Based on harden test results, the addition of plasticizer can increase the 7 days compressive and flexural strength up to 13% from the equivalent strength of normal concrete (67% by 7days), due to easily promotion of cement hydration.

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