# DEVELOPMENT OF COMPRESSIVE STRENGTH AND WORKABILITY OF CONCRETE BY USING ADMIXTURE

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***Abstract:*** ***The aim of paper various types of aggregate and admixture to take higher ultimate compressive strength and workable of concrete .the different types of admixture and aggregate and this imparts different properties to the resulting concrete .the most important properties of concrete is its compressive strength and workability .workability of concrete is defined effort required to manipulate a freshly mixed quantity of concrete with minimum loss of homogeneity .the work focused on concrete mixes having different types of water ñ cement ratio .fine aggregate for different water ñ cement ratio based on trial mixes. This trial indicate if the concrete face produce honey ñcomp the mix having water-cement ratio less than 0.45 so increase water-cement ratio to get more strength and workable concrete .the workability and compressive strength test performed in this research .the experimental result for compressive strength and workability of concrete moderate by using different types water-cement ratio.***

***Keywords****:* Admixture water-cement ratio, strength, aggregate, concrete, fine aggregate, coarse material, cement.

## INTRODUCTION

The workability and compressive strength of concrete depends upon various factor such as ,water-cement ratio, shape of aggreagae,grading of aggregate ,size of aggregate .water serves two function in a concrete mix. Firstly ,it enable chemical reactions which cause setting and hardening to proceed and secondly it lubricates the mixture of gravel, sand cement in order to facilitate placing. concrete can be visualized as a multi-phase composite material made up of three phase namely the mortar ,aggregate interface, and the coarse aggregate phase .the coarse aggregate in normal concrete are mainly from rock fragments characterized by high strength .the concrete can be compacted with specified effort forth coming at the site work. the lubrication required for handing concrete without segregation ,for placing without loss of homogeneity, for compacting with the amount of efforts fourth coming and to finish it sufficiently easily the presence of a certain quantity of water is vital .in this study ,the quality and grading of aggregate in all the mixtures were the same. the main object of this research was to find the workability and strength of concrete .

**Concrete material and their chemical and physical properties**

Cement

Sand

Coarse aggregate

Admixtures

**CEMENT-** the product manufactured by burining and crushing to powder on intimate and well proportioned mixture of calcareous and argillaceous material is called cement. this important building material was first introduced in year 1824 by joseph aspedin,a brick layer of leads in England he discovered that a mixture of slaked lime and clay when heated to high temp and crushed to powder could produce a binding material which would harden in the presence of water .this binding material was named as Portland cement.

**Raw material OF cement**

Calcareous material
Argillaceous material

**Calcareous material-** the material which cantain calcium or limae as their major constitute are known as calcareous material such. Lime stone ,marl,shells etc.

**Argillaceous material-** the material which contain alumina as their major constitute are known as argillaceous material s such as shale,iron oxide ,magnesium oxide.

**Chemical composition of cement**

Since the primary constituents of Portland cement are calcium silicate,we can define Portland cement as a material which cobine cao $sio_2$ in such a proportion that the resulting calcium silicate will react with water at room temperature and under normal pressure .

**Hydration of cement** ñthe chemical reaction between cement and water is known as hydration of cement .this chemical reaction takes place between final compounds of cement i.e tricalcium silicate,dicalcium silicate alumina ferrite and tetra calcium alumina ferrite and water.during hydration of cement,calcium aluminate react first with water as compared to tricalcium silicate aluminate,hydrated

calcium silicate then breaks down to form dicalcium silicate and release the excess lime as calcium hydroxide then the latter precipitates cut in the form of cystal of super satured solution .then both the dicalcium silicate,as originally present and that resulting from hydrolysis,breaking down of $c_3s$ as stated above ,combine directly with water in a process known as hydration and form hydrated calcium silicate .thus owing to high solubility of aluminates in plain water ,trical cium aluminate crystals which are responsible for initial setting of cement.$c_3s$ reacts slowly then $c_3A$ but faster then $c_2s$ .the development of firstly 28 days strength is on account of the hydration of $c_3s$ where as $c_2s$ reacts slowly and takes 2 to 3 year for its complete hydrated and contributes towards ultimate strength of concrete .all these properties of of different compounds of cement are illustrated graphically.

**Types of cement**

- Ordinary Portland cement
- Rapid hardening cement
- Low heat cement
- Blast furnace slag cement
- Sulphate resistant cement
- Air entraining cement
- Coloured cement
- High alumina cement

**Naturally occurring aggregate** - the aggregate obtained from natural deposits of sand and gravel or quarries by cutting rock are called naturally occurring aggregate .these aggregate should ,their actual use specially while preparing concrete for reinforced concrete work

**Artificial or processed aggregate-** The aggregate obtained artificially by breaking brick or blast furnace slag into graded particles of required size are known as artificially occurring or processed aggregate. the most common artificial aggregate are broken brick and air cooled blast furnace slag .broken brick are commonly used for mass concrete works where as blast furnace slag is used for fire resisting concrete work.

**Classification according to size-**

According to size the aggregate are classified into the following three types

- ☐ Coarse aggregates
- ☐ Fine aggregate
- ☐ Oil well cement

Test on **cement**

Fineness test

Soundness

Setting time test

Compressive strength test

**Aggregate** -Aggregate is the broad category of basic material used in Construction, including sand gravel, crushed stone ,slag saw dust, broken bricks etc. its constitutes about 85 % of the volume of concrete .they are chemically inert and forms of mortar and concrete when mixed with cement aggregates do not take part in the various chemical reaction taking place in concrete during setting and hardening of concrete ,thus they are called inert materials. the aggregate are generally used to increase the volume of concrete .they are economical and cheaper than cement .

**Source of Aggregate**

- ☐ Almost all natural aggregate materials originate from bed rocks .

There are three kind of rocks

- ☐ Igneous rock
- ☐ Sedimentary rock
- ☐ Metamorphic rock

**Classification of aggregate**

various aggregate being used for manufacture of concrete are classified.

- According to source
- According to size
- According to shape

**According to source**

Classified into following two types

- ☐ Naturally occurring aggregate
- ☐ Artificial or processed aggregate
- ☐ All-in- aggregate

**Coarse aggregates-** the aggregates which pass through 75mm I.S sieve and entirely retain on 4.75mm I.S sieve are known as coarse aggregate .the maximum particle size of coarse aggregate is 75mm and its minimum particle size is 4.75mm. The aggregate of particle size greater than 75mm is known as cyclopean aggregate. The size of coarse aggregate depends on the type of work and arrangement of reinforcement provided in the concrete

**Fine aggregate** -The aggregate which passing through 4.75mm I.S sieve and retain on 75 micron I.S sieved are known as fine aggregate the maximum particle size of coarse aggregate is 4.75mm and its minimum particle size is 0.075mm.(75micron).the material having particle size ,varying from 0.006 to 0.002 mm termed as silt and that with particle less than 0.002mm is known as as clay. the commonly used fine aggregate are made naturally sand artificial sand. natural sand is obtained from nala beds, river beds and sea beds and is named accordingly viz, nala sand ,river sand and sea sand .artificial is made crushing stone or gravels to powder .

**All in aggregate-** The aggregate containing a proportion of all size of aggregate is known as all-in-aggregate .this types of aggregate comprises of of the material obtained from the pit ,river bed ,quarry or crushing plant in its original .this type of aggregate is used only from un-important works. for important works all-in ñaggregate are sorted out into coarse and fine aggregate by sieving through the standard sieves

(75mm,4.75mm and 75micorn I.S sieved ) which are then graded so as to obtain a dense and strong concrete with less quantity of cement.

Classification according to shape-According to the shapes of their particles, aggregate are classified into the following type.

- Rounded aggregates
- Irregular aggregates
- Angular aggregates
- Flaky aggregate

**Rounded aggregate** -these aggregate have 33% to 35% voids. hence gives more workability. They require lesser amount of water-cement ratio. They are not considered for high strength concrete because of poor interlocking behaviour and weak bond strength.

**Irregular aggregate** - The aggregate of this shape in naturally irregular or partly shaped by attrition and has rounded edges. These aggregate have 35% to 37% voids. These will give lesser workability when compared to rounded aggregates.

**Angular aggregate**-the aggregate of this shape possesses well defined edges formed at the intersection of roughly planer faces. These aggregate have 38% to 41% voids. Hence gives less workability. They give 10-20% more compressive strength due to development of stronger aggregate-mortar bond. So, these are useful in high strength concrete manufacturing.

**Flaky aggregate**-The aggregate of this shape is usually angular and has small thickness as compared to its width or length. These aggregate have the highest percentage of voids.

**Test on Aggregate**

- ☐ Fineness modulus and grain size distribution.
- ☐ Abrasion test
- ☐ Workability of concrete
- ☐ Shape test/ frankness and elongation
- ☐ Impact test
- ☐ Compressive strength test
- ☐ Specific gravity
- ☐ Water absorption
- ☐ Bulk density and voids of aggregate
- ☐ Sieve analysis

**Admixture ñ**is a material which is used in the concrete to modify the property of concrete so that the prepared concrete is suitable in all the situation..Admixtures can be classified by function as follows.

- Air-entraining admixtures
- Water-reducing admixtures
- Plasticizers
- Accelerating admixtures
- Hydration-control admixture
- Corrosion inhibitors
- Shrinkage reducers
- Alkali-silica reactivity inhibitors
- Coloring admixtures
- Miscellaneous admixture such as workability, watertight, wear resistant.

**The major reasons for using admixtures are .**

1. To maintain the quality of concrete during the stages of mixing, transporting, placing, and curing in ad-verse weather conditions.
2. To reduce the cost of concrete construction.
3. To overcome certain emergencies during concreting operations.
4. To achieve certain properties in concrete more effectively than by other means.
5. To accelelerate the rate of setting and hardening of cement and to develop more strength.
6. To retard setting and hardening of concrete.
7. To make the concrete weather ñproof, water-proof and acid-proof i.e resistant to frost action and to chemical attack etc.
8. To reduce bleeding and segregation of concrete without increasing water content
9. To make reduction in the rate which heat of hydration is evolved

**Table; Concrete admixtures by classification**

| Types of admixture | Desired effect | Material |
|---|---|---|
| Air-entraining admixtures | Improve durability in freeze-thaw,deicer,sulfate,and alkali-reactive environments improve workability | Salt of wood resins, some synthetic detergents, salt of suffocated lignin, salt of petroleum acid, salt of proteinaceous material,faty and resinous acid and their salt,alkylbeneze sulfonates,salt of suffocated hydrocarbons |
| Water reducer | Reduce water content at least 5% | Lignosulfonates ,hydroxylated carboxylic acids, carbohydrates,(also tend to retard set so accelerator is often added ) |
| Accelerati | Accelerate | Calcium chloride |

| | | |
|---|---|---|
| ng admixtures | setting and early strength development | chloride triethanolamine,sodium thiocyanate,calcium formate,calcium nitrite, calcium nitrate. |
| Hydration-control admixture | Suspend and reactivate cement hydration with stabilizer and activator | Carboxylic acids,phosphours-cantaining organic acid salt |
| Coloring admixtures | Reduce steel corrosion activity in a chloride-laden environment | Calcium nitrite ,sodium nitrite ,sodium, benzonate,certain phosphates or fluosillicates,fluoaluminates,ester amines |
| Shrinkage reducers | Reduce drying shrinkage | Poyoxyalkylene alkyl ether propylene glycol |
| Superplasterziers | Increase flow ability of concrete water cement ratio | Suffocated melamine formaldehyde condensates,sulfonated naphthalene formaldehyde condensates,lignosulfontes,polycarboxylates |

**Workability**-the concrete is placed in the form works and compacted is termed as the workability of concrete .the concrete when used require a certain degree of workability, higher workability is required if the section are thin and heavily reinforced .the workability of concrete depends on the properties of various ingredients of concrete .

**Factor affecting on workability ñ**

Water content

Shape of aggregate

Size of aggregate

Grading of aggregate

Surface texture of aggregate

Porosity and absorption of aggregate

Air entraining agents

Temperature

**Measurement of workability-the water ñcement ratio is expressed workability of concrete mix measured by various methods**

Compaction factor test

Slump test

Flow test

Vee bee consist meter test

**Slump test of concrete**
**Recommended slup test value varies with the different concrete mixes**

| S.NO | CONCRETE MIXES | SLUMP RANGE IM MM |
|---|---|---|
| 1 | Column Retaining wall | 75-150mm |
| 2 | Beam and Slab | 50-100mm |
| 3 | CC Pavement | 20-30mm |
| 4 | Vibrated Concrete | 12-25mm |
| 5 | Deck of Bridge | 30-75mm |
| 6 | Huge mass Construction | 25-50mm |

**Workability for different purposes and appropriate test values.**

| Placing conditions | Degree of workability | Slump (mm) |
|---|---|---|
| Binding concrete ; Shallow section; Pavement using pavers | Very low | C.F* (0.75 to 0.80) |
| Mass concrete; Lightly reinforced section in slab, Beam,walls,column ; Floor; Hand placed pavements; Canal lining; Strip footings | low | 25-75 |
| Heavily reinforced section in slab Beams,walls,columns,slipfrom work; Pumped concrete | Medium | 50-100 |
| Trench fill; In-situ pilling | High | 100-150 |
| Termie concrete | Very high | Flow in mm |

**CONCLUSION**

- Admixtures are useful in extending the set ting time of concrete but they are often used in attempts to decrease slump loss and extend workability.
- Strength of concrete depends upon the water cement ratio.
- Highest compressive strength achieved to use admixture and containing crushed aggregate, followed by concrete containing grading aggregate.
- Admixture makes it possible to reuse concrete returned in a ready mix truck by suspending setting

overnight. The admixture is also useful in mainlining concrete in a stabilized non-hard-ened state during long hauls.

- Admixture that act to block the capillaries in concrete corrosion in chemically aggressive environments .such admixture designed for use in high-cement content/low ñwater ñcement ration concrete contain aliphatic fatty acid and an aqueous emulsion of polymeric and aromatic globules.
- Use admixture increase the workability of concrete.
- Corrosion inhibitors are used in concrete for parking structure, marine structure and bridge where chloride salt is present. The chloride can cause corrosion of steel reinforcement in concrete .so used admixture by removed corrosion.
- They increase the workability of the concrete without reduing the compressive strength or without changing water cement ratio.this is particularly used when concrete pores are restricted either due to to congested reinforcement or due to thin sections.

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