COMPARATIVE ANALYSIS OF COMPRESSIVE STRENGTH OF CONCRETE USING THREE DIFFERENT ADMIXTURES

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A thesis submitted to the Department of Civil Engineering in partial fulfillment for the degree of science in Civil Engineering

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Section: 26A

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DECLARATION

It is hereby declared that this thesis/project or any part of it has not been submitted elsewhere for the award of any degree or diploma.

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Dedicated

to

"Our Parents"

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ABSTRACT

This study was carried out to evaluate the effect of chemical admixtures on the compressive strength of concrete. All concrete mixes were prepared with a mix ratio of 1:1.5:3, while water to cement (w/c) ratios of 0.39 were adopted. Different concrete mixtures were produced using three chemical admixtures (Fosroc Auramix 300_QCDB-615, Sika Plast 2029 NS BD, and CasTech LRPS 3000.S.) applied at the rate of 0.8% (weight of the cement), during the production process. Laboratory results of the fine aggregate used for the concrete production showed that it was well graded and met international standards. All the concretes were produced and tested in accordance with American Society for Testing and Materials (ASTM) standard procedures. Results indicated that the concrete produced with the chemical admixtures showed better concrete performances both in the fresh and hardened state. After 28 days of casting, concrete produced with Fosroc Auramix 300 QCDB-615 admixture had the best compressive strength (4655 Psi), compared with the compressive strength of the concrete produced with the Sika Plast & CasTech admixture (4438 Psi & 4293Psi), and the control concrete samples that had compressive strength of 4000 Psi. In addition, the fresh concrete produced with chemical admixtures gave a better slump than the fresh concrete produced without any chemical admixture. Likewise, Fosroc Auramix 300 QCDB-615 admixture performs better among the three admixtures used, given a more linear relationship between the slump and water/cement ratio. These results showed the importance of chemical admixtures when higher compressive strength becomes a vital factor in structural construction.

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CHAPTER 1

Introduction

1.1 General

Concrete is one of the most widely used construction materials, known for its strength, durability, and versatility. The compressive strength of concrete is a critical property that determines its ability to withstand axial loads without failure. It is a key factor in ensuring the safety and stability of structures such as buildings, bridges, and highways.

1.1.1 Compressive Strength of Concrete

Compressive strength refers to the capacity of a material or structure to resist axial load or compression. In concrete, this strength is typically measured in Mega Pascal (MPa) or pounds per square inch (psi). The compressive strength of concrete depends on several factors, including the water-to-cement ratio, curing conditions, the type and proportion of aggregates, and the mix design.

1.1.2 Role of Chemical Admixtures

Chemical admixtures are substances added to concrete in small quantities during mixing to modify its properties. These admixtures play a significant role in enhancing various aspects of concrete performance, such as workability, setting time, durability, and most importantly, its strength. By improving the quality of the mix, chemical admixtures can improve the compressive strength of concrete.

1.1.3 Impact of Chemical Admixtures on Compressive Strength

When used in appropriate quantities, chemical admixtures can significantly improve the compressive strength of concrete. The combination of admixtures with the right proportions of cement, water, and aggregates can result in a concrete mix that is not only stronger but also more durable, with reduced permeability and better resistance to environmental factors.

In summary, chemical admixtures provide a means to enhance the compressive strength of concrete by optimizing hydration, improving workability, controlling setting times, and enhancing durability. Their use allows for more efficient, cost-effective, and sustainable construction practices, making them indispensable in modern concrete technology.

1.2 Objective

The objectives of the thesis are as follows

- To evaluate and compare the compressive strength of concrete containing three different chemical admixtures at various curing ages.
- To identify the admixture that provides the highest compressive strength under identical mix and curing conditions.

1.3 Organization of The Thesis

Typically, a thesis contains the following chapters: an introduction; a literature review; a description of methodology; a report and discussion of results; and conclusion.

Chapter 1: Introduction

This chapter provides the background and motivations of the research. The overall objectives and expected outcomes are also described in this chapter.

Chapter 2: Literature Review

This chapter reviews the related works in the concrete strength test field with a special focus on chemicals.

Chapter 3: Methodology

This chapter describes the methodology adopted to carry out the research.

Chapter 4: Results

This chapter describes the collected date and time of different materials for our research work.

Chapter 5: Conclusion

This chapter summarizes the conclusions

Chapter 6: Limitations and Recommendations

This chapter presents the contributions of this study limitation and provides recommendations for future studies.

CHAPTER 2
LITERATURE REVIEW

2.1 General

The compressive strength of concrete is one of the most important properties that determine its structural performance. Various factors influence the compressive strength of concrete, including its mix design, water-cement ratio, curing conditions, and the use of admixtures. Chemical admixtures are added to concrete to enhance specific properties, such as workability, setting time, durability, and ultimately, strength. This literature review focuses on the impact of different chemical admixtures on the compressive strength of concrete, analyzing recent research findings.

2.2 Types of Chemical Admixtures

Chemical admixtures are typically categorized into several groups based on their purpose and effect on the concrete mix.

2.2.1 Water-Reducing Admixtures (Plasticizers)

These admixtures reduce the water content in a concrete mix without altering its workability. By reducing the water-cement ratio, they help to improve the compressive strength. They are especially useful in high-strength concrete and in mixtures where a low water-cement ratio is required. [2]

2.2.2 Superplasticizers (High-Range Water Reducers)

These are more potent than standard plasticizers and can significantly reduce the water content while maintaining or increasing workability. Superplasticizers have been shown to improve the compressive strength of concrete by enhancing the density and reducing the porosity of the hardened material. [1]

2.2.3 Retarding Admixtures

These slow down the setting time of concrete, allowing more time for mixing, transporting, and placing. While they may initially reduce the early-age compressive strength, their influence on long-term strength can be beneficial by allowing the hydration process to occur more uniformly. [5]

2.2.4 Accelerating Admixtures

These admixtures are used to speed up the setting and hardening process. They are often used in cold weather to ensure that concrete sets and gains strength rapidly. However, their impact on the long-term compressive strength can be variable, and excessive use may reduce durability. [3]

2.2.5 Air-Entraining Admixtures

These admixtures introduce tiny air bubbles into the concrete, which helps improve the freeze-thaw resistance. While air entrainment may decrease compressive strength slightly, it enhances durability in certain environments, making it valuable for exposure to harsh weather conditions.

2.2.6 Shrinkage-Reducing Admixtures

These reduce the shrinkage of concrete during curing, helping to minimize cracking. While these admixtures primarily affect the dimensional stability and durability of concrete, their impact on compressive strength is usually indirect. [7]

2.3 Factors Influencing the Effectiveness of Admixtures

The impact of chemical admixtures on the compressive strength of concrete depends on several factors.

2.3.1 Mix Design

The proportions of cement, water, aggregates, and admixtures significantly affect how each admixture influences the final compressive strength.

2.3.2 Curing Conditions

Proper curing is critical for the hydration of cement. The presence of admixtures can either enhance or inhibit the curing process, thus affecting the final strength.

2.3.3 Type and Quantity of Admixture

The type of admixture (e.g., superplasticizer vs. accelerator) and the dosage used will determine its effects on strength. Excessive or improper dosages may have a detrimental effect on the concrete's properties.

2.3.4 Environmental Conditions

Exposure to extreme temperatures, humidity, and other environmental factors can alter the effectiveness of admixtures and, consequently, the compressive strength of concrete. [12]

2.4 Conclusions

Chemical admixtures play a vital role in enhancing the compressive strength of concrete, although their effects can vary depending on the type of admixture and the conditions under which they are used. Water-reducing and super plasticizing admixtures generally provide the most significant improvements by reducing the water-cement ratio, thereby increasing density and reducing porosity. However, other types of admixtures, such as retarders and accelerators, have more nuanced effects on the compressive strength, with their influence varying based on curing conditions and the specific mix design.Future research should focus on the long-term effects of admixtures on compressive strength and durability, as well as on developing more sustainable admixtures that can reduce environmental impact without compromising performance. Additionally, the interaction between various admixtures, particularly in high-performance concrete, warrants further investigation to optimize their combined effects on the properties of concrete.

CHAPTER 3
METHODOLOGY

3.1 General

Concrete methodology refers to the systematic and scientific approach to producing concrete that involves the selection and characterization of materials, mix design, mixing, transportation, placement, curing, testing, and quality control. The methodology is designed to produce high-quality concrete with the desired properties for various construction applications, including strength, durability, workability, and consistency. By following a well-defined methodology, concrete producers can ensure that the concrete they produce meets the required specifications and standards and is suitable for its intended use.

3.2 Material Characterization:

Aggregates, cement, and water, should be characterized for their chemical and physical properties, including particle size distribution, specific gravity, and chemical composition.

3.2.1 Stone Chips

We use them hard enough to resist wear and tear and maintain their shape and size over time. 10 and 20 mm size stone chips were used for concrete and we wash them very well.

3.2.2 Cement

We use the PCC (Portland Composite Cement) Cement. Our cement was mixing clinker 80%-94%, B.F. Slag fly Ash, Limestone 6% - 20% and gypsum 0%-5%.

3.2.3 Sand

We collect the sand with a fineness modulus of 2.0 to 2.5 is commonly used for concrete production. Then we sieve the sand.

3.2.4 Chemical

3.2.4.1 Fosroc Auramix 300_QCDB-615

Fosroc Auramix 300 QCDB-615 is a liquid chemical admixture used to improve workability and strength of concrete.

Method of Application:

Charge cement & aggregates to concrete mixer as per mix design & mix in dry state for 1-2 minutes. Start adding 75-80% mixing water & mix for 2-3 minutes. Add Fosroc Auramix 300_QCDB-615 as per dosage with remaining gauging water & add to concrete mixer & mix for another 2 minutes. Place the concrete or apply plaster as needed. Cure the applied mortar or concrete as per standard construction practices.

Application Area:

Foundation, beams, slabs, columns, reinforced concrete structures, precast elements, pavements, industrial floors, water tanks, staircases, boundary walls, balcony, culvert, general construction works.

3.2.4.2 Sika Plast 2029 NS BD

Sika Plast 2029 NS BD is a normal-setting plasticizing admixture used to improve workability and reduce water demand of concrete.

Method of Application:

Charge cement & aggregates to concrete mixer as per mix design & mix in dry state for 1-2 minutes. Start adding 75-80% mixing water & mix for 2-3 minutes. Add Sika Plast 2029 NS BD with remaining gauging water & add to concrete mixer & mix for another 2 minutes. Place the concrete or apply plaster as needed. Cure the applied mortar or concrete following good construction practices.

Application Area:

Foundation, beams, slabs, columns, floor slabs, precast elements, staircases, water tanks, pavements, brickwork mortar, plastering, balcony, culvert, general reinforced concrete works.

3.2.4.3 CasTech LRPS 3000.S

CasTech LRPS 3000.S is a liquid chemical admixture used to improve workability, reduce water content and enhance strength of concrete.

Method of Application:

Charge cement & aggregates to concrete mixer as per mix design & mix in dry state for 1-2 minutes. Start adding 75-80% mixing water & mix for 2-3 minutes. Add CasTech LRPS 3000.S with remaining gauging water & add to concrete mixer & mix for another 2 minutes. Place the concrete or apply plaster as needed. Cure the applied mortar or concrete as per normal construction practices.

Application Area:

Foundation, beams, slabs, columns, reinforced concrete structures, precast elements, industrial floors, pavements, water tanks, staircases, balcony, culvert, general concrete works.

Mixing rules

Use 200 ml super strength for each 50 kg/1 bag of cement. The dosage of application could be little or more as per requirement.

Figure 3.1 : Auramix, Sika Plast, CasTech

3.3 Mix Proportion and Preparation

The mix proportion refers to the ratio of the components in the concrete. It can be designed either by weight or volume, with the most common method being weight-based. The main aim is to achieve the desired strength, workability, and durability for a specific application.

The proportion of materials typically consists of:

Cement (Binding material)

Fine aggregate (Sand)

Coarse aggregate (Gravel or crushed stone)

Water (For hydration)

Admixtures (To modify specific properties)

Concrete mix ratio like 1:1,5:3 (cement: sand: coarse aggregate) for M20 grade concrete, but the specific proportions vary depending on the requirements.

3.3.1 Data Collection

Figure 3.2 : Sieve Analysis

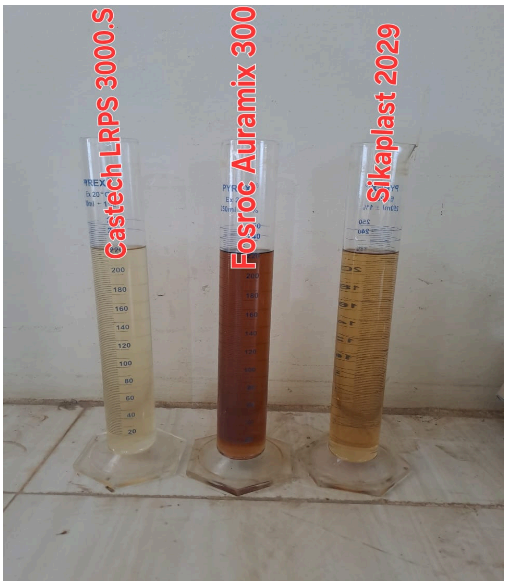

Figure 3.3 : Three Item Admixture

Figure 3.4 : Weighing

Figure 3.5 (a) :Cylinder Making Preparation

Figure 3.5 (b) : Cylinder Making Preparation **Figure 3.6 : Cylinder Casting**

Figure 3.7 : Cylinder Curing

Figure 3.8 (a) : Cylinder Crushing

Figure 3.8 (b) : Cylinder Crushing

3.3.2 Testing of mechanical properties

The mechanical properties of the concrete are evaluated, including its compressive strength, tensile strength, and flexural strength. The tests are conducted according to relevant standards, such as ASTM or ISO

CHAPTER 4

Results & Discussion

Table 4.1 Bulk Density (Unit Weight) of Coarse Aggregate (ASTM C 29/C 29M)

CONCRETE RESEARCH LABORATORY

Bulk Density (Unit Weight) of Coarse Aggregate (ASTM C 29 /C 29M)

Name of Sample : 20mm Downgrade Lime Stone. **Date of Test: 10-11-2025**

1. Unit Weight (Wet Loose)

SL No	Determination	Unit	Sample No			Average Unit Weight kg/cft
			1	2	3	
1.00	Weight of Measure	kg	8.66	8.66	8.66	**44.26**
2.00	Weight of Measure Filled with Aggregate	kg	53.12	52.76	52.83	
3.00	Net Weight of Aggregate	kg/cft	44.46	44.10	44.23	**Average kg/m³**
4.00	Unit Weight of Aggregate	kg/m³	1570.10	1557.39	1561.98	**1563.16**

2. Unit Weight (Wet Rodded)

SL No	Determination	Unit	Sample No			Average Unit Weight kg/cft
			1	2	3	
1.00	Weight of Measure	kg	8.66	8.66	8.66	**46.94**
2.00	Weight of Measure Filled with Aggregate	kg	55.84	56.05	54.92	
3.00	Net Weight of Aggregate	kg/cft	47.18	47.39	46.26	**Average kg/m³**
4.00	Unit Weight of Aggregate	kg/m³	1666.16	1673.58	1633.67	**1657.80**

Table 4.2 Bulk Density (Unit Weight) of Fine Aggregate

ARMCL CONCRETE RESEARCH LABORATORY

Bulk Density (Unit Weight) of Fine Aggregate

Name of Aggregate: Sylhet Sand **Date of Test: 10-11-2025**

1. Unit Weight (Wet Loose)

SL No	Determination	Unit	Sample No			Average Unit Weight kg/cft
			1	2	3	
1.00	Weight of Measure	kg	8.62	8.62	8.62	**38.94**
2.00	Weight of Measure Filled with Aggregate	kg	48.04	46.99	47.64	
3.00	Net Weight of Aggregate	kg/cft	39.42	38.37	39.02	**Average kg/m³**
4.00	Unit Weight of Aggregate	kg/m³	1392.12	1355.04	1377.99	**1375.05**

2. Unit Weight (Wet Rodded)

SL No	Determination	Unit	Sample No			Average Unit Weight kg/cft
			1	2	3	
1.00	Weight of Measure	kg	8.62	8.62	8.62	**41.79**
2.00	Weight of Measure Filled with Aggregate	kg	49.92	50.57	50.74	
3.00	Net Weight of Aggregate	kg/cft	41.30	41.95	42.12	**Average kg/m³**
4.00	Unit Weight of Aggregate	kg/m³	1458.51	1481.46	1487.47	**1475.81**

Table 4.3 Sieve Analysis of Coarse (20 mm Down) Aggregates

CONCRETE RESEARCH LABORATORY

Seive Analysis of Coarse (20 mm Down) Aggregates

Name of Sample : 100% Imported Dubai Stone (10-20 mm) **Date of Test : 10-Nov-25**

Sieve Size	Weight Retained (gm)	Cumulative Retained	Cumulative Percent of Retained %	Percent of Passing %	ASTM Limit C33-93
25	0	0	0.00	100.00	100
19	492	492	9.84	90.16	90-100
12.5	2154	2646	52.92	47.08	40-70
9.5	1297	3943	78.86	21.14	20-55
4.75	1022	4965	99.30	0.70	0-10
2.36	18	4983	99.66	0.34	0-5
Pan	17	5000	100.00	0.00	
Total	5000				

Table 4.4 Specific Gravity & Water Absorption of Coarse Aggregate (ASTM C-128)

SPECIFIC GRAVITY & WATER ABSORPTION OF COARSE AGGREGATE (ASTM C-128)

Sample condition	S.S.D	Date of Testing	10-Nov-25

Observation		Weight(gm)
Weight of Pycnometer	W1	197
Weight of Pycnometer+Stone	W2	1197
Weight of Pycnometer+Stone+ water	W3	3821
Weight of Pycnometer+water	W4	3189
Weight of Oven Dry Stone	W5	995

#Specific Gravity (Bulk)	=	2.704
#Specific Gravity (S.S.D)	=	2.717
#Specific Gravity (Apparent)	=	2.741
#Water Absorption of F.A	=	0.5 %

Table 4.5 Sieve Analysis Of Fine Aggregate (ASTM C-136)

CONCRETE RESEARCH LABORATORY SIEVE ANALYSIS OF FINE AGGREGATE (ASTM C-136)								
Weight of Sample	**500**	**gm**		**Date of Testing**	**10-11-25**			
US STD. SIEVE SIZE	**SIEVE OPENING (mm)**	**WEIGHT OF RETAINED (gm)**	**PERCENT RETAINED BY WEIGHT**	**CUMULATIVE PERCENT RETAINED**	**PERCENT PASSING**	**ASTM C33 LIMIT**		**REMARKS**
						LOWER LIMIT	**UPPER LIMIT**	
	9.5	0	0	0	100	***100***	***100***	
No. 4	4.75	7.4	1.5	1.5	98.5	***95***	***100***	
No. 8	2.36	26.6	5.3	6.8	93.2	***80***	***100***	
No. 16	1.18	82.8	16.6	23.4	76.6	***50***	***85***	
No. 30	0.6	119.8	24	47.3	52.7	***25***	***60***	
No. 50	0.3	134.6	26.9	74.2	25.8	***10***	***30***	
No. 100	0.15	108	21.6	95.8	4.2	***2***	***10***	
Pan		20.8						
Fineness Modulus (FM) = 2.48								

Determination of Silt Content			
OBSERVATION SHEET			
Siral No	**DESCRIPTION**	**SAMPLE NO**	
		Sample -1 (ml)	**Sample -2 (ml)**
1	**Volume of Sample (V1) ml**	165	144
2	**Volume of Silt (V2) ml**	7	6
3	**Percentage of Silt (V2/V1) * 100**	**4.24**	**4.17**
	Average	**4.2**	

Table 4.6 Trial Mix Summary (CasTech LRPS 3000.S)

Trial Mix Summary (CasTech LRPS 3000.S)							
Master Mix Design for 1 m³							
Strength (PSI)	**Cement Kg/m³**	**WCR**	**Water (Kg/m³)**	**Stone Chips 5-20 mm (Kg/m³)**	**Coarse Sand Kg/m³**	**Admixture Kg/m³**	**Total Weight Kg/m³**
4000	400	0.39	156	1055	765	3.20	2380
1. Cement Type: Portland Composite Cement, CEM-II (A-M)							
2. Coarse Aggregate Type: 100% Crushed Imported Stone Chips (UAE).							
3. Coarse Sand Type: 100% Coarse Sand (Sylhet).							
4. Admixture: CasTech LRPS 3000.S							
5. Condition: Water and Admixture does depend on moisture content & weather Condition.							
Trial Details :	R & D Trial - CasTech LRPS 3000.S + Akij Cement						
Date of Trial :	10-Nov-2025						
Target Strength :	4000 PSI						
Admixture Dose :	0.80%						
Mix Design for Trial Mix- 0.02 m³							
Strength (PSI)	**Cement Kg**	**WCR**	**Water Kg**	**Stone Chips 5-20 mm (Kg)**	**Coarse Sand Kg**	**Admixture Kg**	**Total Weight**
4000	8	0.39	3.12	21.1	15.3	0.064	48
Note: Total Cylinder Making (3 Set)							

Table 4.7 Trial Mix Summary (Fosroc Auramix 300_QCDB-615)

Trial Mix Summary (Fosroc Auramix 300_QCDB-615)

Master Mix Design for 1 m³

Strength (PSI)	Cement Kg/m³	WCR	Water (Kg/m³)	Stone Chips 5-20 mm (Kg/m³)	Coarse Sand Kg/m³	Admixture Kg/m³	Total Weight Kg/m³
4000	400	0.39	156	1055	765	3.20	2380

1. Cement Type: Portland Composite Cement, CEM-II (A-M)
2. Coarse Aggregate Type: 100% Crushed Imported Stone Chips (UAE).
3. Coarse Sand Type: 100% Coarse Sand (Sylhet).
4. Admixture: Fosroc Auramix 300_QCDB-615
5. Condition: Water and Admixture does depend on moisture content & weather Condition.

Trial Details :	R & D Trial - Fosroc Auramix 300_QCDB-615
Date of Trial :	10-Nov-2025
Target Strength :	4000 PSI
Admixture Dose :	0.80%

Mix Design for Trial Mix- 0.02 m³

Strength (PSI)	Cement Kg	WCR	Water Kg	Stone Chips 5-20 mm (Kg)	Coarse Sand Kg	Admixture Kg	Total Weight
4000	8	0.39	3.12	21.1	15.3	0.064	48

Note: Total Cylinder Making (3 Set)

Table 4.8 Trial Mix Summary (Sika Plast 2029 NS BD)

Trial Mix Summary (Sika Plast 2029 NS BD)

Master Mix Design for 1 m³

Strength (PSI)	Cement Kg/m³	WCR	Water (Kg/m³)	Stone Chips 5-20 mm (Kg/m³)	Coarse Sand Kg/m³	Admixture Kg/m³	Total Weight Kg/m³
4000	400	0.39	156	1055	765	3.20	2380

1. Cement Type: Portland Composite Cement, CEM-II (A-M)
2. Coarse Aggregate Type: 100% Crushed Imported Stone Chips (UAE).
3. Coarse Sand Type: 100% Coarse Sand (Sylhet).
4. Admixture: Sika Plast 2029 NS BD
5. Condition: Water and Admixture does depend on moisture content & weather Condition.

Trial Details :	R & D Trial - Sika Plast 2029 NS BD
Date of Trial :	10-Nov-2025
Target Strength :	4000 PSI
Admixture Dose :	0.80%

Mix Design for Trial Mix- 0.02 m³

Strength (PSI)	Cement Kg	WCR	Water Kg	Stone Chips 5-20 mm (Kg)	Coarse Sand Kg	Admixture Kg	Total Weight
4000	8	0.39	3.12	21.1	15.3	0.064	48

Note: Total Cylinder Making (3 Set)

Table 4.9 Compressive Strength Test of Concrete Cylinder (Fosroc Auramix 300_QCDB-615)

Concrete Research Laboratory									
Admixture Brand		:	Fosroc Auramix 300_QCDB-615						
Strength		:	4000 PSI						
Test		:	Compressive Strength Test of Concrete Cylinder (ASTM C39)						
Date of Crushing		:	10-Nov-2025						
Date of Crushing	Specimen Dia (mm)	Specimen Area (mm²)		Machine Load (X) (KN)	Calibrated Actual Load (Y) (KN)	Crushing Strength (Mpa)	Crushing Strength (PSI)	Average Crushing Strength (PSI)	Percentage of Strength Achieved %
	7 DAYS TEST REPORT								
	100.00	7854.0		193.00	182.77	23.27	3374		
	100.00	7854.0		216.00	205.35	26.15	3791		
17-Nov-2025	100.00	7854.0		199.00	188.66	24.02	3483	3550	89%
	14 DAYS TEST REPORT								
	100.00	7854.0		235.00	224.00	28.52	4136		
	100.00	7854.0		223.00	212.22	27.02	3918		
25-Nov-2025	100.00	7854.0		214.00	203.39	25.90	3755	3936	98%
	28 DAYS TEST REPORT								
	100.00	7854.0		255.00	243.64	31.02	4498		
	100.00	7854.0		262.00	250.51	31.90	4625		
08-Dec-2025	100.00	7854.0		274.00	262.29	33.40	4842	4655	116%
Calibration Factor		:	Y= 0.9817X -6.6954		*Combined= Mortar and Aggregate failure.				

Table 4.10 Compressive Strength Test of Concrete Cylinder (Sika Plast 2029 NS BD)

Concrete Research Laboratory									
Admixture Brand		**:**	**Sika Plast 2029 NS BD**						
Strength		**:**	**4000 PSI**						
Test		**:**	**Compressive Strength Test of Concrete Cylinder (ASTM C39)**						
Date of Crushing		**:**						**10-Nov-2025**	
Date of Crushing	**Specimen Dia (mm)**	**Specimen Area (mm²)**		**Machine Load (X) (KN)**	**Calibrated Actual Load (Y) (KN)**	**Crushing Strength (Mpa)**	**Crushing Strength (PSI)**	**Average Crushing Strength (PSI)**	**Percentage of Strength Achieved %**
	7 DAYS TEST REPORT								
17-Nov-2025	100.00	7854.0		169.00	159.21	20.27	2939		
	100.00	7854.0		180.00	170.01	21.65	3139		
	100.00	7854.0		195.00	184.74	23.52	3411	**3163**	**79%**
	14 DAYS TEST REPORT								
25-Nov-2025	100.00	7854.0		214.00	203.39	25.90	3755		
	100.00	7854.0		228.00	217.13	27.65	4009		
	100.00	7854.0		206.00	195.53	24.90	3610	**3791**	**95%**
	28 DAYS TEST REPORT								
08-Dec-2025	100.00	7854.0		251.00	239.71	30.52	4426		
	100.00	7854.0		237.00	225.97	28.77	4172		
	100.00	7854.0		243.00	231.86	29.52	4281	**4293**	**107%**
Calibration Factor		:	Y= 0.9817X -6.6954		*Combined= Mortar and Aggregate failure.				

Table 4.11 Compressive Strength Test of Concrete Cylinder (CasTech LRPS 3000.S)

Concrete Research Laboratory									
Admixture Brand		**:**	**CasTech LRPS 3000.S**						
Strength		**:**	**4000 PSI**						
Test		**:**	**Compressive Strength Test of Concrete Cylinder (ASTM C39)**						
Date of Crushing		**:**						**10-Nov-2025**	
Date of Crushing	**Specimen Dia (mm)**	**Specimen Area (mm²)**		**Machine Load (X) (KN)**	**Calibrated Actual Load (Y) (KN)**	**Crushing Strength (Mpa)**	**Crushing Strength (PSI)**	**Average Crushing Strength (PSI)**	**Percentage of Strength Achived %**
	7 DAYS TEST REPORT								
	100.00	7854.0		206.00	195.53	24.90	3610		
	100.00	7854.0		192.00	181.79	23.15	3356		
17-Nov-2025	100.00	7854.0		181.00	170.99	21.77	3157	**3374**	**84%**
	14 DAYS TEST REPORT								
	100.00	7854.0		211.00	200.44	25.52	3701		
	100.00	7854.0		224.00	213.21	27.15	3936		
25-Nov-2025	100.00	7854.0		201.00	190.63	24.27	3519	**3719**	**93%**
	28 DAYS TEST REPORT								
	100.00	7854.0		250.00	238.73	30.40	4407		
	100.00	7854.0		261.00	249.53	31.77	4607		
08-Dec-2025	100.00	7854.0		244.00	232.84	29.65	4299	**4438**	**111%**
Calibration Factor		:	Y= 0.9817X -6.6954		*Combined= Mortar and Aggregate failure.				

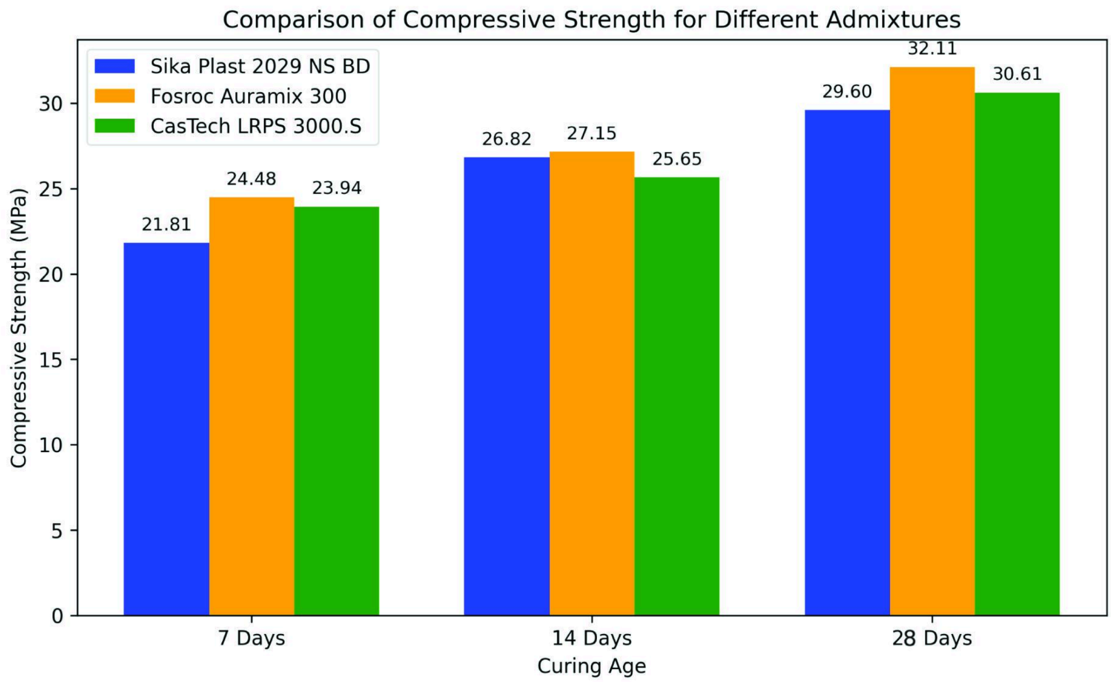

Figure 4.1 : Bar chart showing comparison of compressive strength

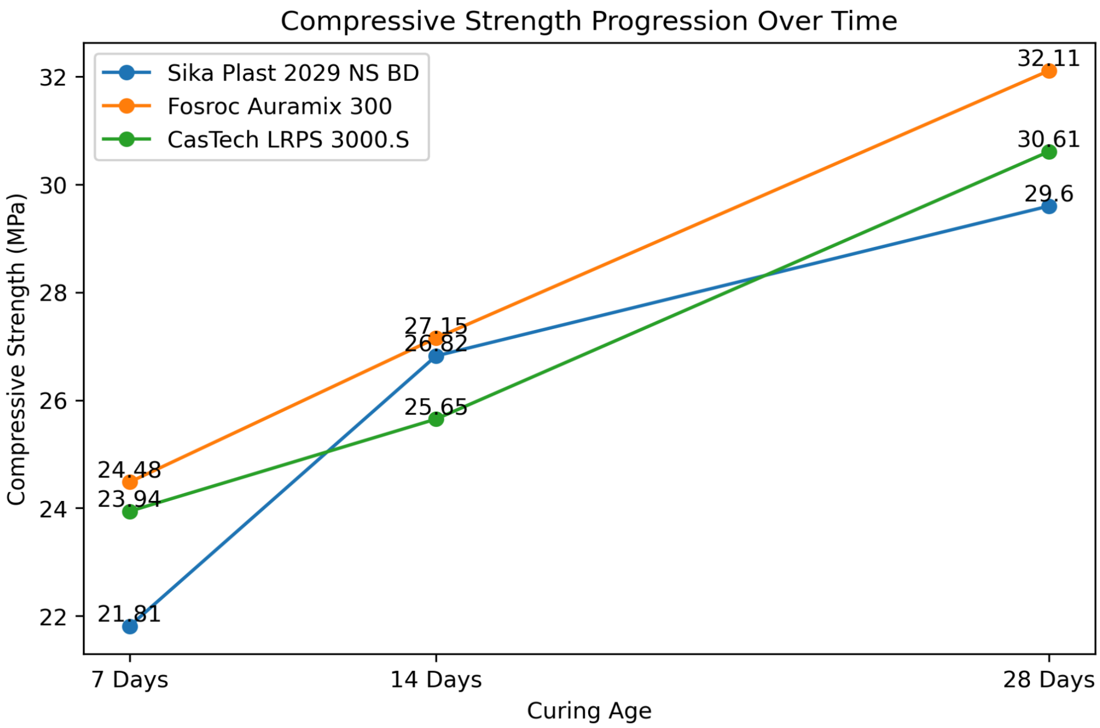

Figure 4.2 : Compressive Strength Trend Chart

CHAPTER 5
Conclusions and Future Works

5.1 Conclusions

Based on the experimental investigations conducted in this study, the following specific conclusions can be drawn:

1. The use of chemical admixtures significantly improves the compressive strength of concrete compared to normal concrete without admixtures.

2. Among the chemical admixtures tested, Fosroc Auramix 300 QCDB-615 provided the highest enhancement in compressive strength.

3. Superplasticizers effectively increase workability and reduce the water-cement ratio, leading to higher compressive strength.

4. Retarders are useful in hot weather to delay setting time, although they may slightly reduce early strength.

5. Proper selection of admixtures, along with accurate mix design and dosage control, is essential for achieving optimal concrete performance.

5.2 Limitations

Despite the findings, the study has some limitations:

1. The effect of chemical admixtures on compressive strength may vary with different cement types, aggregate sources, and environmental conditions.

2. Some chemical admixtures may react with cement or other components, potentially reducing strength if not properly dosed.

3. The study focused only on compressive strength; other properties such as flexural strength, durability, shrinkage, and creep were not evaluated.

4. Use of chemical admixtures increases cost and may complicate the mix design, requiring careful handling and quality control.

5.3 Recommendations

Based on the study findings and limitations, the following recommendations are suggested for future work and practical application:

1. Select chemical admixtures carefully based on project requirements, environmental conditions, and desired concrete properties.

2. Ensure proper mixing and curing to achieve the maximum strength of chemically modified concrete.

3. Implement strict quality control during production, including accurate dosing of admixtures and monitoring of mix consistency.

4. Conduct further studies on long-term durability, flexural strength, shrinkage, and creep of concrete containing chemical admixtures.

5. Consider combining chemical and non-chemical admixtures to optimize concrete performance under various construction conditions.

REFERENCES

[1] A. Chajec, Granite powder vs. fly ash for the sustainable production of air-cured cementitious mortars, Materials (Basel) 14 (2021) 1–26, https://doi.org/10.3390/ma14051208

[2] A.A. Shubbar, H. Jafer, A. Dulaimi, K. Hashim, W. Atherton, M. Sadique, The development of a low carbon binder produced from the ternary blending of cement, ground granulated blast furnace slag and high calcium fly ash: an experimental and statistical approach, Constr. Build. Mater. 187 (2018) 1051–1060, https://doi.org/10.1016/j.conbuildmat.2018.08.021

[3] A.A. Phul, M.J. Memon, S.N.R. Shah, A.R. Sandhu, GGBS And fly ash effects on compressive strength by partial replacement of cement concrete, Civ. Eng. J. 5 (2019) 913–921, https://doi.org/10.28991/cej-2019-03091299

[4] A. Torres, L. Bartlett, C. Pilgrim, Effect of foundry waste on the mechanical properties of portland cement concrete, Constr. Build. Mater. 135 (2017) 674–681, https://doi.org/10.1016/j.conbuildmat.2017.01.028

[5] A.R. Khaloo, M. Dehestani, P. Rahmatabadi, Mechanical properties of concrete containing a high volume of tire-rubber particles, Waste Manag. 28 (2008) 2472–2482, https://doi.org/10.1016/j.wasman.2008.01.015

[6] D.M. Cotsovos, M.N. Pavlovi'c, Numerical investigation of concrete subjected to compressive impact loading. Part 2: parametric investigation of factors affecting behaviour at high loading rates, Comput. Struct. 86 (2008) 164–180, https://doi.org/10.1016/j.compstruc.2007.05.015

[7] E. Benhelal, G. Zahedi, E. Shamsaei, A. Bahadori, Global strategies and potentials to curb CO2 emissions in cement industry, J. Clean. Prod. 51 (2013) 142–161, https://doi.org/10.1016/j.jclepro.2012.10.049

[8] F. Farooq, A. Akbar, R.A. Khushnood, W.L.B. Muhammad, S.K.U. Rehman, M.F. Javed, Experimental investigation of hybrid carbon nanotubes and graphite nanoplatelets on rheology, https://doi.org/10.3390/ma13010230.

[9] H. Yan, Q. Shen, L.C.H. Fan, Y. Wang, L. Zhang, Greenhouse gas emissions in building construction: a case https://www.fhwa.dot.gov/pavement/concrete/trailer/resources/MCTC_Water_Reduction.pdf

[10] H. Xiao, Z. Duan, Y. Zhou, N. Zhang, Y. Shan, X. Lin, G. Liu, CO2 emission patterns in shrinking and growing cities case study of Northeast China and the Yangtze River Delta, Appl. Energy. 251 (2019) 113384, https://doi.org/10.1016/j.apenergy.2019.113384

[11] L. Barcelo, J. Kline, G. Walenta, E. Gartner, Cement and carbon emissions, Mater. Struct. Constr. 47 (2014) 1055–1065, https://doi.org/10.1617/s11527-013-0114-5

[12] M. Batayneh, I. Marie, I. Asi, Use of selected waste materials in concrete mixes, Waste Manag. 27 (2007) 1870–1876, https://doi.org/10.1016/j.wasman.2006.07.026

[13] M. Li, H. Hao, Y. Shi, Y. Hao, Specimen shape and size effects on the concrete compressive strength under static and dynamic tests, Constr. Build. Mater. 161 (2018) 84–93, https://doi.org/10.1016/j.conbuildmat.2017.11.069

[14] R. Kajaste, M. Hurme, Cement industry greenhouse gas emissions - Management options and abatement cost, J. Clean. Prod. 112 (2016) 4041–4052, https://doi.org/10.1016/j.jclepro.2015.07.055

[15] S. Czarnecki, M. Shariq, M. Nikoo, L. Sadowski, An intelligent model for the prediction of the compressive https://doi.org/10.1016/j.measurement.2020.108951