

UNIT-V
SPECIAL CONCRETE

1. Define light weight concrete.

The concrete is said to be light weight concrete whose density is between 300 to 1850 kg/m³

2. Name some of the natural light weight aggregate

- a. Pumice
- b. Diatomite
- c. Scoria
- d. Volcanic cinders
- e. Saw dust
- f. Rice husk

3. Name some of the artificial light weight aggregate

- a. Brick bat
- b. Foamed slag
- c. Cinder, clinker
- d. Bloated clay
- e. Sintered fly ash
- f. Exfoliated vermiculite
- g. Expanded perlite

4. Define Guniting or Shotcrete?

It is defined as a mortar conveyed through a hose and pneumatically projected at a high velocity on to a surface.

5. Define Polymer concrete?

Polymer concrete is part of group of concretes that use polymers to supplement or replace cement and uses polymer as a binder.

- i. polymer impregnated concrete
- ii. polymer cement concrete(pcc)
- iii. polymer concrete

6.Define SIFCON?

Slurry Infiltrated Fibre Concrete (SIFCON). Steel fibre bed is prepared and cement slurry is infiltrated .With this techniques macro-fibre content upto about 20% by volume can be achieved.

7.Define ferrocement?

Ferrocement is a relatively new material consisting of wire meshes and cement mortar. It consists of closely spaced wire meshes which are impregnated with rich cement mortar mix.

8. What is Geopolymer?

Geopolymer concrete is concrete based on an inorganic binder polymerized from Al-Si rich materials of geological or industrial origin, such as fly-ash. Geopolymer is used as the binder, instead of cement paste, to produce concrete.

9.Define Ready-mix concrete?

Concrete which is mixed in a stationary mixer in a central batching plant or in truck mixer and supplied in fresh condition to the purchaser either at site or into purchaser vehicle is called ready mix concrete.

10.Explain Fibre reinforced concrete

Fibre reinforced concrete is defined as the composite material consists of mixture of cement, mortar or concrete and discontinuous, discrete uniformly dispersed suitable fibres.

NATURAL FIBRES

Coconut fibre , Sugarcane, Straw, Jute fibres

SYNTHETIC FIBRES

Glass, carbon ,steel, polypropylene, nylon

PART B

1.Explain the Ready Mix Concrete?

Concrete which is mixed in a stationary mixer in a central batching plant or in truck mixer and supplied in fresh condition to the purchaser either at site or into purchaser vehicle is called ready mix concrete. The age of fresh concrete is 2 to 3 hours and should be delivered within 30 to 60 minutes.

Concrete itself is a mixture of Portland cement, water and aggregates comprising sand and gravel or crushed stone. In traditional work sites, each of these materials is procured separately and mixed in specified proportions at site to make concrete.

Ready Mixed Concrete is bought and sold by volume - usually expressed in cubic meters.

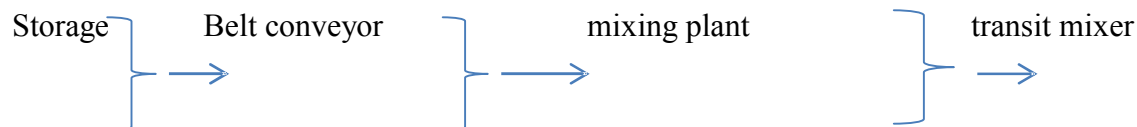
The first ready-mix factory was built in the 1930s, but the industry did not begin to expand significantly until the 1980s, and it has continued to grow since then.

The capacity is about 1.52 m^3 . The output of ready mix concrete is $30.58 \text{ m}^3/\text{hr}$ and can supply to a maximum of 1.33 m^3 for six times daily

Process:

A ready-mix concrete plant consists of silos that contain cement, sand, gravel and storage tanks of additives such as plasticizers, as well as a mixer to blend the components of concrete. These components are gravity fed into the preparation bin. The quality of concrete should be maintained.

The water dosage in particular must be very precise and the mixing itself must remain continuous and consistent. Finally, the concrete prepared in a batch plant is loaded into a mixer truck, also known as a transit mixer, which delivers it to the construction site. A concrete factory must be located within a radius of 20 to 30 km from the work site, depending on traffic conditions.



or silo or machine or batching unit

Components of RMC Plant:

- ✓ RMC Plant with Auxiliary or supporting equipment's.
- ✓ Transit mixer.
- ✓ Site equipment for handling concrete. (concrete pump)

Supporting equipment's:

- cement silos
- cement weight hopper
- aggregate bins
- conveyor

Properties:

- Good durability,
- High strength,
- Water tightness,
- Resistance to abrasion.

Advantages

- Speed in construction
- Elimination of storage needs
- Uniform and assured quantity of concrete
- Reduction in wastage
- RMC is eco-friendly
- Documentation of mix design
- Easy addition of admixtures

Disadvantages

- The materials are batched at a central plant, and the mixing begins at that plant, so the travelling time from the plant to the site is critical over longer distances.
- Generation of additional road traffic. Furthermore, access roads and site access have to be able to carry the greater weight of the ready-mix truck plus load.
- Concrete's limited time span between mixing and going-off means that ready-mix should be placed within 90 minutes of batching at the plant. Modern admixtures can

modify that time span precisely, however, so the amount and type of admixture added to the mix is very important.

2. Explain the Light Weight Concrete?

Light weight concrete is produced by including large quantities of air in the aggregate, in the matrix or in between the aggregate particles, or by a combination of processes.

Aggregate that weight less than about 1000kg/m^3 are used. The light weight is due to the cellular structure or highly porous microstructure.

Natural light weight aggregates are made by processing igneous volcanic rocks such as pumice, scoria and tuff.

Synthetic light weight aggregates can be manufactured by thermal treatment from a variety of materials such as clay, shale, slate fly ash pallets, blast furnace slag.

Making:

The mixing procedure for light weight concrete is the same as for normal concrete and is produced in the same type of mixer or mixing plant. In first stage, the mortar is mixed i.e., cement, sand, admixtures, and about two-third of mixing water .in the second stage, the coarse aggregate is added with the rest of the water and final mixing is done. At times, light weight dry fines cause the material to form balls in the mixer.

It can be avoided if less water is added at the start and then the amount is increased gradually .the size of the aggregate should be less than 8 or 10 mm.

Classification of light weight concretes:

- i. By using porous light weight aggregate of low apparent specific gravity, i.e. lower than 2.6. This type of concrete is known as light weight aggregate concrete.
- ii. By introducing large voids within the concrete or mortar mass; these voids should be clearly distinguished from the extremely fine voids produced by air

entertainment. This type of concrete is variously known as aerated, cellular, foamed or gas concrete.

iii. By omitting the fine aggregate from the mix so that large amount of interstitial voids is present; normal weight coarse aggregate is generally used. This concrete is known as no-fine concretes.

Properties:

- Low compressive strength
- High water absorption and moisture content.
- High creep and shrinkage.
- Good thermal insulation due to air filled voids.
- Low thermal expansion.

Advantages

- Rapid and relatively simple construction.
- Economical in terms of transportation as well reduction in man power
- Most of the light weight concrete have better nailing and sawing properties.
- Significant reduction of overall weight and results in saving structural frames, footings and piles

Disadvantages:

- ✚ Inability to provide high compressive strength
- ✚ Less density
- ✚ Very sensitive to moisture content
- ✚ Mixing time is longer than conventional concrete to obtain proper mixing.

3.Explain polymer concrete?

Polymer concrete is part of group of concretes that use polymers to supplement or replace cement and uses polymer as a binder.

Process:

The main technique in producing PC is to minimize void volume in the aggregate mass so as to reduce the quantity of polymer needed for binding the aggregates. This is

achieved by properly grading and mixing the aggregates to attain the maximum density and minimum void volume.

The graded aggregates are prepacked and vibrated in a mould. Monomer is then diffused up through the aggregates and polymerization is initiated by radiation or chemical means. A silane coupling agent is added to the monomer to improve the bond strength between polymer and the aggregate. In polyester resins are used no polymerization is required. Polymer concrete can develop compressive strengths of the order of 140 MPa (20,000 psi) within hours or even minutes.

Such polymer concretes tend to be brittle and it is reported that dispersion of fibre reinforcement would improve the toughness and tensile strength of the material. The use of fibrous polyester concrete in the compressive region of reinforced concrete beams provides a high strength, ductile concrete at reasonable cost.

The types include polymer-impregnated concrete, polymer concrete, and polymer-Portland-cement concrete.


Properties:

- High tensile, flexural, and compressive strengths
- Good adhesion to most surfaces
- Good long-term durability with respect to freeze and thaw cycles
- Low permeability to water and aggressive solutions
- Good chemical resistance
- Good resistance against corrosion

Advantages:

- Rapid [curing](#) at ambient temperature.
- Lighter weight (only somewhat less dense than traditional concrete, depending on the resin content of the mix)
- mines, tunnels, and highways.
- Pump manufacturing and chemical processing.
- industries

Disadvantages

-  More expensive

✚ The monomers can be volatile, combustible and toxic.

✚ Initiators which are used as catalyst are combustible and harmful to human skin

POLYMER IMPREGNATED CONCRETE

PIC is a hardened Portland cement concrete that has been impregnated with a monomer (low viscosity liquid organic material)and subsequently polymerized insitu.

In this case the cement concrete is cast and cured in the conventional manner. After the concrete product gets hardened and dried, air from the voids is removed under partial vacuum and low viscosity monomer(styrene, vinyl chloride) is diffused through the pores of the concrete.

The concrete product is then finally subjected to polymerization by radiation or by heat treatment thereby converting the monomer filled in the voids into solid plastic.

Application:

- precast slabs for bridge decks,
- roads,
- marine structures
- food processing buildings

1. POLYMER CEMENT CONCRETE(PCC)

PCC is produced by incorporating an emulsion of a polymer or a monomer in ordinary Portland cement concrete.

The ingredients comprising cement, aggregate and monomer are mixed with water and monomer in the concrete mix in the concrete is polymerized after placing concrete in position. The resultant concrete has improved :

- Strength,
- Adhesion
- Chemical resistance
- Impact and abrasion résistance
- Increased impermeability
- Reduced absorption

Application:

- Marine Works

3.POLYMER CONCRETE

In polymer concrete polymer /monomer is used to act as binder in place of cement. The monomer and aggregate are mixed together and the monomer is polymerized after placement of concrete in position. It is imperative to pre-heat the coarse and fine aggregates while mixing monomer.

Application :

- Irrigation Works

4. Explain Fibre reinforced concrete?

Fibre reinforced concrete is defined as the composite material consists of mixture of cement, mortar or concrete and discontinuous, discrete uniformly dispersed suitable fibres.

➤ Plain cement concrete, due to its low tensile strength and impact resistance is considered to be a brittle material.

➤ However, marked improvement in these properties can be brought about by the addition of small diameter, short length, and randomly distributed fibres.

➤ The fibres can be imagined as an aggregate with an extreme deviation in shape from the rounded smooth aggregate. The fibres interlock and entangle around aggregate particles and considerably reduce the workability, while the mix becomes more cohesive and less prone to segregation.

➤ The fibres suitable for reinforcing the concrete have been produced from steel, glass and organic polymers.

The major factors affecting the characteristics of fibre reinforced concrete are:

- ❖ water cement ratio;
- ❖ size of coarse aggregate
- ❖ mixing
- ❖ Percentage of fibres;
- ❖ Aspect ratio
- ❖ Diameter and length of fibres

The location and extent of cracking under load will depend upon the orientation and number of fibres in the cross section.

The fibre stress strain the shrinkage and creep movements of unreinforced matrix. However fibres have been found to be more effective in controlling compression creep than tensile creep of unreinforced matrix.

Properties:

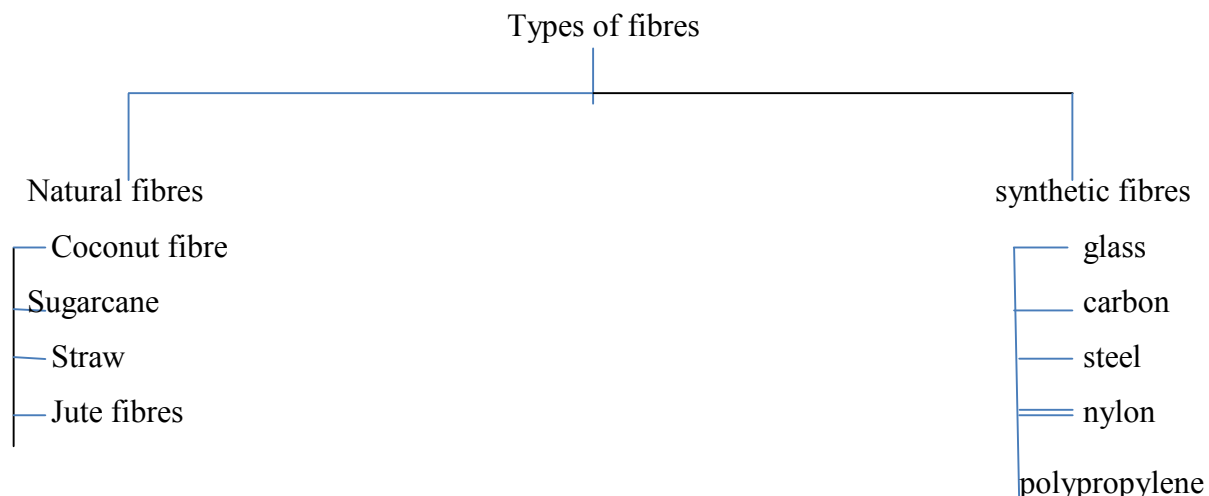
- Increased tensile and bending strength
- Improved ductility and resistance to cracking
- High impact strength and toughness
- Spalling resistance
- High energy absorption capacity

Application:

- Hydraulic structures
- Airfield and highway pavement
- Bridge decks
- Tunnel lining
- Heavy duty floors

Disadvantage:

- ✚ The main **disadvantage** associated with the fiber reinforced concrete is Fabrication. The process of incorporating fibers into the cement matrix is labor intensive.
- ✚ Costlier than the production of the plain concrete.



SYNTHETIC FIBRES:

Steel fibre reinforced concrete

This type of concrete is formed by adding steel fibres in the ingredients of concrete. Round steel fibres are commonly used. The typical diameter lies in the range of .25 to .75 mm, by addition of 2 to 3 percent of fibre(by volume).

It is possible to achieve two or three times increase in the flexural strength of concrete and substantial increase in explosion resistance, crack resistance etc.

Application:

- Construction of pavement
- Bridge decks,
- Pressure vessels ,
- Tunnel lining

Glass fibre reinforced concrete:

Glass fibres are made up from 200 to 400 individual filaments which are highly bonded to make up a strand. These strands can be chopped into various lengths or combined into make cloth,mat or tape.

The process of manufacture of glass-fibre cement products may involve spraying, premixing or incorporation of continuous rovings.

It has been observed that addition of 10% of glass fibres by volume brings almost two folds increase in tensile strength and substantial increase in impact resistance of concrete.

Application:

- Used in sewer lining
- Roofing elements, swimming pool, tanks etc.
- Polypropylene and nylon fibres.
- Increase the impact strength.
- Possess very high tensile strength

Asbestos:

- It is a mineral fibre
- Tensile strength varies between 560 and 980 N/mm².

Carbon fibres:

- Possess a tensile strength of 2110 to 2815N/ mm².
- Used in cladding, panels, shells

NATURAL FIBRES:**Coconut fibre as reinforcement**

Natural reinforcing materials can be obtained at low cost and low levels of energy using local manpower and technology. Utilization of natural fibres as a form of concrete enhancement is of Particular interest to less developed regions where conventional construction materials are not readily available or are too expensive.

Coconut and sisal-fibre reinforced concrete have been used for making roof tiles, corrugated sheets, pipes, silos and tanks. The dry cement and aggregates were mixed for two minutes by hand in a 0.1m³ laboratory mixer pan.

The mixing continued for further few minutes while about 80% of the water was added. The mixing was continued for another few minutes and the fibres were fed continuously to the concrete for a period of 2–3 min while stirring.

Finally, the remaining water along with super -plasticizer was added and the mixing was continued for an additional two minutes. This ensured a complete distribution of fibres throughout the concrete mix. For each mix, a total of six cylinders with dimension of 100×200mm and three cubes of 100mm were cast.

5. Explain

(i) High strength concrete

(ii) High performance concrete

(iii) Geo polymer concrete

(iv) Ferro cement

High strength concrete

The manufacture of high strength concrete will grow to find its due place in concrete construction for all the obvious benefits. In the modern batching plants high strength concrete is

produced in a mechanical manner. Of course, one has to take care about mix proportioning, shape of aggregates, use of supplementary cementitious materials, silica fume and superplasticizers. With the modern equipments, understanding of the role of the constituent materials, production of high strength concrete has become a routine matter.

There are special methods of making high strength concrete. They are given below.

- (a) Seeding (b) Revibration (c) High speed slurry mixing;
- (d) Use of admixtures (e) Inhibition of cracks (f) Sulphur impregnation
- (g) Use of cementitious aggregates.

Seeding:

This involves adding a small percentage of finely ground, fully hydrated Portland cement to the fresh concrete mix. The mechanism by which this is supposed to aid strength development is difficult to explain. This method may not hold much promise.

Revibration:

Concrete undergoes plastic shrinkage. Mixing water creates continuous capillary channels, bleeding, and water accumulates at some selected places. All these reduce the strength of concrete. Controlled revibration removes all these defects and increases the strength of concrete.

High Speed slurry mixing:

This process involves the advance preparation of cement- water mixture which is then blended with aggregate to produce concrete. Higher compressive strength obtained is attributed to more efficient hydration of cement particles and water achieved in the vigorous blending of cement paste.

Use of Admixtures: Use of water reducing agents are known to produce increased compressive strengths.

Inhibition of cracks:

Concrete fails by the formation and propagation of cracks. If the propagation of

cracks is inhibited, the strength will be higher. Replacement of 2– 3% of fine aggregate by polythene or polystyrene —lenticules□ 0.025 mm thick and 3 to 4 mm in diameter results in higher strength. They appear to act as crack arresters without necessitating extra water for workability. Concrete cubes made in this way have yielded strength upto 105 MPa.

Sulphur Impregnation:

Satisfactory high strength concrete have been produced by impregnating low strength porous concrete by sulphur. The process consists of moist curing the fresh concrete specimens for 24 hours, drying them at 120°C for 24 hours, immersing the specimen in molten sulphur under vacuum for 2 hours and then releasing the vacuum and soaking them for an additional ½ hour for further infiltration of sulphur. The sulphur-infiltrated concrete has given strength upto 58 MPa.

Use of Cementitious aggregates:

It has been found that use of cementitious aggregates has yielded high strength. Cement found is kind of clinker. This glassy clinker when finely ground results in a kind of cement. When coarsely crushed, it makes a kind of aggregate known as ALAG. Using Alag as aggregate, strength upto 125 MPa has been obtained with water/cement ratio 0.32.

High performance concrete:

High Performance Concrete (HPC) is a specialized series of concretes designed to provide several benefits in the construction of concrete structures. High performance concrete possess high level of all characteristics of concrete, strength, durability, all service life for durability of concrete. Conventional concrete designed on the basis of compressive strength does not meet any functional requirements such as impermeability, resistance to frost, thermal cracking etc. While high strength concrete aims at enhancing strength. The term high performance concrete is used to refer concrete of required performance for the majority of construction applications.

Making:

The mixing sequence of high performance concrete is as follows. Loading of the aggregates and water, addition of the air entraining agent and mixing to develop a satisfactory air bubble system

and stabilizing it. Mixing of cement. Addition of super plasticizer and mixed finally.

Properties:

- High workability.
- High durability
- Resistance to chemical attack.
- High strength
- High modulus of elasticity

Advantage:

- ease of placement and consolidation without affecting strength
- long-term mechanical properties
- early high strength
- toughness
- volume stability
- bridge decks, pavements and paving structures
- longer life in severe environments

Disadvantage:

- ✚ Highly expensive
- ✚ Proportion of admixtures should be accurate otherwise the properties get changed.

GEOPOLYMER CONCRETE :

Geopolymer concrete is concrete based on an inorganic binder polymerized from Al-Si rich materials of geological or industrial origin, such as fly-ash.

Geopolymer is used as the binder, instead of cement paste, to produce concrete. The geopolymer paste binds the loose coarse aggregates, fine aggregates and other unreacted materials together to form the geopolymer concrete. The manufacture of geopolymer concrete is carried out using the usual concrete technology methods.

As in the Portland cement concrete, the aggregates occupy the largest volume, that is, approximately 75 to 80% by mass, in geopolymer concrete. The silicon and the aluminum in the fly ash are activated by a combination of sodium hydroxide and sodium silicate solutions to form the geopolymer paste that binds the aggregates and other

unreacted materials.

PROCESS:

Materials

The materials needed to manufacture the geopolymer concrete are the same as those for making Portland cement concrete, except for the Portland cement. Low calcium (class F) dry fly ash obtained from a local power station was used as the source material. For the alkaline activator, a combination of sodium hydroxide solution and sodium silicate solution was used.

The sodium hydroxide solution was prepared by dissolving the sodium hydroxide solids, either in the form of pellets or flakes, in water. Extra water and Naphthalene Sulfonate-based superplasticizer were also added to improve the workability of the fresh fly ash-based geopolymer concrete. The sodium silicate solution used contained $\text{Na}_2\text{O}=14.7\%$, $\text{SiO}_2=29.4\%$, and 55.9% of water, by mass. All the liquids were mixed together before adding to the solids.

Mixing and Compacting

The aggregates in saturated surface dry condition and the dry fly ash were mixed in a pan mixer for 3-4 minutes. At the end of this mixing, the liquid component of the geopolymer concrete mixture, i.e. the combination of the alkaline solution, the superplasticiser and the extra water, was added to the solids, and the mixing continued for a specified period of time. In this study, the wet mixing period was designated as the ‘_mixing time’.

The fresh concrete had a stiff consistency and was glossy in appearance. The fresh concrete was then cast in moulds. Compaction was performed using the usual practice, either by applying strokes or using vibration or a combination of both. After casting, the

concrete samples were cured at an elevated temperature for a specified period of time.

Curing

Curing was carried out at a specified elevated temperature, either in an oven (dry curing) or in a steam chamber. At the end of the curing period, the test specimens were left in the mold for about six hours. The samples were then removed from the molds, and left to air dry in the room temperature before testing at a specified age

ENGINEERING PROPERTIES

- Compressive strengths ranging from 20-30MPa to 80-100MPa Ref. 1.
- Flexural strengths typically 2-3MPa higher than for OPC concrete at the same compressive strength
- Hardening in 5-7 days vs. 28 days for OPC concrete at ambient temperature.
- Does not generate any heat of hydration during curing due to the polymerization nature of its chemistry.
- Low specific creep: typ. 25-30 microstrains at 40% load, vs. 50-60 for OPC concrete.
- Low drying shrinkage: typ. 100-150 microstrains @ 1 yr., vs. 500-800 for OPC concrete.
- Excellent resistance to freeze-thaw cycles
- Adhesion to fresh and old concrete substrates, steel, glass, ceramics.
- Inherent protection of steel reinforcing due to low chloride diffusion rates.

SUPERIOR DURABILITY :

1) High level of resistance to a range of acids and salt solutions

- Na₂SO₄, MgSO₄, NaCl, Sulfuric Acid, Hydrochloric Acid
- . Resistant to seawater corrosion

- 2) Not subject to deleterious alkali-aggregate reactions.
- 3) Impervious to water.
- 4) Fire resistance
 - ✓ No water molecules present in the geopolymer structure hence does not spall at high temperatures, unlike OPC concrete.
- 5) Does not burn or release toxic fumes, unlike organic polymers.

APPLICATIONS:

- ✚ metro/railroad systems,
- ✚ highways, bridges,
- ✚ marine infrastructure,
- ✚ dams, canal linings,
- ✚ water and sewage pipes,
- ✚ mine tailings.

ADVANTAGES:

- ❖ geopolymer concrete has significantly higher resistance to acid than ordinary concrete
- ❖ 80% reduction in CO₂ footprint comparing to OPC, opportunity to obtain tradable CO₂ certificates.
- ❖ Can be used in a wide range of ready-mix, pre-cast, and pre-stressed/pre-cast applications
- ❖ Excellent fire and heat resistance. It has the ability to remain stable in temperatures of more than 1200 °C

DISADVANTAGES

- Activator is necessary to start the geopolymerisation process.
- Due to the dangers of handling chemicals and the liability issues that ensue, geopolymer concrete is generally sold as a pre-cast or pre-mixed material

FERROCEMENT CONCRETE :

It is well known that conventional reinforced concrete members are too heavy, brittle, cannot be satisfactorily repaired if damaged, develop cracks and reinforcements are liable to be corroded. The above disadvantages of normal concrete make it inefficient for certain types of work.

Ferrocement is a relatively new material consisting of wire meshes and cement mortar. It consists of closely spaced wire meshes which are impregnated with rich cement mortar mix. The wire mesh is usually of 0.5 to 1.0 mm dia wire at 5 mm to 10 mm spacing and cement mortar is of cement sand ratio of 1 : 2 or 1 : 3 with water/cement ratio of 0.4 to 0.45. The ferrocement elements are usually of the order of 2 to 3 cm. in thickness with 2 to 3 mm external cover to the reinforcement.

The steel content varies between 300 kg to 500 kg per cubic meter of mortar. The basic idea behind this material is that concrete can undergo large strains in the neighbourhood of the reinforcement and the magnitude of strains depends on the distribution and subdivision of reinforcement throughout of the mass of concrete.

6. Describe in detail about Shotcrete and its advantages.

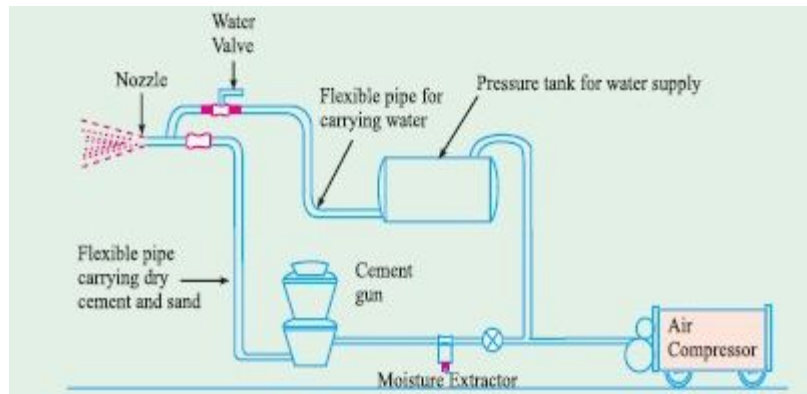
Shotcrete or Guniting can be defined as mortar conveyed through a hose and pneumatically projected at a high velocity on to a surface. Recently the method has been further developed by the introduction of small sized coarse aggregate into the mix deposited to obtain considerably greater thickness in one operation and also to make the process economical by reducing the cement content. Normally fresh material with zero slump can support itself without sagging or peeling off. The force of the jet impacting on the surface compacts the material. Sometimes use of set accelerators to assist overhead placing is practised. The newly developed —Redi-set cement— can also be used for shotcreting process.

There is not much difference between guniting and shotcreting. Guniting was first used in the early 1900 and this process is mostly used for pneumatical application of mortar of less thickness, whereas shotcrete is a recent development on the similar principle of guniting for achieving greater thickness with small coarse aggregates.

There are two different processes in use, namely the Wet-mix process and the dry-mix process. The dry mix process is more successful and generally used.

Dry-mix Process

The dry mix process consists of a number of stages and calls for some specialised plant. A typical small plant set-up is shown in Fig. The stages involved in the dry mix process is given below:



- Cement and sand are thoroughly mixed.
- The cement/sand mixture is fed into a special air-pressurised mechanical feeder termed as 'gun'.
- The mixture is metered into the delivery hose by a feed wheel or distributor within the gun.
- This material is carried by compressed air through the delivery hose to a special nozzle.
- The nozzle is fitted inside with a perforated manifold through which water is sprayed under pressure and intimately mixed with the sand/cement jet.
- The wet mortar is jetted from the nozzle at high velocity onto the surface to be gunited.

The Wet-mix Process

In the wet-mix process the concrete is mixed with water as for ordinary concrete before conveying through the delivery pipe line to the nozzle, at which point it is jetted by compressed air, onto the work in the same way, as that of dry mix process. The wet-mix process has been

generally discarded in favour of the dry-mix process, owing to the greater success of the latter.

The dry-mix methods makes use of high velocity or low velocity system. The high velocity gunite is produced by using a small nozzle and a high air pressure to produce a high nozzle velocity of about 90 to 120 metres per second. This results in exceptional good compaction. The lower velocity gunite is produced using large diameter hose for large output. The compaction will not be very high

Advantages of Wet and Dry Process

Although it is possible to obtain more accurate control of the water/cement ratio with the wet process the fact that this ratio can be kept very low with the dry process largely overcomes the objection of the lack of accurate control. The difficulty of pumping light-weight aggregate concrete makes the dry process more suitable when this type of aggregate is used.

The dry process on the other hand, is very sensitive to the water content of the sand, too wet a sand causes difficulties through blockade of the delivery pipeline, a difficulty which does not arise with the wet process. The lower water/cement ratio obtained with the dry process probably accounts for the lesser creep and greater durability of concrete produced in this way compared with concrete deposited by the wet process, but air-entraining agents can be use to improve the durability of concrete deposited by the latter means.

Admixtures generally can be used more easily with the wet process except for accelerators. Pockets of lean mix and of rebound can occur with the dry process. It is necessary for the nozzelman to have an area where he can dump unsatisfactory shotcrete obtained when he is adjusting the water supply or when he is having trouble with the equipment. These troubles and the dust hazard are less with the wet process, but wet process does not normally give such a dense concrete as the dry process. Work can be continued in more windy weather with the wet process than with the dry process, Owing to the high capacities obtainable with concrete pumps,

a higher rate of laying of concrete can probably be achieved in the wet process than with the dry process.