CHAPTER-3
MATERIALS
3.1 Concrete Making Materials

There are many types of concrete available, created by varying the proportions of the main ingredients below. By varying the proportions of materials, or by substitution for the cement and aggregate phases, the finished product can be tailored to its application with varying strength, density, or chemical and thermal resistance properties. The mix design depends on the type of structure being built, how the concrete will be mixed and delivered, and how it will be placed to form this structure.

3.1.1 Cement

The most common cement used is an Ordinary Portland Cement (OPC). The Ordinary Portland Cement of 43 grade (Jaypee OPC) conforming to IS:8112-1989 is used. Many tests were conducted on cement; some of them are specific gravity, consistency tests, setting time tests, compressive strengths, etc. (IS8112, 2013)

Fig:3.1 JAYPEE Cement (OPC 43 grade)
3.1.2 Water

Water is an important ingredient of concrete as it actually participates in the chemical reaction with cement. Since it helps to from the strength giving cement gel, the quantity and quality of water is required to be looked into very carefully. Water cement ratio used is 0.46 for M20, 0.42 for M25, 0.38 for M30 concretes. Combining water with a cementitious material forms a cement paste by the process of hydration. The cement paste glues the aggregate together, fills voids within it, and allows it to flow more freely. Less water in the cement paste will yield a stronger, more durable concrete; more water will give a free-flowing concrete with a higher slump. Impure water used to make concrete can cause problems when setting or in causing premature failure of the structure. Hydration involves many different reactions, often occurring at the same time. As the reactions proceed, the products of the cement hydration process gradually bond together the individual sand and gravel particles, and other components of the concrete, to form a solid mass.

Reaction:

Cement chemist notation: C₃S + H → C-S-H + CH

Standard notation: Ca₃SiO₅ + H₂O → (CaO).2(SiO₂).H₂O(gel) + Ca(OH)₂

Balanced: 2Ca₃SiO₅ + 7H₂O → 3(CaO).2(SiO₂).4(H₂O)(gel) + 3Ca(OH)₂

3.1.3 Aggregates

Fine and coarse aggregate make up the bulk of a concrete mixture. Sand, natural gravel and crushed stone are mainly used for this purpose. Recycled aggregates (from construction, demolition and excavation waste) are increasingly used as partial
replacements of natural aggregate, while a number of manufactured aggregates, including air-cooled blast furnace slag and bottom ash are also permitted.

The fractions from 20 mm to 4.75 mm are used as coarse aggregate. The Coarse Aggregates from crushed Basalt rock, conforming to IS: 383(1970) are used. Those fractions from 4.75 mm to 150 micron are termed as fine aggregate. The river sand and crushed sand is used in combination as fine aggregate conforming to the requirements of IS: 383. The river sand is washed and screened, to eliminate deleterious materials and over size particles. fine aggregate, coarse aggregate and grit. (IS383, 1970)

Fig: 3.2 Aggregate in open field
3.1.4 Chemical Admixtures

Chemical admixtures are materials in the form of powder or fluids that are added to the concrete to give it certain characteristics not obtainable with plain concrete mixes. In normal use, admixture dosages are less than 5% by mass of cement, and are added to the concrete at the time of batching/mixing. The common types of admixtures are as follows.

i. Accelerators speed up the hydration (hardening) of the concrete. Typical materials used are CaCl$_2$ and NaCl. However, use of chlorides may cause corrosion in steel reinforcements and is prohibited in some countries.

ii. Retarders slow the hydration of concrete, and are used in large or difficult pours where partial setting before the pour is complete is undesirable. Typical polyol retarder is sugar, sucrose, sodium gluconate, glucose, citric acid, tartaric acid and etc.

iii. Air entrainments add and entrain tiny air bubbles in the concrete, which will reduce damage during freeze-thaw cycles thereby increasing the concrete durability. However, entrained air is a trade-off with strength, as each 1% of air may result in 5% decrease in compressive strength.

iv. Plasticizers/Super Plasticizers (water-reducing admixtures) increase the workability of plastic or “fresh” concrete, allowing it to be placed more easily, with less consolidating effort. Typical plasticizers are liginsulphate, polyol type. Alternatively, plasticizers can be used to the water content of a concrete (and have been called water reducers due to this application) while maintaining workability. This improves its strength and durability.
characteristics. Super plasticizers (high-range water-reducing admixtures) are a class of plasticizers which have fewer deleterious effects when used to significantly increase workability, representative super plasticizers are sulfonated naphthalene formaldehyde condensate, sulfonated melamine formaldehyde condensate and acetone formaldehyde condensate, etc. more advanced super plasticizers is polycarboxylate type. In the experimental program Glenium Sky 8630 which is a high performance super plasticiser based on polycarboxylic ether was used.

Fig:3.3 Superplasticiser used in Experimental Work
3.1.5 Fly Ash

Fly Ash used was taken from L&T plant which is bought and brought from Reliance power plant in Rosa, Uttar Pradesh with a density of 746kg/m³

3.1.6 Brick Dust

Brick Dust was collected from the fields of Brick Kilns near Kukrail, Lucknow, Uttar Pradesh. The brick waste collected was then ball ground. After grinding Brick Dust was sieved from 300µ sieve and the portion which passed from the sieve was used in the experiment. Density measured was 1542kg/m³
3.1.7 Rice Husk Ash

Rice Husk taken from lucknow region was burnt in the gasifier plant in G.S.K. Bharat pvt limited under a controlled burning of 600-800 degree celcius and then the residue ash was ball grinded to a fine powder. After grinding Rice Husk Ash was sieved from 300μ sieve and the portion which passed from the sieve was used in the experiment. Density measured was 167kg/m³