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HIGH-STRENGTH CONCRETE MIX DESIGN USING VARIOUS ADMIXTURES ANDEVALUTION OF PROPERTIES

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ABSTACT

Portland cement, water, coarse and fine aggregates, and admixtures are used to make concrete. Obtaining an appropriate ratio of diverse concrete elements with the needed qualities at a cheaper cost is the art of proportioning a concrete mix for a given purpose. The main difference between high-strength and normal-strength concrete is compressive strength. High-strength concrete has a compressive strength of up to 100Mpa, as opposed to regular concrete, which has a compressive strength of less than 40Mpa. A low water-cement ratio is essential, which can be accomplished by introducing chemical admixtures like as plasticizers. A mineral admixture includes. Shrinkage and heat development of hydration behavior that favors durability. The project centers on the creation of high compressive strength with the proper combination of elements. When it comes to the construction of high-rise structures and bridges, high-strength concrete offers various benefits. Many nations use conventional aggregates and cement to build concrete with strengths more than 40 MPa. Chemical and mineral admixtures have become an integral component of high strength concrete production. Normal strength concrete is currently utilized in reinforced concrete building in Sri Lanka. As the present trend of high-rise structures and the usage of precast concrete continues, the need for high-strength concrete in Sri Lanka will increase. A high range water reduction additive currently available on the market was utilized to lower the water/cement ratio of the concrete mixes while maintaining appropriate workability. Combining locally yielded compressive strengths of up to 65 MPa.

Key word: admixtures, high-strength, workability

1. INTRODUCTION:

1.1 GENERALINTRODUCTION:

What is the high strength of concrete?

- It is, as the name implies, high-strength concrete that can sustain compressive pressures of up to 100MPa.
- Traditional-method concrete can have strengths of up to 40 MPa.
- Admixtures are utilised in the production of high-strength concrete.
- The water-cement ratio is low.

- Particle packing that is dense; the strategy is to employ admixtures to create a high-strength concrete mix.
- Depending on building industry advances, the definition of high-strength concrete evolves throughout time and place.
- ACI report 363R-84 classifies concretes with strengths more than 40 MPa as HSC. Many nations now make commercial concrete with strengths in the 50-60 range, and 80 MPa may be utilised as the lower limit for HSC.

1.2 OBJECTIVE OF STUDY

• To gain knowledge of material evolution, production processes, mechanical qualities, and applications [1-10].

• To look into the functions of admixtures [11-25].

• Be familiar with the principles of high-strength concrete.

• Creating a concrete mix with strength more than 40MPa.

3. METHODOLOGY

Method Used:

- Trial and error method
- Target strength; 50Mpa

1. High strength is attained when particle packing is dense with few vacancies; this necessitates a large paste volume

2. A rich blend is employed.

3. Mineral and chemical mixes are employed.

4. Two batches of concrete were made: one without superplasticizer and one with.

Important Criteria:

1. High Strength Concrete

2. Low Water Binder Ratio

3. Proper Mix for Minimum Void

4. Rich Mix With Additions Of Minerals Binder

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INGREDIENTS OF HSC

- Chemical and mineral admixtures are employed in addition to traditional concrete constituents in figure 1.
  The following are the ingredients:

Ingredients	Size/Grade
Cement	OPC 53 Grade
Fly Ash	Class-F
Fine Aggregates	2.36mm
Coarse Aggregates	10 mm
Coarse Aggregates	20 mm
Water	Portable
Plasticizer	Auramix-400
Marble Dust	2.36 mm

Fig 1. Ingredients of High Strength Concrete

Admixtures:

- Admixtures are used to alter the characteristics of both new and hardened concrete.

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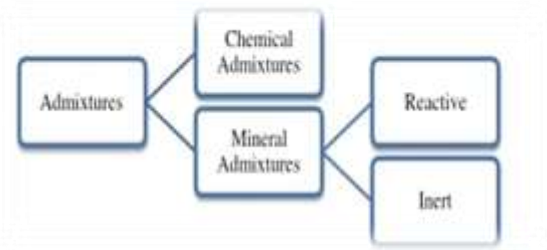
Types of admixtures:

Admixtures Used



Chemical Admixtures	**Mineral Admixtures**
Super plasticizer	Fly Ash
Poly carboxylic acid	Marble Dust

Super plasticizer:

- Model number: Auramix-400 (FOSROC)
- Aura mix 400 is a blend of the most recent generation super plasticizers, based on a poly carboxylic acid polymer with long lateral chains that allows for water reduction while still providing high workability.

How Super Plasticizer Works:

- Cement particles generate floes, which trap water. • If this trapped water could be freed, the flow ability of concrete would increase.
- Super plasticizer has the same effect. The super plasticizer is absorbed by the cement particles and creates a thin layer around them.
- Negatively charged particles are now repulsive to each other.
- As a result, the cement particles will deflocculate and the imprisoned water will be freed. This water will improve the concrete's flow qualities.
- The use of a super plasticizer allows for water reduction in this manner.

4. EXPERIMENTAL PROCEDURE

- In this study, a wide number of concrete mixes with goal strengths more than 40 N/mm were chosen based on mix proportions described in the literature and the recommendations provided by the DoE technique for normal concrete.

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- For these mixtures, laboratory specimens (standard cubes) were cast from locally accessible materials and evaluated for 7 and 28 day strength.
- For concrete grades 40 and 50, the DoE technique was utilised. Initially, no admixtures were used in the trial mixes, but subsequently chemical admixtures were introduced to lower the w/c ratio and increase workability.
- No cement additives were utilised because to their non-availability and exorbitant pricing**.**

Trail 1: In the investigation, ordinary Portland cement of grade 53 according to IS 12269- 1987 is employed. As coarse material, crushed angular granite metal from a nearby source was employed. 2.74 is the specific gravity. Fine aggregates with rounded particle shapes and smooth textures require less mixing water in concrete and are thus preferred in high strength concrete. High strength concrete generally has such high concentrations of fine cementitious elements that the fine aggregate grading is negligible. However, increasing the fineness modulus is occasionally beneficial since a lower fineness modulus of fine aggregate can give the concrete a sticky consistency and a higher water demand.

As a result, sand with a Fineness modulus of around 3.0 is typically recommended for HSC (ACI 363R, 1992). The fineness modulus of fine aggregate was computed for numerous samples in this study, and one sample was chosen, with the fine aggregate having a fineness modulus value of 3.0. Concrete is utilized for a wide range of functions to make it appropriate for a variety of circumstances. Ordinary concrete may fail to provide the requisite quality performance or durability under these conditions. Admixture is used in such instances to adjust the qualities of conventional concrete to make it more suited for any condition. During the selecting process, dependable performance on prior projects should be taken into account.

5. RESULTS AND DICUSSIONS

- The previous data indicate the results of experimental combinations. The results show that the w/c ratios calculated using the charts of the British approach (DoE technique) for both grade 40 and grade 50 concretes were insufficient. The method worked. Not only that, but it lacks the necessary workability. The water/cement ratio for Grade 40 concrete mixtures is Because of the 0.45 ratio, Mixes 1 and 2 had low strengths. The targeted amount of strength was Mixes 3, 4, and 5 were created using a lower w/c ratio of 0.42 and resources sourced locally.
- The resulting combinations appeared to be dry and only suitable for mould vibrators. According to the test results, a cement content of 450 kg/nr' or higher and a water content of 190 kg/m" were sufficient to produce the required strength. Grade 40 concrete. A sufficiently high workability was obtained without segregation. Rheobuild 1000, a high range water decrease, was used in Mix 5 (super plasticizer)

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- Mixes 6 to 12 had cement concentrations ranging from 475 to 558 kg/m", and Mixes 6 to 9 were intended for Grade 50 concrete. Mix 6's high cement and water concentrations did not generate the desired strength or workability. The reduced cement content employed in Mixes 7, 8, and 9 with lower w/c ratios and the water lowering additive, on the other hand, produced good results for Grade 50 concrete.
- Mixes 10, 11, and i2 did not yield the predicted strength based on the mix proportions indicated in the literature. The use of extremely high cement concentrations in Mixes 10 and 11 did not result in a substantial improvement in strength.
- Despite aggregate particle failure (due to high stress concentrations) in these trial mixes, the aggregate strength of locally available Granite aggregates did not appear to be a concern for the concrete strength levels targeted in this investigation.
- The results also showed that the local resources and cement are sufficient to manufacture Grade 50-60 concrete. However, for such grades of concrete, a w/c ratio of less than 0.35 and the usage of a super plasticizer are required. The additive employed was barely sufficient for Grade 50 concrete. Higher concrete strengths will need the use of a more effective super plasticize.


Compaction by Vibration


Casted Elements


Broken Element


Casted Elements

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3 Day Highest Strength

7 Day Highest Strength

28 Day Highest Strength

Fig 3 After testing of concrete mix

M50 Grade Concrete Mix-Proportion:

Binder(Cement + Fly Ash)	Fine Aggregates	Coarse Aggregates
1	1.30	1.70

Water/Binder Ratio	0.32
Fly Ash	10% replacement of cement content
Marble Dust	10% of binder content
Superplasticizer	1% of binder content

M50 Grade Concrete Mix Design for 1 Cubic Meter:

INGREDIENT	QUANTITY
Cement	540 kg
Fly Ash (Class-F)	60 kg
Sand-1 (2.33 mm)	390 kg
Sand-2 (1.18 mm)	390 kg
C.A. (10 mm)	510 kg
C.A. (20 mm)	510 kg
Water (Portable)	192 liters
Super plasticizer (Auramix 400)	6 kg

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Marble Dust	60 kg

Table 2 Representation of Admixtures

6. CONCLUSIONS

Created high-strength concrete by applying certain admixtures. Fly ash marble dust should be utilized in place of cement in some cases. More paste volume is necessary to attain high strength. A rich mix, with increased binder content and fine particles, should be employed. Lowering the w/c ratio enhanced compressive strength. The use of a superplasticizer allows for a decrease in water content. This blend has a lot of early strength. After only three days, you'll have acquired around half your strength. Formworks and members can be deleted and loaded sooner. Because of the large paste volume, the surface finishing is excellent. In the slump test, collapse was seen. As a result, good self-compaction. The results demonstrate the significance of a low w/c ratio and compact particle packing.

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