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Factors Affecting Self Compacting Concrete Compressive Strength

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Abstract

The primary goal of this research is to investigate the effects of utilizing three kinds of cement (CEM I 52.5, SRC 42.5, and CEM III 42.5), Natural dolomite aggregate was also used from three different quarries, adding silica fume with two different percentages on the strength of self-compacting concrete. Nineteen concrete specimens were prepared using various cement types, crushed stone, and with or without silica fume. X-ray diffraction and petrographical studies were carried out on the three types of dolomite to clarify the composition difference between them. To regulate the new mixes for self-compacting concrete, a slump flow test was performed. Compressive strength was the mechanical feature that was tested. The compression test was conducted on hardened self-compacting concretes after water curing for 28, 180, and 365 days. Results showed that the best behavior of natural dolomite was type1. While when adding silica fume based on the results, it was observed that CEMIII42.5 recorded an increase in compressive strength compared to CEM

KEYWORDS: *Petrographical studies, Dolomite Type, Cement type, Silica fume, X-ray diffraction*

Introduction

Self-compacting concrete (SCC) is one of the concrete types that may be deposited and compressed by its own weight having minimal or no vibrational action, as well as being cohesive sufficiently to be manipulated without any segregation or leaking of the concrete mixture. SCC could cause up to 40% quicker building times than conventional concrete [1,2]. Therefore, it is utilized in place of traditional concrete in portions with extensive reinforcement. Because it is a highly practical concrete that flows quickly through dense reinforcements without mechanical disturbance. High-range water-reducing chemical additives have been used with minimum water content between 0.37 and 0.4 in SSC due to high operational requirements [3]. The elasticity modulus and shrinkage of SCC concrete properties are not remarkably different from those of conventional concrete [4].

We can get high-performance concrete from self-compacting concrete due to high flow ability, passing ability through the formwork without any segregation or need of vibration [5,6], and maintaining the flow ability more than ordinary concretes [7]. Dolomite is a widespread sedimentary rock used in concrete structures because it is cheap and locally available material.According to Tviksta [8], natural, spherical, moderately, or crushed aggregates could be utilized to generate SCC.

For the required performance of fresh and hardened concrete, it is necessary to be put in consideration the characteristics of the aggregates (Neuwald, 2004 [9] and Janssen and Kuosa, 2001 [10]). The coarse aggregate's size and form significantly impact the paste volume of mortar and are required to cover all particles. Typically, uncrushed gravel naturally requires less paste or mortar than limestone. In comparison, granite requires greater mortar volume. Due to the cross-linking of the angular particles, crushed aggregate tends to decrease stream, whereas rounded aggregate enhances flow due to lower internal friction (Alexander and Prosk, 2003 [11]). It deserves to be noted that the key to economically producing SCC is to utilize a source of well-graded aggregate. SCC mixtures may employ a poorly graded aggregate, necessitating a higher viscosity to prevent segregation issues (Neuwald, 2004 [9]).

Khaleel, R,O., et al., [12] Operated the coarse aggregates, including uncrushed, crushed gravel, and crushed limestone. Several tests are performed to measure the operability, including U-box, the slump flow, V-funnel, and L-box tests. Additionally, they discovered that flowability and passing skills decreased when the coarse aggregate's maximum size increased. Furthermore, When uncrushed gravel was incorporated into the concrete mix, the flowability, porosity, and resistance to segregation increased in comparison to crushed gravel-containing concrete. The compressive and curvature strengths and the elasticity modulus were determined. The hardness and elasticity

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modulus of concrete mixtures made using crushed limestone was greater than those made with gravel (crushed and/or uncrushed). Moreover, in SCC mixtures, coarse aggregate with a maximum smaller size results in greater strength than those with a maximum larger size.The collected results show that these materials may be utilized in various ways to produce cost-effective SCC. When fine materials were substituted in the quarry as an alternative to natural sand, it decreased the need for additives, such as high-range water-reducing admixture (HRWRA) and viscosity-modifying admixtures (VMAs), without compromising the strength of the SCC. The 28-day compressive strength of combinations in which up to 50% of the sand was substituted with quarry fines was between 7,500 and 9,000 psi, qualifying the mixtures for classification as high strength SCC (≥ 6500 psi). Additionally, high-strength SCC with a 28-day strength between 9,000 and 10,000 psi was generated cost-effectively by substituting approximately 55 percent of the total mass of cement with class C fly ash. To summarize, utilizing quarry fines and Class C fly ash in the production of SCC greatly decreased the number of costly additives like HRWRA and VMA [13].

Ghazy, M., [14] evaluated the effectiveness of several self-compacting concrete mixtures cast with varied constituents to that of standard vibrating concrete. The purpose of the experimental approach was to generate a variety of self-compacting concrete mixtures manufactured from local resources. The types of cement utilized were OPC and HSPC, while the aggregate was dolomite (Attaka quarry, and gravel). Nineteen concrete mixtures were made using various cement sorts and percentages, aggregate types and proportions, and filler types and ratios. The findings indicated that the high slag Portland cement or lime stone filer may be utilized effectively to produce self-compacting concrete with reduced possibility for segregation.

Abdelalim, A., et al., [15] examined the impact of coarse aggregate variety and polypropylene fiber inclusion on the mechanical characteristics of normal concrete (NC) and SCC. Three types of regional aggregates were implemented, including natural gravel, basalt, and dolomite. The fire resistance test of the manufactured concrete was evaluated in terms of its residual strength and raveling. Various degrees of temperature (200, 400, 600, and 800 °C) were given consideration. The influence of exposure periods of 15, 30, 60, and 120 minutes was tested while the temperature was fixed at 800 °C. Before and following high temperatures treatment, the compressive strength, the indirect tensile strength, the permeability, the near-surface absorption, and the spalling were determined. The resulting outcomes revealed that the kind of aggregate had a small impact on the fire resistance of concrete. Nevertheless, dolomite aggregates offered the greatest fire resistance, whereas natural aggregates produced the least.

Teja et al., [16] focuse to study the performance of self-compacting high-performance concretes using calcined and uncalcined zeolite with polyethylene glycol (PEG) as self-curing agent. Two sets of concretes were casted for investigations, the first set consists five concrete mix proportions with control concrete and self-curing concrete’s replacing cement with 5% of calcined and uncalcined zeolite containing 1% and 2% of polyethylene glycol in both. The second set of concretes were casted to replace 10% of cement content with calcined and uncalcined zeolite containing1% and 2% of polyethylene glycol in both. A relative comparison of the performance characteristics were evaluated by measuring the mechanical and durability characteristics of proposed self-curing self-compacting concretes. They found that the concretes containing calcined zeolite required lesser water content in comparison to concretes containing uncalcined zeo-lite to achieve similar slump flow values corresponding to self-compacting concretes.

The quality of any concrete depends primarily on curing and compaction process which defines the pore structure resulting in enhanced mechanical and durability characteristics. There is scarcity of water in many parts of world like drought affected areas, deserts. As the construction requires a lot of water for mixing and curing. Curing of concrete in construction site is always accompanied with many uncertainties resulting in reduction of the quality of end product. Often, concretes used in the construction of rigid pavements are posed with challenge of improper curing due to time constraints. In many applications the ambient temperature also plays key role in affecting the curing regime.Therefore, attempts to develop self-curing self-compacting concretes has been gaining prominence in the field of construction [17]

The effects of the curing and drying regime on the mechanical properties and permeation characteristics of concrete containing both crumbed rubber and steel fibers that are removed from waste tires. Five concrete mixes were designed, and concrete cubes, cylinders, and prisms were cast using waste tires extracts. Crumb rubber was treated by submersion in sodium hydroxide and then used to partially replace 10% and 30% of fine aggregates in the concrete mix. Extracted steel fibers were added at the rate of 1% and 2% per volume of each mix. Compressive and indirect splitting tensile as well as flexural strengths were conducted after normal curing while observing several drying conditions. Additionally, air permeability was assessed using a portable apparatus that was developed to assess permeability easily. For the concrete test specimens containing 10% partial replacement of fine aggregate by crumb rubber and 1% steel fibers, it was discovered that the splitting tensile strength and flexural strength were higher than that of the control mix by 21% and 22.6%, respectively. For specimens that included the 10% crumb rubber and 1% steel fibers, when exposed to oven drying at 105°C for 12 h, the compressive strength results increased by 17% compared with the control specimens exposed to the same conditions. Unlike the compressive strength results, the splitting tensile and flexural strength results decreased after exposing the specimens to elevated temperature. The addition of crumb rubber and steel fibers as a partial fine-aggregate replacement resulted in increasing the air permeability of the concrete to different degrees depending on the percentages used. The oven-drying curing regime improved the permeability by reducing it in specimens containing the 10% crumb rubber and 1% steel fibers as indicated by increasing their permeability time index by 15% when compared with air-dried specimens. Using waste tire extracts as a partial replacement of concrete fine aggregate can be recommended for both indoor and outdoor applications. This study showed that this was a viable, economic, and environmentally friendly method for reducing carbon foot print [18].

TiO2 is a primary photocatalytic ingredient that can significantly reduce smog-forming air pollutants in urban and metropolitan areas (pollution abatement). The effect of commercial grade TiO2 powder on fresh state flow, compressive strength, shrinkage, sulfate resistance and carbonation. The results indicated that TiO2 decreased the workability as mortars became more sticky and dry with increased TiO2 content. The compressive strength was also reduced in TiO2 containing samples compared to the control samples especially at early ages. However, TiO2 powder as an additive in mortar was useful in reducing carbonation due to the filler effect. No samples in the current investigation showed signs of cracking or expansive mass loss due to sulfate exposure. It is recommended that TiO2 powder should be used as an additive to the mortar plaster to help in controlling the air pollution problem. However, some mix adjustment may be needed to counteract the loss in flow and strength due to the inclusion of TiO2 powder [19].

2. Research Significant

Based on the research gap from the above literature review, the current study aims to investigate the effect of different types of cement, dolomite, and adding silica fume on compressive strength of self compacting concrete. This will be achieved by testing 171 concrete cubes for nineteen mixes.

3.Experimental Program

3.1 Constituent Ingredients

The components mixtures employed across the experiment were Portland cement, sulphate resistance cement, blast furnace cement, silica fume, three types of dolomite aggregate, natural siliceous sand, high range water reducer (HRWR), and water. The next sections describe the characteristics of these substances.

3.1.1. Cement and Cement Replacement substances

Three types of cement were employed in preparing the specimens: Portland cement (grade 52.5) CEM I52.5, sulfate resistance cement (SRC) (42.5), and blast furnace cement CEM III 42.5,with a blast furnace proportion of 50%. The ingredients were provided by an Egyptian manufacturer and correspond to European specifications [20]. The physical and mechanical characteristics of the cement are listed in Table 1. Moreover, The concrete mixing station delivered the silica fume, which conformed with ASTM C 1240 [21]. The characteristics of silica fume are listed in Table 2. (provided by the supplier).

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Table 1 : Physical and Chemical characteristics of cement

property	OPC	SRC 42.5	CEM III 42.5 (50% blast)
Fineness	3260	3358	4350
Specific gravity	3.15	3.15	3.15
Soundness (expansion)	0.5mm	1mm	1mm
Silica dioxide (SiO2)	21.45%	20.4	30.27
Aluminum oxide (Al2O3)	5.8%	4.1	8.45
Iron oxide (Fe2O3)	3.6%	4.78	2.39
Calcium oxide (CaO)	63.63%	62.9	49.7
Magnesium oxide (MaO) %	1.4%	1.21	3.85
Sulphur trioxide (SO3) %	3.17%	1.73	1.47
Moisture % – Loss due to ignition	4.1	3.5	1.3
Compressive strength at 28 days	56.8Mpa	44.5Mpa	47.7Mpa

Table 2: Characteristics of the Employed Silica Fume

Component	Percentage %
SiO_2	89.25
Moisture	0.2
Free CaO	0.14
L.O.I	2.61
Cl-	0.036

3.1.2 Fine Aggregate

Through the fine sample preparation, the aggregate utilized was natural siliceous sand with specific gravity (S.S.D.) of 2.631. Fine aggregate was devoid of contaminants and organic substances with a fineness modulus of 3.6. The results of the sieving analysis test conducted in line with ESS No. 1109/2002 [24] and the data are provided in Table 3. Additionally, Fig. 1 displays the fine aggregate sieving curve. The light weight particales (%) was 0.01. The chemical analysis of sand was recorded in table 4.

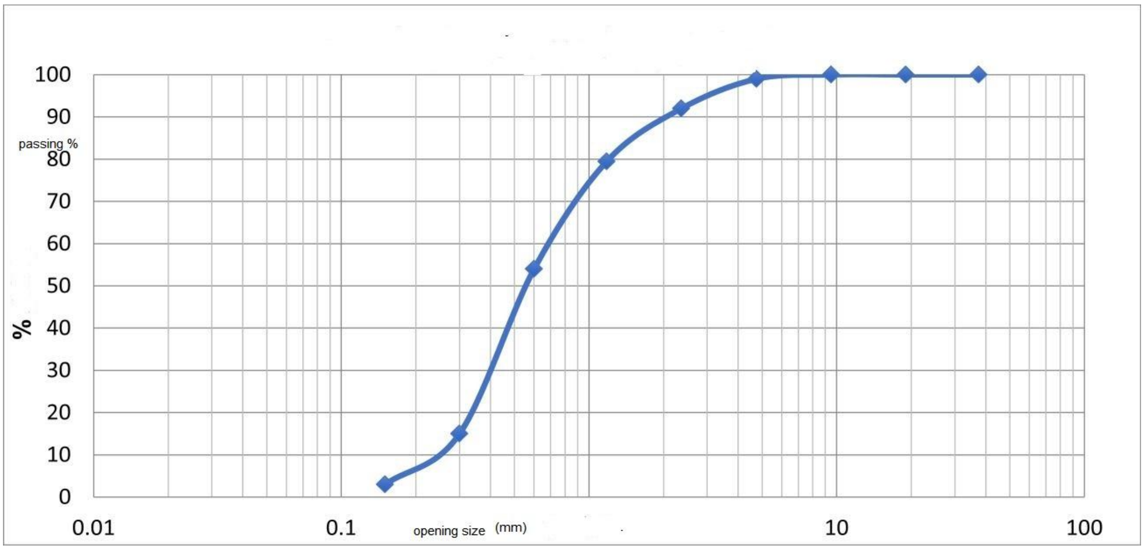


Figure1. Sieve Analysis of Sand

Table 3: Sieve Analysis Test Results for Fine Aggregate

Sieve size (mm)	37.5	19	10	4.75	2.36	1.18	0.6	0.3	0.15
% passing	100	100	100	99	92.7	79.5	54	11.9	3.8

Table 4: Chemical analysis of Fine Aggregate

No	**Compound**	**Results**	**Limits**	**Specifications**
1	Chlorides (%)	0.05	Not more than 0.06%	BS 812 part 117
2	Sulphates (%)	0.17	Not more than 0.3%	BS 812 part 1178
3	PH	7.75	----	
4	Soundness (Na_2SO_4)	2.18%	Not more than 10%	ASTM C88

3.1.3 Dolomite

Three types of dolomite aggregate were involved (Type 1 was mainly dolomite (Ataqa), the second was fossiliferous dolomite limestone (Galala), and the third (Wadi al Natroon) was siliceous limestone aggregate). The particles had a maximum size of 19 mm for type 2 and 3 and 14mm for type 1. Specific Gravity of 2.74 for (type 1,2) and 2.63 for type3, water absorption of 2% for type 1, 2, and 1.5% for type3. Sieving analysis was performed in compliance with ESS No. 1109/2002 [24], and Table 5 contains the test findings. Table 6 concluded the chloride, sulphates, and soundness values which were conducted according to Specifications BS 812 part 117 [25], BS 812 part 118 [26], and ASTM C88, respectively [27]. The ESS requirements were confirmed by fine and dolomite aggregate (1101-2002). The three kinds of dolomite are porous, rough, and irregularly shaped. Surfaces of Type 1 were erratic and rough.

Table 5: Sieving analysis test results for coarse aggregate

Type	**Sieve size (mm)**	**50**	**37.5**	**19**	**14**	**10**	**5**	**2.36**
1	% passing	100	100	100	95.6	72.5	3.1	0.3
2		100	100	100	93.6	51.8	2.44	0.45
3		100	100	100	85.5	25.8	7.3	0.3

Table 6: Chloride content and Soundness of dolomite

Type of Dolomite	**Acid Soluble Sulphate SO3-**	**Chloride Content As Cl-**	**Soundness (Na_2SO_4)**
Type 1	0.01	0.02	1.8%
Type 2	0.019	0.011	1.79%
Type 3	0.15	0.011	1.78%

3.1.4 Water and High-Range Water Reducer

The tested specimens were mixed and cured using potable tap water. Table 7 indicates the results of tests conducted on water.Polycarboxylic High Range Water Reducer (HRWR) from BASF Construction Chemicals (Master Rheobuild 1100) was used [28]. Master Rheobuild 1100 which complying with BS EN 934-2 is composed of synthetic polymers, the performance test data was recorded in Table 8.

Test	result	Egyptian Code Limits
Chloride (CI-)	107	Not more 500 (ppm)
Sulphates SO_3	103	Not more 300 (ppm)
TDS	390	Not more 2000 (ppm)
pH	7,01	Not less 7

Table7: Water Tests Results

Aspect	Dark brown free flowing liquid
Relative Density	1.2± 0.02 at 25℃
PH	≥ 6
Chloride Ion content	< 0.2%

Table 8: Performance Test Data of Master Rheobuild 1100

3.2 Mixing process, specimen preparation

Egyptian code and ASTM standards were used to design the mixes and test program. Nineteen mixes of SCC were used to cast the specimen. Mixes containing different types of dolomite and different type of cement with and without adding silica fume. Group 1, consists of 9 mixes the content of cement was 450 kg/m^3 and (W/C) = 0.40. While in Group (2), which also consists of 9 mixes, the cement composition was 450 kg/m^3 and (W/C) = 0.38, and the silica fume was 50kg/m^3. One mix was prepared to compare the effect of silica fume with 450kg/m^3 cement content, silica fume of 25kg/m^3, and (W/C) = 0.38. For each mix, 9 cubes (15Ox150x150 mm) were prepared. The details of the mixed ingredients will be shown in Tables 9 and 10.

Table9: Concrete Mix Proportion for Specimen

Mix	Cement	Water	Sand	Dolomite	Silica Fume /m^3	Admixture (HRWR)

Mix1	475 kg	190 lit	820 kg	820 kg	0	18L
Mix2	450 kg	190 L	797 kg	797 kg	50kg	19.25L
Mix3	475 kg	190 lit	820 kg	820 kg	25kg	18L

Table 10 : Mix Details

Mix	Symbol	Dolomite type	Cement type
Mix1	A1	Type 1	CEMI 52.5
	G1	Type 2	
	W1	Type3	
	A2	Type 1	CEM III 42.5
	G2	Type 2	
	W2	Type3	
	A3	Type 1	SRC 42.5
	G3	Type 2	
	W3	Type3	
Mix 2	A4	Type 1	CEMI 52.5
	G4	Type 2	
	W4	Type3	
	A5	Type 1	CEM III 42.5
	G5	Type 2	
	W5	Type3	
	A6	Type 1	SRC 42.5
	G6	Type 2	
	W6	Type 3	
Mix 3	A7	Type 1	CEMI 52.5

3.2.1. Specimen preparation

Each batch's dry ingredients were weighed and blended using a mechanical concrete mixer. To guarantee the homogeneity of the ingredients, the water was combined with the additives and cement or cement filler for 30 sec. Simultaneously, sand was delivered to the mixer and mixed for 30 sec, accompanied by dolomite aggregate and another 2 minutes of mixing. Fresh concrete for SCC was evaluated for slump flow (flowability), passingability, and propensity for segregationby using slump flow experiment of the freshly mixed SCC [29].

Standard slump cone (200 x 100 x 300 mm) was filled with cement and needed both the time (T50 cm) for concrete to achieve a 500 mm slump flow radius and the mean diameters D of the spread lifting the cone, as seen in Figure 2. The average measured Slump flow diameter was recorded in Table 10. Figure 3 showed casted cubes.

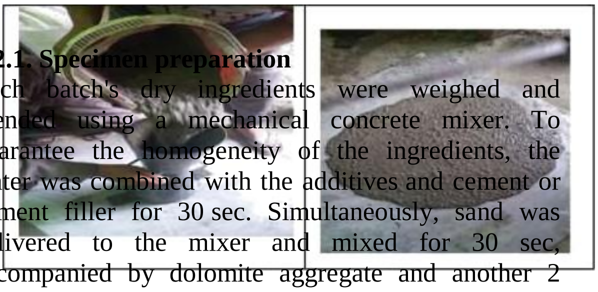


Figure. 2: Slump Flow Test Pouring

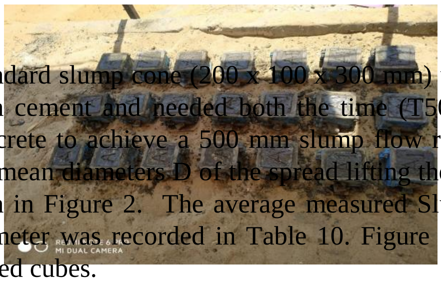


Figure 3:Specimen after the pouring

Table 11: The experimental outcomes of the Slump flow test

Mix Code	Cement type	Dolomite type	Slump flow	T 50 (min)

			diameter (mm)	
A1	CEMI 52.5	Type 1	700	2.65
G1		Type 2	710	2.17
W1		Type3	700	1.65
A2	CEM III 42.5	Type 1	700	2.18
G2		Type 2	700	1.98
W2		Type3	620	3.11
A3	SRC 42.5	Type 1	700	1.8
G3		Type 2	700	1.7
W3		Type3	700	1.78
A4	CEMI 52.5	Type 1	680	2.9
G4		Type 2	640	2.9
W4		Type3	700	2.8
A5	CEM III 42.5	Type 1	650	3.6
G5		Type 2	690	2.8
W5		Type3	700	2.2
A6	SRC 42.5	Type 1	660	3.9
G6		Type 2	700	2.7
W6		Type3	630	3.9
A7	CEMI 52.5	Type 1	700	2

Compression test was carried out according to ECCS 203-2003 appendix 3, parts 7-2 and 7-3 for checking the hardened concrete. The hardened concrete samples were continuously stored in water (20 ± 2 ^{o}C) until the days of testing. Figure 4 shows standardized cubes (150 x 150 x 150 mm) of the concrete mixture were made to assess compressive strength at ages 28, 180, and 365 days.

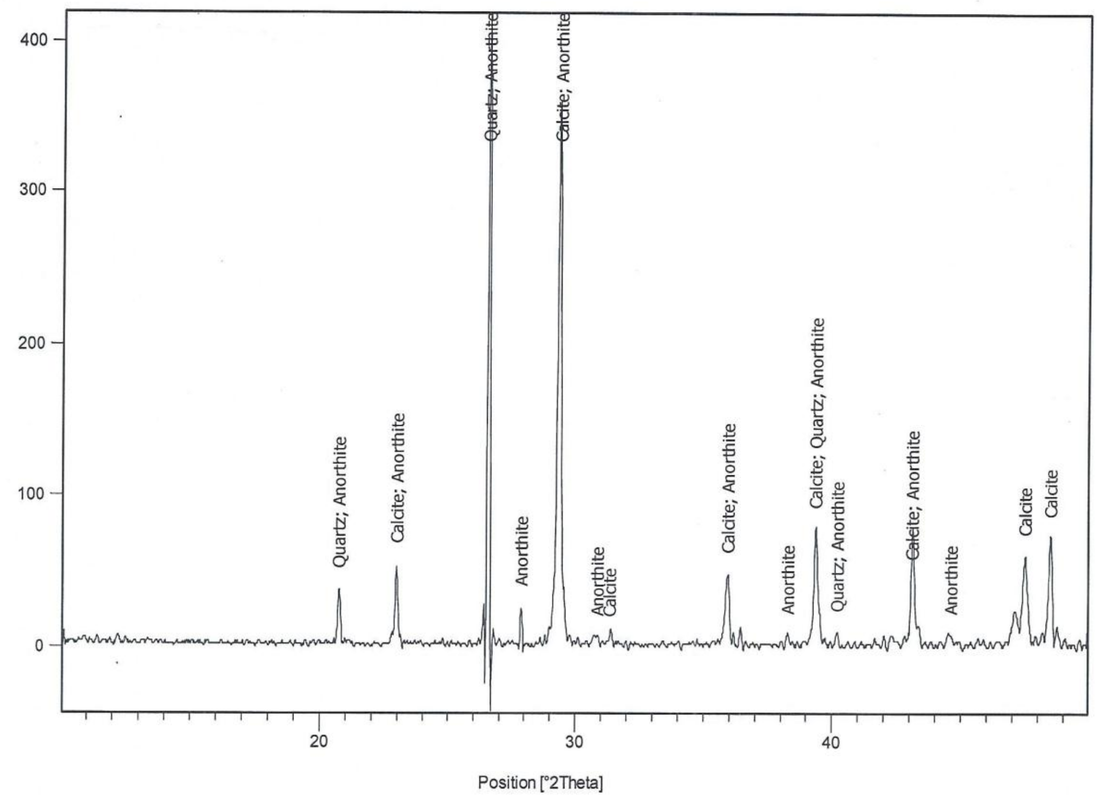
Figure 4: Compression Test Machine

4. Text on Natural Dolomite

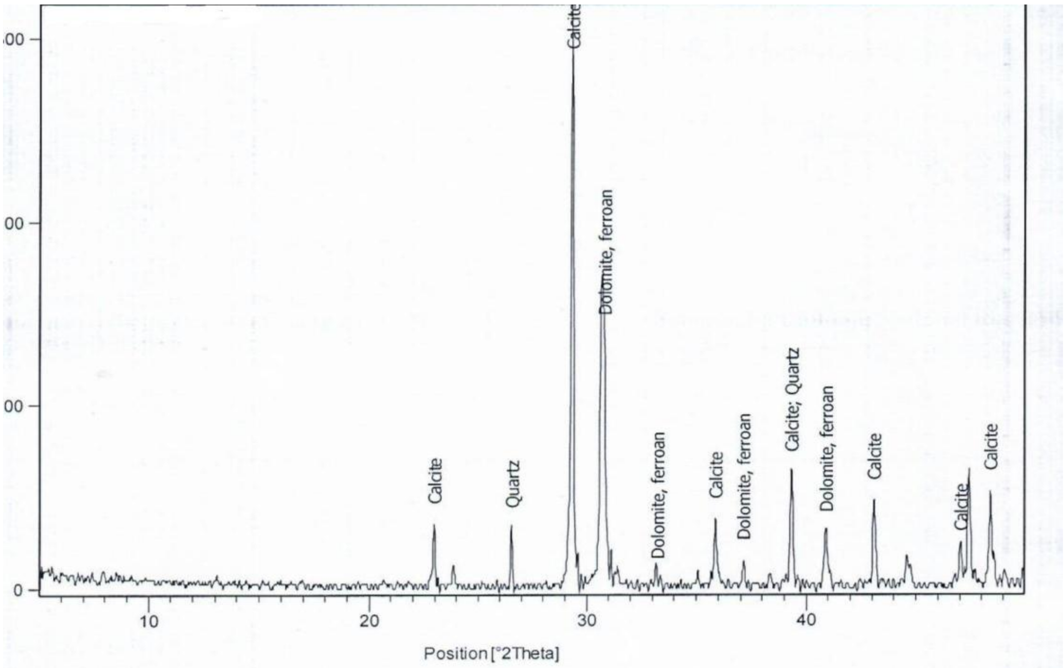
To find the difference between the three dolomite samples from three different quarries which helps in results explanation, the samples were tested under two tests the Xray diffraction and the Petrographical Studies

4.1 X-Ray Diffraction

The X-ray diffraction (XRD) examinations were conducted using A Philips X-Ray Diffraction instrument model (*PW/1710*) with Monochromator, Curadiation (A=1.542A) at 40 KV, 30 MA, and scanning speed 0.02° *Isec*. The reflection spectra were obtained between 28 =2° and 60°, and their spacing (d, A) and relative intensities (I/10). We got the reflection peaks between 28 =2° and 60°, their spacing (d, A), and relative intensities (I/10). The collected data from the diffractometer were evaluated. Using International Center for Diffraction Data Base (ICDD) files, diffraction graphs and relative spectra are collected and compared [30]. The results are illustrated in Table 12 and Figure 5.



A:Type1



B: :Type2

Figure.5: X-ray of Dolomite

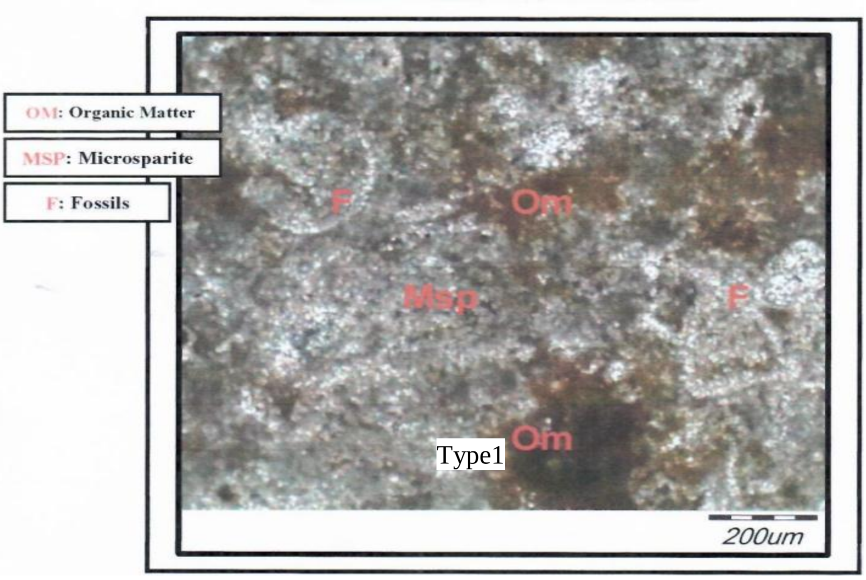
Table 12 : Chemical Composition of dolomite

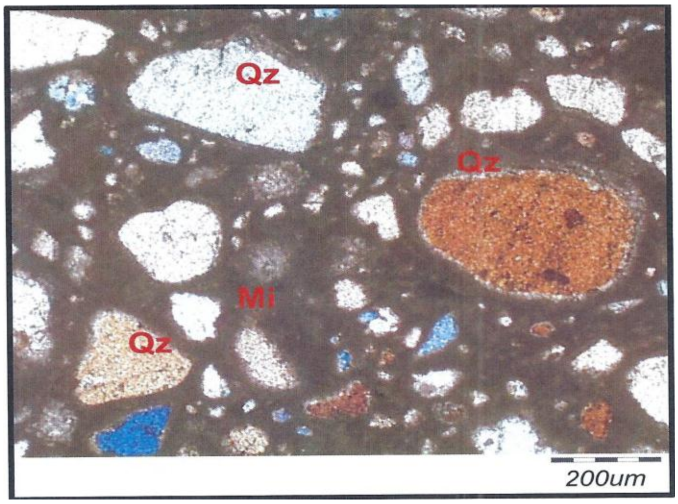
Type of Dolomite	Compound name	Chemical Formula
Type3	Calcite	$Ca\ CO_3$
	Quartz	Sio_2
	Anorthite	$(Ca_{0.94}Na_{0.06})$ $Al_2Si_2O_8$
Type 2	Calcite	$Ca\ CO_3$
	Dolomite, ferroan	$Ca\ (Mg,\ fe)\ (CO_3)_2$
	Quartz	Sio_2
Type 1	Dolomite	$CaMg(CO_3)_2]$
	Calcite	$Ca\ CO_3$
	Quartz	Sio_2

4.2 Petrographical Studies

The test was done following the American Society for Testing and Materials (ASTM) C-295 and ASTM Cards, the findings of the test reflected that the studied sample of dolomite (Ataqa) was dolomite with the major mineral constituent (about 90.3% of the whole sample) associated with minor amounts of calcite and rare amounts of quartz, iron oxides, opaques and clay minerals. The second sample (Galala) aggregate was composed mainly of fine calcite crystals represented the background of the studied fabric. In addition, relict of fossils embedded in a carbonate micritic matrix (lime-mud). Mostly, there is unnoticeable evidence of dolomitization action. Immurate dolomite crystals were recognized in the texture as a result of beginning of dolomization process. The main texture of the studied sample was called packed biomicrite texture as shown in Figure 6.

The third sample: Wadi Al Natroon aggregate was composed essentially of fine mecritic calcitet in addition to medium to coarse angular, monocrystalline and polycrystalline quartz grains. It can be observed presence of organic matter content. The main texture of studied sample is porphyrotopic texture [24]. Figure 6 shows the composition of sample.





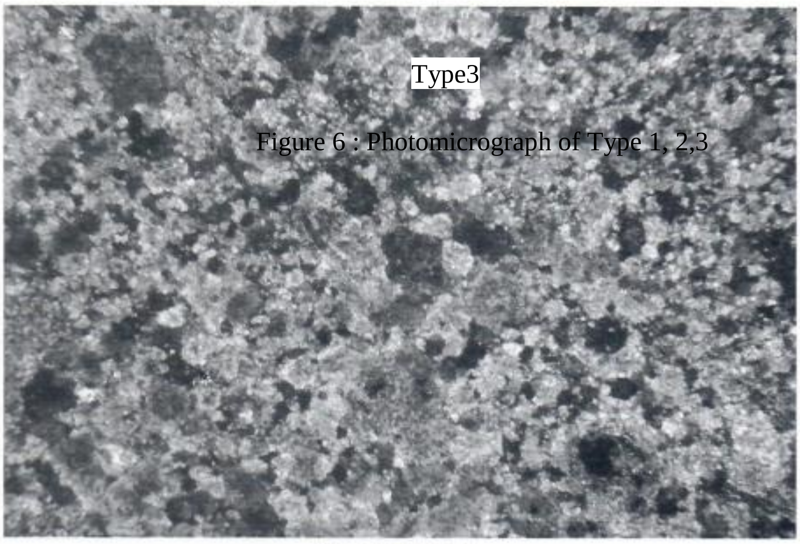
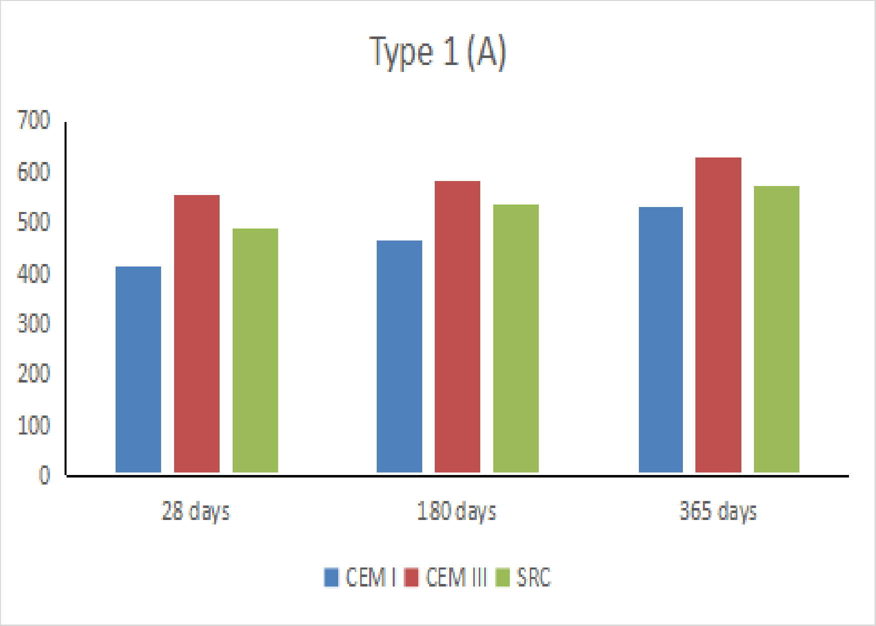


Figure 6 : Photomicrograph of Type 1, 2,3



From the X -ray diffraction and Petrographical Study, it was clear that sample 1 was microscopically, dolomite is the major mineral constituent (about 90.3% of the whole sample) associated with minor amounts of calcite and rare amounts of quartz, iron oxides, opaques and clay minerals. Sample2: Fossiliferous dolomite limestone aggregate, while sample 3 was silicous limestone aggregate.

5. Results and Discussion

5.1 .Fresh concrete

The SCC characteristics, such as flowability, passing ability, and segregation resistance, were determined by slump flow. Generally, it was investigated that silica fume elevated the T50 and decreased the diameter D. As the silica fume percentage decreases, the time T50 increases.

5.2. Hardened concrete

5.2.1 Effect of cement type

Figures 7, 8, and 9 show the cement types' impact on the compressive strength of concrete cast with three types of aggregate. All of the concrete specimens' compressive strength improved with age, as predicted.

In aggregate type 1, it was observed that, using of CEM III 42.5 cement recorded the highest compressive strength values compared to CEM I and SRC 42.5. At 28 days, the increases recorded was 33% and 13%. At 180 days, the increase was 22.2%, and 10%. At 360 days, 7%, and 12.9%, when compared to CEM I,and SRC. According to aggregate type 2, at 28 days, the increases recorded was 36.55% and 13%. At 180 days, the increase was 12%, and 10%. At 360 days, 11.4%, and 13%, when compared to CEM I, and SRC.Type 3, at 28 days, the increases recorded was 13% and 9%. At 180 days, the increase was 26.2%, and 13.3%. At 360 days, 24.4%, and 13%, when compared to CEM I,and SRC.

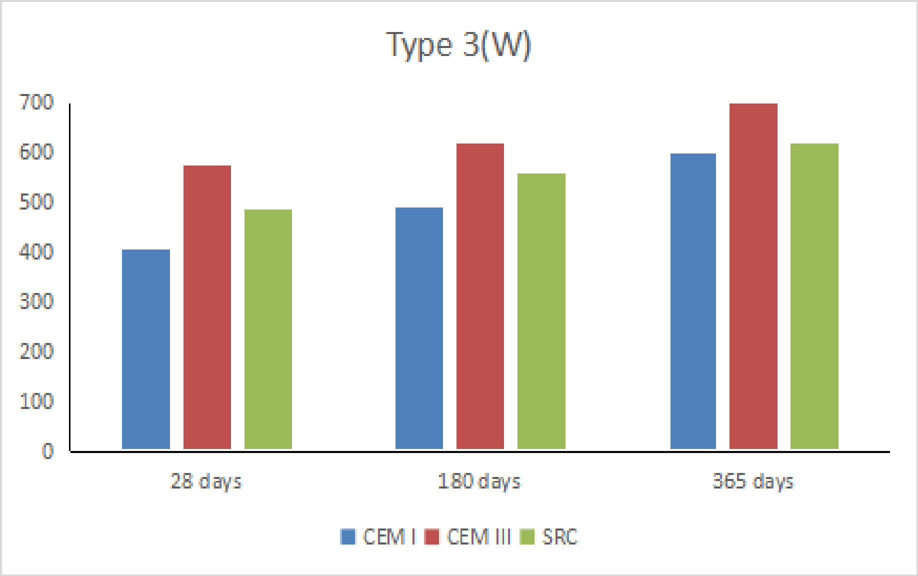


Figure 7: The influence of Cement Type on Compressive Strength of Aggregate Type 1

Figure 8: The influence of Cement Type on Compressive Strength of Aggregate Type 2

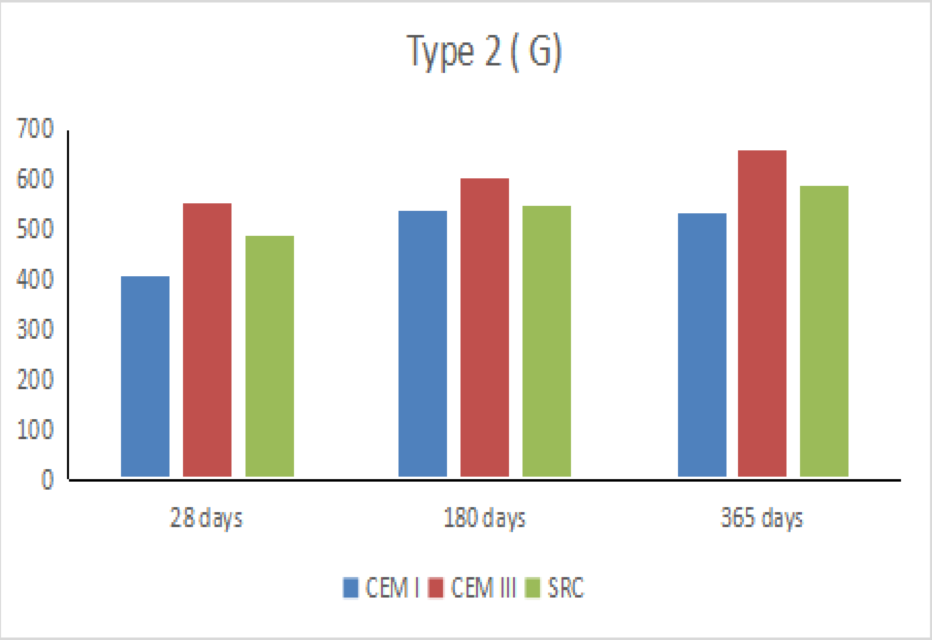


Figure 9: The influence of Cement Type on Compressive Strength of Aggregate Type 3

The results were agreed with Ghazy, M.F [14] who illustrated that by using dolomite aggregate, the increase in compressive strength when using BFC cement recorded were 16.9 % and , 4.3 % compared to OPC cement.

5.2.2 Effect of Dolomite Aggregate Type

According to figures 10, 11 and 12. The use of aggregate type1 (A) indicated increases in compressive strength compared to aggregate type 2 and type 3 when using any type of cement. Type 1 recorded the highest compressive strength, while type days, the increases recorded was slight, while at 180 days, the increase was 20.4%, and 13%. At 360 days, the increment was 12.7%, when compared to type 2 and type3.The increment was the same according to type 1 and 2 compared to type3 nearly 5% when SRC and CEM III cement were used.

The results were agreed with Ghazy, M.F [14]who illustrated that by using dolomite aggregate, the increase in compressive strength when using BFC cement recorded were 16.9 % and , 4.3 % compared to OPC cement.

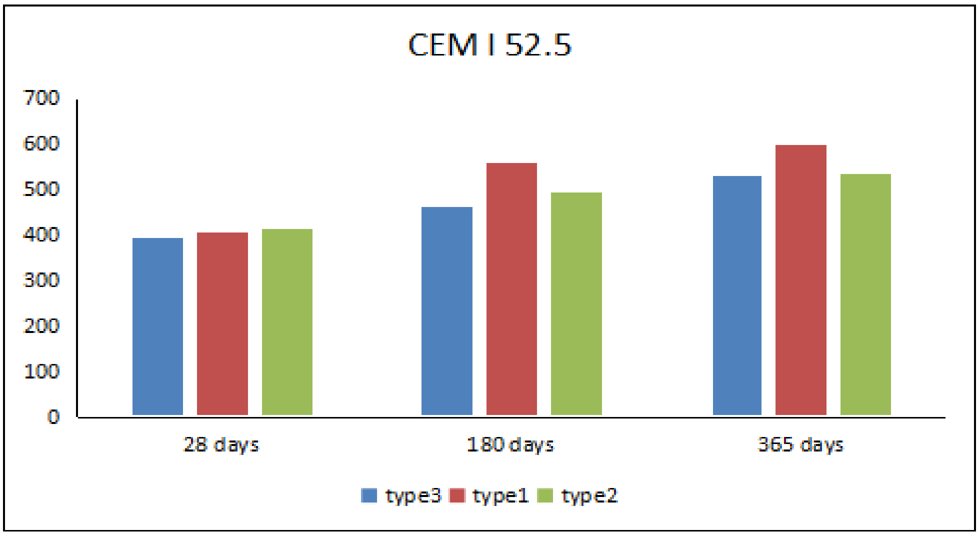


Figure 10: The influence of Aggregate Type on Compressive Strength of CEM I

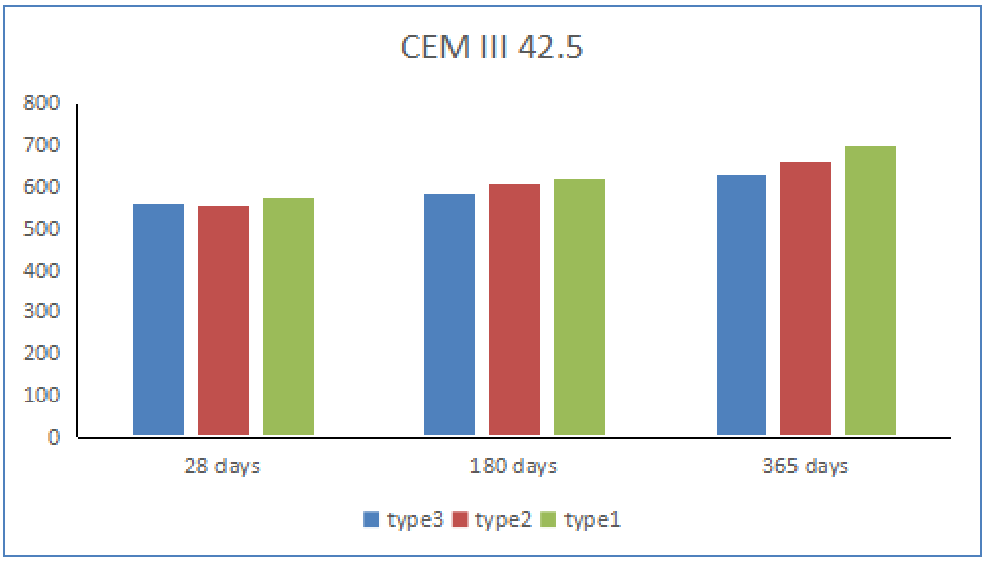


Figure 11: The influence of Aggregate Type on Compressive Strength of CEM III

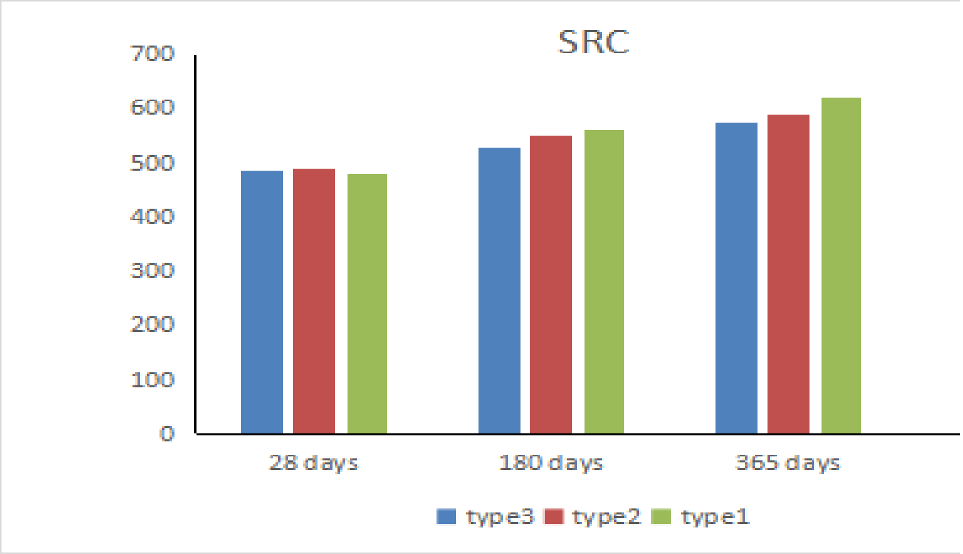


Figure 12: The influence of Aggregate Type on Compressive Strength of SRC

Aitcin et al. [25] who investigated the effect of three different coarse aggregates in superplasticized concrete mixtures with identical materials and properties (w/c: 0.24). They discovered that the 91-day compressive strengths of calcareous limestone aggregate (85% calcite), dolomitic limestone aggregate (80% dolomite), and quartzitic-gravel aggregate including schist were 93,103, and 83 MPa, respectively. In addition, they determined that due to the interfacial reaction impact, the bonding of aggregate cement paste was stronger in limestone aggregate than in gravel concretes.

5.2.3 .Effect of silica fume

From results illustrated in figures 13, 14, and 15, it was found that adding silica fume decreased compressive strength. That was at any type of cement or aggregate. This result was found in research by Ghazy, M. [14]. She recorded that adding silica fume to dolomite aggregate decreased the compressive strength, but using silica fume powder was better with gravel than dolomite. The results agreed with Bhanja and Senjupta [26], in which raising the silica fume level to 16% by weight of cement increases the compressive strength at ages 7, 28, and 90 days by about 20.59%, 21.74%, and 25%, respectively.

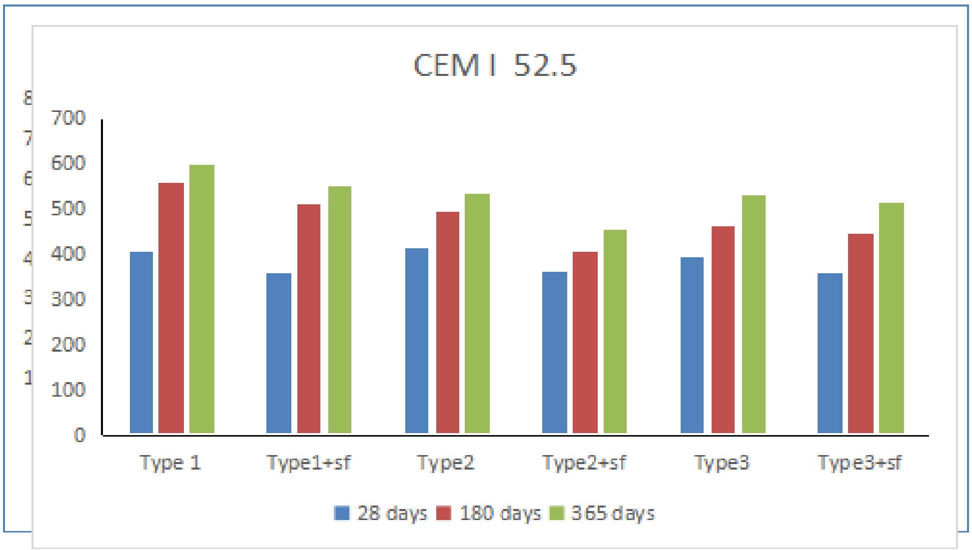


Figure 13: The Effect of Silica Fume on Compressive Strength of CEMI

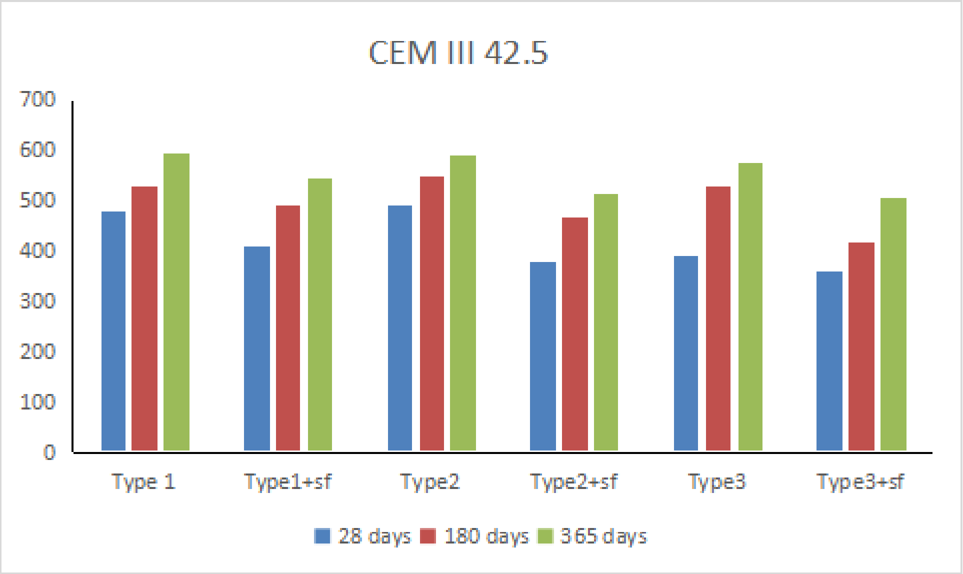


Figure 14: Effect of Silica Fume on Compressive Strength of CEMIII

Figure 15: Effect of Silica Fume on Compressive Strength of SRC

CONCLUSION

From this study program, the research outcomes may be derived:

1- At all ages, Type 1 dolomite aggregates had the maximum compressive strength compared to Type 2 and Type 3 aggregates in self-compacting concrete.

2- Cement CEMIII42.5 was the best compressive strength values compared to OPC and SRC.

3- Silica fume increased the compressive strength for all cement types

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