AS-4031

BTECH III[rd] SEMESTER

CIVIL ENGINEERING BRANCH

SUBJECT: CIVIL ENGINEERING MATERIALS AND CONCRETE TECHNOLOGY

TIME: **3 HOURS** SUBJECT CODE: **21CE04T** MAX. MARKS: **60**

NOTE: 1) All questions of Section-A is compulsory
2) Answer any one part from each unit of section-B

SECTION-A (10x2=20 Marks)

A-I	What is a metamorphic rock? Give the agents of metamorphism.	**02**
A-II	Give the Geological Classification of rocks with examples.	**02**
A-III	What is porcelain and terracotta? How they are used in civil engineering.	**02**
A-IV	What is a plastic? Give the types of plastics according to the thermal property.	**02**
A-V	What is Hydrophobic Cement? Where it is used?	**02**
A-VI	Give the different sources and types of sand?	**02**
A-VII	What is meant by slump of fresh concrete? Why it is required?	**02**
A-VIII	What is meant by segregation of concrete? How it affect quality of concrete?	**02**
A-IX	What is a ready mix concrete? Specify its uses.	**02**
A-X	What is a recycled aggregate? Why it is used for making concrete?	**02**

SECTION-B (5x8=40 Marks)

UNIT-I

B-I (a) Explain with a neat sketch, the working of Hoffman's Kiln used for burning of bricks. **08**
or
(b) Give in detail the common building stones of India with their uses and places of availability.

UNIT-II

B-II (a)Give the characteristics properties and types of paints along with their specific uses. **08**
or
(b) Mention the characteristics properties of varnishes along with their specific uses.

UNIT-III

B-III a) Explain with a neat sketch, manufacturing of cement by wet process **08**
or
(b)What is meant by steel? Give the different types of steel. Mention the properties of mild steel or low carbon steel or soft steel

UNIT-IV

B-IV a) What is meant by design of a concrete mix? Describe in detail design of a M25 mix design. Assume suitable material data. **08**
or
(b)Explain with neat sketch, the functioning of a rebound hammer with its components. Write about the sensitivity of the test results.

UNIT-V

B-V a) Describe the properties and uses of Ready mix concrete **08**
or
(b) Describe the properties and uses of shortcrete concrete

X

KEY_AS-4031

BTECH IIIrd SEMESTER

CIVIL ENGINEERING BRANCH

SUBJECT: CIVIL ENGINEERING MATERIALS AND CONCRETE TECHNOLOGY

TIME: **3 HOURS** SUBJECT CODE: **21CE04T** MAX. MARKS: **60**

SECTION-A **(10x2=20 Marks)**

A-I What is a metamorphic rock? Give the agents of metamorphism. **02**

Ans. *A metamorphic rock is a changed rock in character of the pre-existing rocks. The agents of metamorphism are heat, pressure and chemically acting fluids*

A-II Give the Geological Classification of rocks with examples. **02**

Ans. *According to geological classification rocks are classified as i) Igneous rocks (granite, dolerite, basalt etc.), ii) Sedimentary rocks (gravel, sand stone, lime stone, gypsum etc.), iii) Metamorphic rocks (gneiss, slate etc.)*

A-III What is porcelain and terracotta? How they are used in civil engineering. **02**

Ans. *Porcelain is fine earthenware which is white, thin and semi transparent (used in sanitary, electrical insulator, storage vessels, and reactor chambers etc.). Terracotta is a baked earth or earthenware or porous pottery made from local clays and glazed. It is soft to scratch by knife (used to make ornamental carvings, statues etc.).*

A-IV What is a plastic? Give the types of plastics according to the thermal property. **02**

Ans. *Plastic is a polymer of carbon compounds. These polymers are capable of plastic deformation when heat and pressure are applied, and hence are called as plastics According to thermal property the plastics are classified as i) Thermo plastics ii) Thermo setting plastics*

A-V What is Hydrophobic Cement? Where it is used? **02**

Hydrophobic cement is water resistant and impermeable cement. It is used when the humidity in the region is more. Used in the construction of water resistant and impermeable basements etc.

A-VI Give the different sources and types of sand? **02**

The various sources and types of sand are i) Pit sand (coarse in size), ii) River Sand (fine in size), iii) Stream sand (coarse in size), iv) Crushed stone sand (fine aggregate) v) Sea sand (fine in size)

A-VII What is meant by slump of fresh concrete? Why it is required? **02**

The measure of height of fall of a standard cone (slump cone) is called slump of fresh concrete. Workability of fresh concrete is measured in terms of slump of concrete. So slump tests are carried in laboratory and field to measure workability of fresh concrete.

A-VIII What is meant by segregation of concrete? How it affect quality of concrete? **02**

Tendency of separation of C.A. grains from the concrete mass is called segregation of concrete. It will have harmful affect on the properties of concrete

A-IX What is a ready mix concrete? Specify its uses. **02**

Ready Mix Concrete (RMC) is a concrete mixed in a centrally located batching plant in a factory for the requirements such as slump, grade, pumpability, etc. The mixed concrete is dispatched in special trucks with rotating drums to the site. Used in work such as for piles or multistoreyed buildings etc.

A-X What is a recycled aggregate? Why it is used for making concrete? **02**

Recycled aggregate is an aggregate obtained from the rubble of the old or demolished concrete constructions. Recycled aggregate is used for making concrete because of the depletion of natural aggregate resources and also to promote the use of construction wastes.

SECTION-B (5x8=40 Marks)

UNIT-I

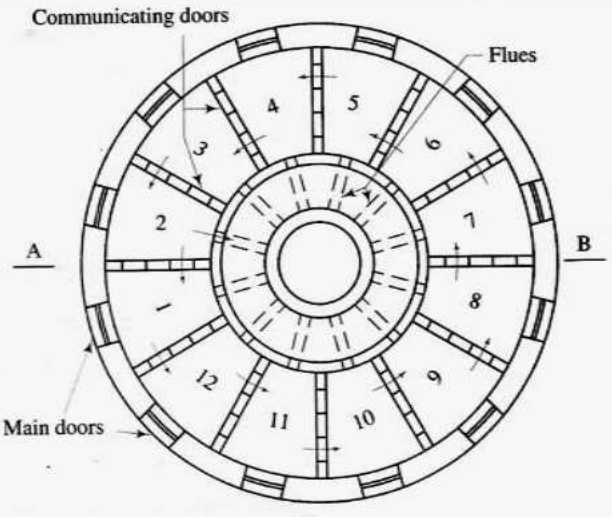
B-I (a) Explain with a neat sketch, the working of Hoffman's Kiln used for burning of bricks. **08**

Hoffman's kiln: This kiln is constructed overground and hence it is sometimes known as the *flame kiln*. Its shape is circular in plan and it is divided into a number of compartments or chambers. As a permanent roof is provided, the kiln can even function during rainy season.

shows plan and section of the Hoffman's kiln with 12 chambers. Each chamber is provided with the following:

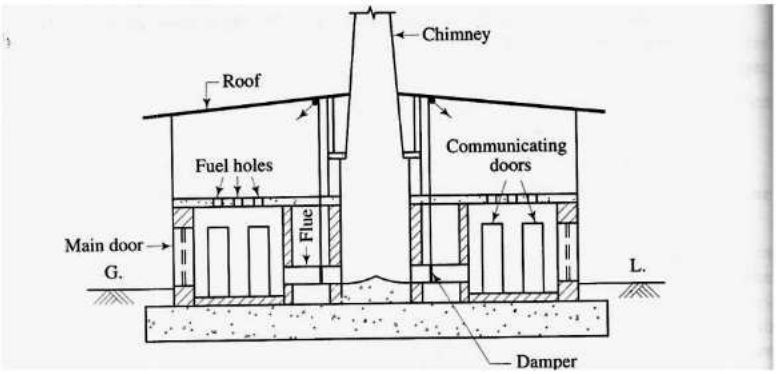
(a) a main door for loading and unloading of bricks,
(b) communicating doors which would act as flues in open condition,
(c) a radial flue connected with a central chimney, and
(d) fuel holes with covers to drop fuel, which may be in the form of powdered coal, into burning chambers.

The main doors are closed by dry bricks and covered with mud, when required. For communicating doors and radial flues, the dampers are provided to shut or open them. In the normal condition, only *one* radial flue is connected to the chimney to establish a draught.



Plan

Hoffman's kiln



In this type of kiln, each chamber performs various functions in succession, namely, loading, drying, burning, cooling and unloading.

As an illustration, 12 chambers shown may be functioning as follows:

Chamber 1 – Loading

Chambers 2 to 5 – Drying and pre-heating

Chambers 6 and 7 – Burning

Chambers 8 to 11 – Cooling

Chamber 12 – Unloading.

With the above arrangement, the circulation of the flue gas will be as shown by arrows in fig. 4-7. The cool air enters through chambers 1 and 12 as their main doors are open. After crossing the cooling chambers 8 to 11, it enters the burning section in a heated condition. It then moves to chambers 2 to 5 to dry and pre-heat the raw bricks. The damper of chamber 2 is in open condition and hence it escapes into atmosphere through chimney.

The capacity of the kiln will depend upon the dimensions of chambers. If each chamber is of about 11 m length, 4.50 m average width and 2.50 m height, it will contain about 25000 bricks. Hence, if it is so arranged that one chamber is unloaded daily, such a kiln will manufacture about 25000 bricks daily or about 8 to 9 million bricks annually. The quantity of coal dust required for burning *one* lakh of bricks is about 120 to 150 kN.

It may be noted that in case of Bull's trench kiln and Hoffman's kiln, the chambers are zoned in accordance with the brick-processing stages, namely, loading, drying, preheating, burning, cooling and unloading. The source of fire and other zones are moving continuously along the channel of kiln while the bricks in process remain stationary.

or

(b) Give in detail the common building stones of India with their uses and places of availability.

COMMON BUILDING STONES OF INDIA

No.	Stone	Classification	Qualities	Uses	States localities
1.	Basalt and trap	Igneous	Hard and tough: difficult to work. Its sp. gr. is 3 and compressive strength varies from 150 to 185 N/mm^2. Its weight varies from 18 to 29 kN per m^3.	Road metal, for rubble masonry, foundation work, etc.	Maharashtra, Bihar, Gujarat, Bengal and M.P.
2.	Chalk	Sedimentary	Pure white limestone; soft and easy to form powder.	In preparing glazier's putty; as colouring material in manufacture of Portland cement.	Same as limestone.
3.	Gneiss	Metamorphic	Splits into thin slabs; easy to work. Its sp. is 2.69 and compressive strength is 206 N/mm^2.	Street paving, rough stone masonry work, etc.	Madras, Mysore, Bihar, A.P., Maharashtra, Bengal, Kerala and Gujarat.
4.	Granite	Igneous	Hard, durable and available in different colours, highly resistant to natural forces, can take nice polish. Its sp. gr. varies from 2.6 to 2.7 and compressive strength varies from 75 to 127 N/mm^2. Its weight is about 26 to 27 kN per m^3.	Steps, sills, facing work, walls, bridge piers, columns, road metal, ballast, etc. It is unsuitable for carving.	Kashmir, U.P., Madras, Punjab, M.P., Rajasthan, Mysore, Maharashtra, Assam, Bengal, Bihar, Orissa, Kerala and Gujarat.
5.	Kankar	Sedimentary	Impure limestone.	Road metal, manufacture of hydraulic lime, etc.	North and Central India.
6.	Laterite	Metamorphic	Porous and spongy structure; easily quarried in blocks; contains high percentage of oxide of iron; available in different colours. Its compressive strength varies from 1.80 to 3.10 N/mm^2.	Building stone, road metal, rough stone masonry work, etc.	Bihar, Orissa, Mysore, M.P., A.P., Maharashtra, Kerala and Madras.
7.	Limestone	Sedimentary	Consists of cabonate of lime; easy to work. Its sp. gr. varies from 2.00 to 2.75 and compressive strength is 54 N/mm^2.	Floors, steps, walls, road metal, manufacture of lime in blast furnaces, etc.	Maharashtra, Rajasthan, Punjab, M.P., Gujarat, A.P., Andaman Islands, Bengal, Bihar, Himachal Pradesh and U.P.

No.	Stone	Classification	Qualities	Uses	States localities
8.	Marble	Metamorphic	Can take good polish and avilable in different colours. Its sp. gr. is 2.65 and compressive strength is 71 N/mm^2.	Flooring, facing work, columns, steps, ornamental work, etc. It can take nice polish. It can easily be sawn and carved.	Rajasthan, Maharashtra, Gujarat, A.P., Mysore, M.P. and U.P.
9.	Murum	Metamorphic	Decomposed laterite, deep brown or red in colour.	Blindage for metal roads, for fancy paths and garden walls.	Same as laterite.
10.	Quartzite	Metamorphic	Hard, brittle, crystalline and compact; difficult to work and dress.	Retaining walls, road metal, concrete aggregate, pitching, rubble masonry, facing of buildings, etc.	Bengal, A.P., Himachal Pradesh, Madras, U.P., Mysore, Gujarat, Punjab and Rajasthan.
11.	Sandstone	Sedimentary	Consists of quartz and other minerals, easy to work and dress and available in different colours. Its sp. gr. varies from 2.65 to 2.95 and compressive strength is 64 N/mm^2. Its weight is about 20 to 22 kN per m^3.	Steps, facing work, columns, flooring, walls, road metal, omamental carving, etc.	A.P., M.P., Punjab, Rajasthan, Maharashtra, Gujarat, U.P., Andaman Islands, Bengal, Bihar, Himachal Pradesh, Kashmir, and Madras.
12.	Slate	Metamorphic	Black colour and splits along natural bedding planes; non-absorbent. Its sp. gr. is 2.89 and compressive strength varies from 75 to 207 N/mm^2.	Roofing work, sills, damp-proof courses, etc.	U.P., M.P., Bihar, Madras, Rajasthan and Mysore.

UNIT-II

B-II (a)Give the characteristics properties and types of paints along with their specific uses. **08**

CHARACTERISTICS OF AN IDEAL PAINT

wing are the characteristics of an ideal paint:

It should possess a good spreading power i.e. maximum area of surface should be covered by minimum quantity of the paint.

The paint should be fairly cheap and economical.

The paint should be such that it can be easily and freely applied on the

The paint should be such that it dries in reasonable time and not too

The paint should be such that its colour is maintained for a long

The paint should form a hard and durable surface.

The paint should not affect health of workers during its application.

The paint should not be affected by weathering actions of the atmosphere.

The paint should possess attractive and pleasing appearance.

The surface coated with paint should not show cracks when the paint dries.

When applied on the surface, the paint should form a thin film of uniform nature.

-4. TYPES OF PAINTS

The brief descriptions of different types of paints are given below:

1) **Aluminium paint:** The very finely ground aluminium is suspended in r quick-drying spirit varnish or slow-drying oil varnish as per requirement. spirit or oil evaporates and a thin metallic film of aluminium is formed on surface. The *advantages* of an aluminium paint are as follows:

i) It is visible in darkness.
ii) It resists heat to a certain degree.
iii) The surfaces of iron and steel are better protected from corrosion by this paint than any other paint.
iv) It possesses a high covering capacity. A litre of paint can cover an area of about 200 m^2.
v) It gives good appearance to the surface.
vi) It is impervious to the moisture.
vii) It possesses high electrical resistance.

The aluminium paint is widely used for painting gas tanks, hot water pipes, ne piers, oil storage tanks, radiators, etc.

2) **Anticorrosive paint:** This paint essentially consists of oil and a strong . A pigment such as chromium oxide or lead or red lead or zinc chrome is n and after mixing it with some quantity of very fine sand, it is added to the t. The *advantages* of an anticorrosive paint are as follows:

i) It is cheap.
ii) It lasts for a long duration.
iii) The appearance of the paint is black.

3) **Asbestos paint:** This is a peculiar type of paint and it is applied on the ıces which are exposed to the acidic gases and steam.

(4) **Bituminous paint:** This paint is prepared by dissolving asphalt or mi pitches or vegetable bitumen in any type of oil or petroleum. A variety of bitumi paints is available. The paint presents a black appearance and it is used painting ironwork under water.

(5) **Cellulose paint:** This paint is prepared from nitro-cotton, celluloid sh photographic films, etc. An ordinary paint hardens by oxidation. A cellulose p hardens by evaporation of thinning agent. It thus hardens quickly. It is a more costly, but it presents a flexible, hard and smooth surface. Also, the su painted with cellulose paint can be washed and easily cleaned. The cellulose p is not affected by contact with hot water and the surface can stand extr degrees of cold and heat.

(6) **Cement paint:** This paint consists of white cement, pigment, accele and other additives. It is available in dry powder form. The cement pai available in variety of shades and it exhibits excellent decorative appearance. water-proof and durable. It proves to be useful for surfaces which are damp a time of painting or are likely to become damp after painting. For external fi on cement plastered walls, it is mixed with water immediately before its applica It is desirable to provide cement paint on rough surface rather than on sm surface because its adhesion power is poor on smoothly finished surface.

(7) **Colloidal paint:** No inert material is mixed in this type of paint. It uires more time to settle and in the process of settlement, it penetrates through surface. It may be used for interior as well as exterior walls.

(8) **Emulsion paint:** A variety of emulsion paints is available. It contains ding materials such as polyvinyl acetate, synthetic resins, etc. This paint is easy apply and it dries quickly in about 1½ to 2 hours. The colour of the paint retained for a long period and the surface of paint is tough and it can be aned by washing with water. There is absence of odour and the paint sesses excellent alkali resistance.

The application of emulsion paint can be carried out either by brush or spray . For long service life, it is recommended to apply *two* coats of emulsion paint. rough cement plastered surface, a thin coat of cement paint may first be lied to smoothen the surface. It is necessary to have a sound surface to eive the emulsion paint.

(9) **Enamel paint:** This paint is available in different colours. It contains white d or zinc white, oil, petroleum spirit and resinous matter. It dries slowly and ms a hard and durable surface. The surface provided with this paint is not affected acids, alkalies, fumes of gas, hot and cold water, steam, etc. It can be used for h internal and external walls. In order to improve the appearance, it is desirable apply a coat of titanium white in pale linseed oil before the coat of enamel paint.

(10) **Graphite paint:** The paint presents a black colour and it is applied on n surfaces which come in contact with ammonia, chlorine, sulphur gases, etc. is also used in mines and underground railways.

(11) **Inodorous paint:** No turpentine is used in this paint, but white lead zinc white is mixed with methylated spirit. The white lead or zinc white is ground in oil. The shellac with some quantity of linseed oil and castor oil dissolved in methylated spirit. The paint is not durable, but it dries quickly. methylated spirit evaporates and a film of shellac remains on the surface.

(12) **Luminous paint:** This paint contains calcium sulphide with varnish. surface on which luminous paint is applied shines like radium dials of watch after the source of light has been cut off. The paint should be applied on surfa which are free from corrosion or any other lead paint.

(13) **Oil paint:** This is the ordinary paint and it is generally applied in th coats of varying composition. They are respectively termed as primes, underc and finishing coats. This paint is cheap and easy to apply and it possesses g opacity and low gloss.

It should be remembered that the oil paint should not be applied du humid and damp weather. The presence of dampness on wall surface also considera affects the life of oil paint coating. It is advisable to redecorate the surfa finished with oil paint with a coating of fresh oil paint only. The layer of old paint serves as a foundation for the fresh paint.

(14) **Plastic paint:** This paint contains the necessary variety of plastics and is available in the market under different trade names. The application of pla paint can be done either by brush painting or spray painting. This paint posse pleasing appearance and it is attractive in colour. This paint is widely used show rooms, auditoriums, etc.

The plastic emulsion paints were introduced in our country in 1955 or so they are becoming more and more popular day by day. An emulsion is a liq having fine suspended particles of a substance. For plastic emulsion paints, emulsion is composed of plastic compounds such as vinyl acetate and acryl which are held in water. The typical composition of one litre of plastic emuls

or

(b) Mention the characteristics properties of varnishes along with their specific uses.

-3. VARNISHING

The term *varnish* is used to indicate the solution of resins or resinous substances pared either in alcohol, oil or turpentine.

Following are the main *objects* of applying varnish on a wooden surface:

(i) It brightens the appearance of the grain in wood.

(ii) It renders brilliancy to the painted surface.

(iii) It protects the painted surface from atmospheric actions.

(iv) It protects the unpainted wooden surfaces of doors, windows, roof trusses, floors, etc., from the actions of atmospheric agencies.

15-3-1. CHARACTERISTICS OF AN IDEAL VARNISH

Following are the *characteristics* of an ideal varnish:

(i) It should render the surface glossy.

(ii) It should dry rapidly and present a finished surface which is uniform nature and pleasing in appearance.

(iii) The colour of varnish should not fade away when the surface is expo to the atmospheric actions.

(iv) The protecting film developed by varnish should be tough, hard and dura

(v) It should not shrink or show cracks after drying.

15-3-2. INGREDIENTS OF A VARNISH

Following are the *ingredients* of a varnish:

(1) Resins or resinous substances

(2) Driers

(3) Solvents.

(1) Resins or resinous substances: The commonly used resins are copal, or shellac and rosin. The copal is a hard substance and is available from the ea at places where pine trees existed in past. It is available in variety of forms. T lac or shellac is obtained by exudation of some types of insects in India. T rosin is obtained from pine trees. Other resins are amber, mastic, gum dammar, e

(2) Driers: The function of a drier in varnish is to accelerate the process drying. The common driers used in varnishes are litharge, white copper and lead acet

(3) Solvents: Depending upon the nature of resin, the type of solvent decided. Table 15-5 shows the solvents for different resins.

SOLVENTS FOR RESINS

No.	Solvent	Resins
1.	Boiled linseed oil	Amber, Copal
2.	Methylated spirits of wine	Lac or shellac
3.	Turpentine	Mastic, Gum dammar, Rosin
4.	Wood naphtha	Cheap varieties of resins

15-3-3. TYPES OF VARNISHES

Depending upon the solvent, the varnishes are classified into the follow *four* categories:

(1) Oil varnishes

(2) Spirit varnishes

(3) Turpentine varnishes

(4) Water varnishes.

(1) Oil varnishes: The linseed oil is used as solvent in this type of varnis The hard resins such as amber and copal are dissolved in linseed oil and if t varnish is not workable, a small quantity of turpentine is added. The oil varnishes dry slowly, but they form hard and durable surface. In fact, these are the hardest and the most suitable varnishes. They are specially adopted for exposed works which require frequent cleaning. They are used on coaches and fittings in houses.

(2) **Spirit varnishes:** The methylated spirits of wine are used as solvent in this type of varnish. The resins are of soft variety such as lac or shellac. The spirit varnishes dry quickly. But they are not durable and are easily affected by weathering actions. They are generally used for furniture. The French polish is a variety of this class of varnish and the desired colouring tinge can be obtained by addition of suitable colouring pigment. The French polish is one of the finest finish for ornamental furniture prepared from superior quality of wood.

(3) **Turpentine varnishes:** The turpentine is used as solvent in this type of varnish. The resins adopted are of soft variety such as gum dammar, mastic and rosin. These varnishes dry quickly and possess light colours. They are not durable and tough as oil varnishes.

(4) **Water varnishes:** The shellac is dissolved in hot water and enough quantity of either ammonia or borax or potash or soda is added such that shellac is dissolved. These varnishes are used for varnishing maps, pictures, etc. They are also used for delicate internal work and as a covering for wall paper.

UNIT-III

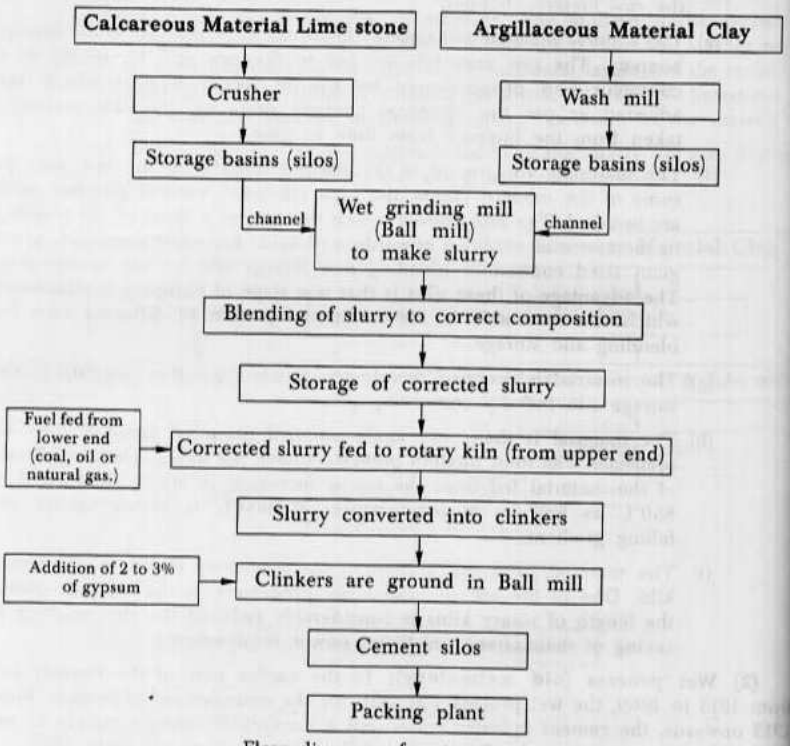
B-III a) Explain with a neat sketch, manufacturing of cement by wet process **08**

(2) **Wet process (old technology):** In the earlier part of the century i.e., from 1913 to 1960, the wet process was used for the manufacture of cement. From 1913 onwards, the cement industry underwent a number of changes mainly to suit the requirements of the manufacturers and the govt. policies till early 1982.

All the cement plants set up after 1980 use the dry process for the manufacture of cement. In this process, the calcareous materials such as limestone are crushed and stored in silos or storage tanks. The argillaceous material such as clay is thoroughly mixed with water in a container known as the *wash mill.* This washed clay is stored in basins.

Now, the crushed limestone from silos and wet clay from basins are allowed to fall in a channel in correct proportions. This channel leads the materials to grinding mills where they are brought into intimate contact to form what is known as the *slurry.* The grinding is carried out either in ball mill or tube mill or both. The slurry is led to correcting basin where it is constantly stirred. At this stage, the chemical composition is adjusted as necessary. The corrected slurry is stored in storage tanks and kept ready to serve as feed for rotary kiln. shows the flow diagram of mixing of raw materials by the wet process.

It is thus seen that in case of mixing of raw materials by dry process, the raw mix is formed and in case of mixing of raw materials by wet process, the slurry is formed. The remaining *two* operations namely, burning and grinding, are the same for both the processes.



Flow diagram of wet process

FIG.

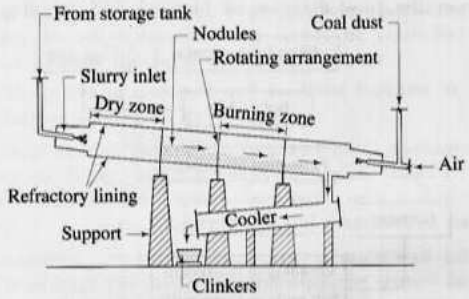
6-10-2. BURNING

The burning is carried out in a rotary kiln as shown in fig. A rotary kiln is formed of steel tubes. Its diameter varies from 2.50 m to 3 m. Its length varies from 90 m to 120 m. It is laid at a gradient of about 1 in 25 to 1 in 30. The kiln is supported at intervals by columns of masonry or concrete. The refractory lining is provided on the inside surface of rotary kiln. It is so arranged that the kiln rotates at about *one* to *three* revolutions per minute about its longitudinal axis.

The corrected slurry is injected at the upper end of kiln. Fig. shows the rotary kiln for the wet process. The hot gases or flames are forced through the lower end of kiln.

The portion of the kiln near its upper end is known as the *dry zone* and in this zone, the water of slurry is evaporated. As the slurry gradually descends, there is rise in temperature and in the next section of kiln, the carbon dioxide from slurry is evaporated. The small lumps, known as the *nodules*, are formed at this stage. These nodules then gradually roll down passing through zones of rising temperature and ultimately reach to the burning zone, where temperature is about 1400°C to 1500°C.

In burning zone, the calcined product is formed and nodules are converted into small hard dark greenish blue balls which are known as the *clinkers*.



Rotary kiln for wet process

In the modern technology of dry process, the coal brought from the coal fields is pulverised in vertical coal mill and it is stored in silo. It is pumped with required quantity of air through the burners. The preheated raw materials roll down the kiln and get heated to such an extent that the carbon dioxide is driven off with combustion gases. The material is then heated to temperature of nearly 1400°C to 1500°C when it gets fused together. The fused product is known as the *clinkers* or raw cement.

The size of clinkers varies from 3 mm to 20 mm and they are very hot when they come out of burning zone of kiln. The clinker temperature at the outlet of kiln is nearly 1000°C. A rotary kiln of small size is provided to cool down the hot clinkers. It is laid in opposite direction as shown in and the cooled clinkers having temperature of about 95°C are collected in containers of suitable sizes.

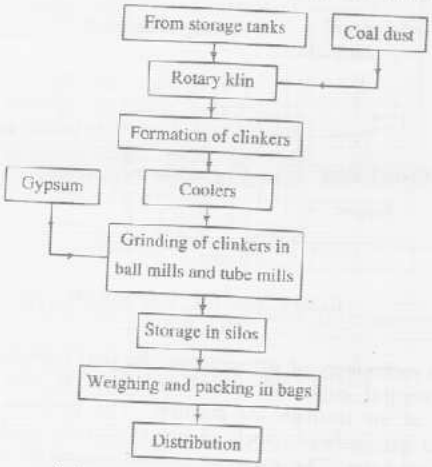
6-10-3. GRINDING

The clinkers as obtained from the rotary kiln are finely ground in ball mills and tube mills. During grinding, a small quantity, about 3 to 4 per cent, of gypsum is added.

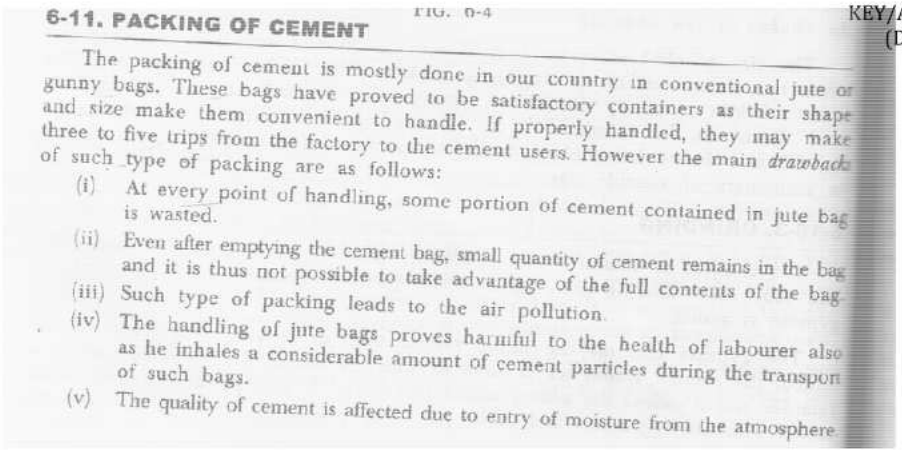
The gypsum controls the initial setting time of cement. If gypsum is not added, the cement would set as soon as water is added. The gypsum acts as a retarder and it delays the setting action of cement. It thus permits cement to be mixed with the aggregates and to be placed in position.

The grinding of clinkers in modern plants is carried out in the cement mill which contains chromium steel balls of various sizes. These balls roll within the mill and grind the mixture which is collected in a hopper and taken in the bucket elevator for storage in silos.

The cement from silos is fed to the packer machines. Most of the modern plants have electric packing plant having provision to account for the weights of empty bags of different types and to ensure a 50 kg net weight of cement bag within ± 200 g limit. Each bag of cement contains 50 kg or 500 N or about 0.035 m^3 of cement. These bags are automatically discharged from the packer to the conveyor belts to different loading area. They are carefully stored in a dry place. shows the flow diagram of burning and grinding operations.



Flow diagram of burning and grinding operations of cement



6-11. PACKING OF CEMENT FIG. 6-4

The packing of cement is mostly done in our country in conventional jute or gunny bags. These bags have proved to be satisfactory containers as their shape and size make them convenient to handle. If properly handled, they may make three to five trips from the factory to the cement users. However the main *drawbacks* of such type of packing are as follows:

(i) At every point of handling, some portion of cement contained in jute bag is wasted.

(ii) Even after emptying the cement bag, small quantity of cement remains in the bag and it is thus not possible to take advantage of the full contents of the bag.

(iii) Such type of packing leads to the air pollution.

(iv) The handling of jute bags proves harmful to the health of labourer also as he inhales a considerable amount of cement particles during the transport of such bags.

(v) The quality of cement is affected due to entry of moisture from the atmosphere.

or

(b)What is meant by steel? Give the different types of steel. Mention the properties of mild steel or low carbon steel or soft steel

Steel

Steel is iron containing less than 1.5 percent carbon. Steel is an alloy of iron and carbon. On the basis of carbon content, steel is classified as

Type of Steel	Carbon Content (%)
Dead mild steel	< 0.15%
Mild Steel	0.15-0.3
Medium carbon steel	0.3-0.8
High carbon steel or hard steel	0.8-1.5
	(>1 is also called cast steel or tool steel)

Mild steel or Low carbon steel or Soft steel:

Properties of Mild Steel

It is also known as low carbon or soft steel.
It can be magnetised permanently.
It can be readily forged and welded.
It cannot be easily hardened and tempered.
It has fibrous structure.
It is malleable and ductile.
It is not easily attacked by salt water.
It is tougher and more elastic than wrought-iron.
It is used for all types of structural works.
It rusts easily and rapidly.
Its melting point is about 1400°C.
Its specific gravity is 7.8
Its ultimate compressive strength is about 800-1200 N/mm^2.
Its ultimate tensile and shear strengths are about 600-800 N/mm^2.

Mild steel is used in the form of rolled sections, reinforcing bars, roof coverings and sheet piles and in railway tracks.

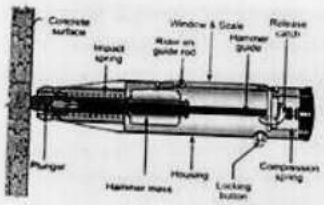
B-IV a) What is meant by design of a concrete mix? Describe in detail design of a M25 mix design. Assume suitable material data. **08**

M-25 CONCRETE MIX DESIGN (As per IS 10262-2009)		
A-1	**Stipulations for Proportioning**	
1	**Grade Designation**	**M25**
2	Type of Cement	OPC 53 grade confirming to IS-12269-1987
3	Maximum Nominal Aggregate Size	20 mm
4	Minimum Cement Content (MORT&H 1700-3 A)	310 kg/m^3
5	Maximum Water Cement Ratio (MORT&H 1700-3 A)	0.45
6	Workability (MORT&H 1700-4)	50-75 mm (Slump)
7	Exposure Condition	Normal
8	Degree of Supervision	Good
9	Type of Aggregate	Crushed Angular Aggregate
10	Maximum Cement Content (MORT&H Cl. 1703.2)	540 kg/m^3
11	Chemical Admixture Type	Superplasticiser Confirming to IS-9103
A-2	**Test Data for Materials**	
1	Cement Used	Coromandal King OPC 53 grade
2	Sp. Gravity of Cement	3.15
3	Sp. Gravity of Water	1.00
4	Chemical Admixture	BASF Chemicals Company
5	Sp. Gravity of 20 mm Aggregate	2.884
6	Sp. Gravity of 10 mm Aggregate	2.878
7	Sp. Gravity of Sand	2.605
8	Water Absorption of 20 mm Aggregate	0.97%
9	Water Absorption of 10 mm Aggregate	0.83%
10	Water Absorption of Sand	1.23%
11	Free (Surface) Moisture of 20 mm Aggregate	nil
12	Free (Surface) Moisture of 10 mm Aggregate	nil
13	Free (Surface) Moisture of Sand	nil
14	Sieve Analysis of Individual Coarse Aggregates	Separate Analysis Done
15	Sieve Analysis of Combined Coarse Aggregates	Separate Analysis Done
15	Sp. Gravity of Combined Coarse Aggregates	2.882
16	Sieve Analysis of Fine Aggregates	Separate Analysis Done
A-3	**Target Strength for Mix Proportioning**	
1	Target Mean Strength (MORT&H 1700-5)	36N/mm^2
2	Characteristic Strength @ 28 days	25N/mm^2
A-4	**Selection of Water Cement Ratio**	
1	Maximum Water Cement Ratio (MORT&H 1700-3 A)	0.45
2	Adopted Water Cement Ratio	0.43
A-5	**Selection of Water Content**	
1	Maximum Water content (10262-table-2)	186 Lit.
2	Estimated Water content for 50-75 mm Slump	138 Lit.
3	Superplasticiser used	0.5 % by wt. of cement
A-6	**Calculation of Cement Content**	
1	Water Cement Ratio	0.43
2	Cement Content (138/0.43)	320 kg/m^3 Which is greater then 310 kg/m^3
A-7	**Proportion of Volume of Coarse Aggregate & Fine Aggregate Content**	
1	Vol. of C.A. as per table 3 of IS 10262	62.00%
2	Adopted Vol. of Coarse Aggregate	62.00%
	Adopted Vol. of Fine Aggregate (1-0.62)	38.00%
A-8	**Mix Calculations**	
1	Volume of Concrete in m^3	1.00
2	Volume of Cement in m^3	0.10
	(Mass of Cement) / (Sp. Gravity of Cement)x1000	
3	Volume of Water in m^3	0.138
	(Mass of Water) / (Sp. Gravity of Water)x1000	
4	Volume of Admixture @ 0.5% in m^3	0.00134
	(Mass of Admixture)/(Sp. Gravity of Admixture)x1000	
5	Volume of All in Aggregate in m^3	0.759
	Sr. no. 1 – (Sr. no. 2+3+4)	
6	Volume of Coarse Aggregate in m^3	0.471
	Sr. no. 5 x 0.62	
7	Volume of Fine Aggregate in m^3	0.288
	Sr. no. 5 x 0.38	
A-9	**Mix Proportions for One Cum of Concrete (SSD Condition)**	
1	Mass of Cement in kg/m^3	**320**
2	Mass of Water in kg/m^3	**138**
3	Mass of Fine Aggregate in kg/m^3	**751**
4	Mass of Coarse Aggregate in kg/m^3	1356
	Mass of 20 mm in kg/m^3	**977**
	Mass of 10 mm in kg/m^3	**380**
5	Mass of Admixture in kg/m^3	**1.60**
6	Water Cement Ratio	0.43

or

(b)Explain with neat sketch, the functioning of a rebound hammer with its components. Write about the sensitivity of the test results.

Rebound hammer test is done to find out the compressive strength of concrete by using rebound hammer as per IS: 13311 (Part 2) – 1992. The underlying principle of the rebound hammer test is. The rebound of an elastic mass depends on the hardness of the surface against which its mass strikes. When the plunger of the rebound hammer is pressed against the surface of the concrete, the spring-controlled mass rebounds and the extent of such a rebound depends upon the surface hardness of the concrete. The surface hardness and therefore the rebound is taken to be related to the compressive strength of the concrete. The rebound value is read from a graduated scale and is designated as the rebound number or rebound index. The compressive strength can be read directly from the graph provided on the body of the hammer. Procedure to determine strength of hardened concrete by rebound hammer. 1. Before commencement of a test, the rebound hammer should be tested against the test anvil, to get reliable results, for which the manufacturer of the rebound hammer indicates the range of readings on the anvil suitable for different types of rebound hammer. 2. Apply light pressure on the plunger – it will release it from the locked position and allow it to extend to the ready position for the test. 3. Press the plunger against the surface of the concrete, keeping the instrument perpendicular to the test surface. Apply a gradual increase in pressure until the hammer impacts. (Do not touch the button while depressing the plunger. Press the button after impact, in case it is not convenient to note the rebound reading in that position.) 4. Take the average of about 15 readings. The rebound reading on the indicator scale has been calibrated by the manufacturer of the rebound hammer for horizontal impact, that is, on a vertical surface, to indicate the compressive strength. When used in any other position, appropriate correction as given by the manufacturer is to be taken into account.



This test method is not intended as the basis for acceptance or rejection of concrete because of the inherent uncertainty in the estimated strength.Use type N rebound hammers that are commercially available to accommodate testing of various sizes and types of concrete construction.

Abrasive Stone – Consisting of medium-grain texture silicon carbide or equivalent material.

Test Anvil – Approximately 150 mm (6 in) diameter by 150 mm (6 in) high cylinder made of tool steel with an impact area hardened to 66 ± 2 HRC as measured by test method ASTM E 18. An instrument guide is provided to center the rebound hammer over the impact area and keep the instrument perpendicular to the surface.

members to be tested shall be at least 100 mm (4 in) thick and fixed within a structure. Smaller specimens must be rigidly supported. Avoid areas exhibiting honeycombing, scaling, or high porosity. Do not compare test results if the form material against which the concrete was placed is not similar. Troweled surfaces generally exhibit higher rebound numbers than screeded or formed finishes. If possible, test structural slabs from the underside to avoid finished surfaces.

Preparation of Test Surface – A test area shall be at least 150 mm (6 in) in diameter. Heavily textured, soft, or surfaces with loose mortar shall be ground flat with the abrasive stone Smooth-formed or troweled surfaces do not have to be ground prior to testing. Do not compare results from ground and unground surfaces.

Do not test frozen concrete.

Moist concrete at 0°C (32°F) or less may exhibit high rebound values. Concrete should be tested only after it has thawed. The temperatures of the rebound hammer itself may affect the rebound number. Rebound hammers at -18°C (0°F) may exhibit rebound numbers reduced by as much as two or three units (1 unit = 1 whole number).

For readings to be compared, the direction of impact, horizontal, downward, upward, or at another angle, must be the same or established correction factors shall be applied to the readings.

Do not conduct tests directly over reinforcing bars with cover less than 0.75 in (20 mm).

The location of reinforcement may be established using reinforcement locators or metal detectors. Follow the manufacturer's instructions for proper operation of such devices.

B-V a) Describe the properties and uses of Ready mix concrete **08**

READY-MIX CONCRETE

The inside of a transit mixer uses a simple Archimedes' screw to mix and to lift the concrete to the delivery chute.

Ready-mix concrete is concrete that is manufactured in a factory or batching plant, according to a set recipe, and then delivered to a work site, by truck mounted in-transit mixers. This results in a precise mixture, allowing specialty concrete mixtures to be developed and implemented on construction sites. 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.

Ready mix concrete is sometimes preferred over on-site concrete mixing because of the precision of the mixture and reduced work site confusion. However, using a pre-determined concrete mixture reduces flexibility, both in the supply chain and in the actual components of the concrete.

Ready Mixed Concrete is also referred as the customized concrete products for commercial purpose. the Ready-mix Concrete Company offer different concrete according to user's mix design or industrial standard.

The ready mixed concrete company is required to equip themselves with up-to-date equipment, such as transit mixer, concrete pump, and Concrete Batching Plant, which needs visualized production management software and also PLC controller.

Ready Mixed Concrete, or RMC as it is popularly called, refers to concrete that is specifically manufactured for delivery to the customer's construction site in a freshly mixed and plastic or unhardened state. 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.

Ready Mixed Concrete is manufactured under controlled operations and transported and placed at site using sophisticated equipment and methods. RMC does not assures its customers numerous benefits.

Contents, Standard ready-mix concrete vs. site-mix concrete, Disadvantages of ready-mix concrete.

Standard ready-mix concrete vs. site-mix concrete

A centralized concrete batching plant can serve a wide area. Site-mix trucks can serve a larger area including remote locations that standard trucks cannot.

The plants are located in areas zoned for industrial use, and yet the delivery trucks can service residential districts or inner cities. Site-mix trucks have the same capabilities.

Better quality concrete is produced. Site mix can produce higher compression strength with less water then standard batching methods.

Disadvantages of ready-mix concrete

The materials are batched at a central plant, and the mixing begins at that plant, so the traveling time from the plant to the site is critical over longer distances. Some sites are just too far away, though this is usually a commercial rather than a technical issue.

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. (Green concrete is approx. 2.5 tonne per m^3.) This problem can be overcome by utilizing so-called 'minimix' companies which use smaller $4m^3$ capacity mixers able to reach more-restricted sites.

Concrete's limited timespan 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 timespan precisely, however, so the amount and type of admixture added to the mix is very important.

Or

(b) Describe the properties and uses of shortcrete concrete

SHOTCRETE

Shotcrete swimming pool under construction in Northern Australia. Shotcrete is concrete (or sometimes mortar) conveyed through a hose and pneumatically projected at high velocity onto a surface, as a construction technique.

Shotcrete is usually an all-inclusive term that can be used for both wet-mix and dry-mix versions. In the pool construction trade however, the term "shotcrete" refers to wet-mix and "gunite" refers to dry-mix; in this context, these two terms are not interchangeable (see "Shotcrete vs. gunite" discussion below).

Shotcrete undergoes placement and compaction at the same time due to the force with which it is projected from the nozzle. It can be impacted onto any type or shape of surface, including vertical or overhead areas.

Shotcrete, then known as gunite, was invented in the early 1900s by American taxidermist Carl Akeley, used to fill plaster models of animals. He used the method of blowing dry material out of a hose with compressed air, injecting water at the nozzle as it was released. This was later used to patch weak parts in old buildings. In 1911, he was granted a patent for his inventions, the "cement gun", the equipment used, and "gunite", the material that was produced. Until the 1950s when the wet-mix process was devised, only the dry-mix process was used. In the 1960s, the alternative method for gunning by the dry method was devised with the development of the rotary gun, with an open hopper that could be fed continuously. Shotcrete is also a viable means and method for placing structural concrete. The nozzleman is the person controlling the nozzle that delivers the concrete to the surface. The nozzle is controlled by hand on small jobs, for example the construction of small swimming pools. On larger work the nozzle can sometimes be held by mechanical arms where the nozzleman controls the operation by a hand-held remote control.

Dry mix vs. wet mix: The dry mix method involves placing the dry ingredients into a hopper and then conveying them pneumatically through a hose to the nozzle. The nozzleman controls the addition of water at the nozzle. The water and the dry mixture is not completely mixed, but is completed as the mixture hits the receiving surface. This requires a skilled nozzleman, especially in the case of thick or heavily reinforced sections. Advantages of the dry mix process are that the water content can be adjusted instantaneously by the nozzleman, allowing more effective placement in overhead and vertical applications without using accelerators. The dry mix process is useful in repair applications when it is necessary to stop frequently, as the dry material is easily discharged from the hose.

Wet-mix shotcrete involves pumping of a previously prepared concrete, typically ready-mixed concrete, to the nozzle. Compressed air is introduced at the nozzle to impel the mixture onto the receiving surface. The wet-gun procedure generally produces less rebound, waste (when material falls to the floor), and dust compared to the dry-mix procedure. The greatest advantage of the wet-mix process is that larger volumes can be placed in less time.

Shotcrete vs. gunite: Shotcrete is today an all-inclusive term that describes spraying concrete or mortar with either a dry or wet mix process. However, shotcrete may also sometimes be used (incorrectly) to distinguish wet-mix from the dry-mix method. The term shotcrete was first defined by the American Railway Engineers Association (AREA) in the early 1930s.[1] By 1951, shotcrete had become the official generic name of the sprayed concrete process - whether it utilizes the wet or dry process. Gunite is a trademarked name that is incorrectly used to describe the dry-mix shotcrete process, in which the dry cementitious mixture is blown through a hose to the nozzle, the water being injected at the nozzle immediately before it exits the nozzle. Gunite was the original term coined by Akeley, trademarked in 1909 and patented in North Carolina. The concrete is blasted by pneumatic pressure from a gun, hence "gun"-ite. The term "Gunite" became the registered trademark of Allentown Equipment, the oldest manufacturer of gunite equipment. Other manufacturers were thus compelled to use other terminology to describe the process such as shotcrete, pneumatic concrete, guncrete, etc. Shotcrete emerged as the only acceptable industry term to correctly describe "pneumatically applied concrete" - either the wet or dry process. Because the term "Gunite" is a noun (product name) and not a verb (action), it is impossible to "gunite" anything.

X