DHANBAD INSTITUTE OF TECHNOLOGY

NEP – 2024

DEPARTMENT OF CIVIL ENGINEERING

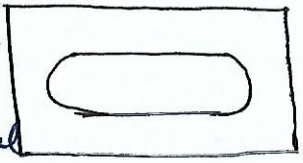
SUBJECT: CONSTRUCTION MATERIALS

HAND WRITTEN NOTES BY ER. ABHISHEK RAI (7654596461)

Brick :- It is one of the oldest ~~method~~ and leading building material used for construction due to its less cost, durability and ease of handling.

→ It is a rectangular Block in shape and size that convieutly handeled with one hand.

→ It is made up of clay or mixture of Sand and lime or OPC.



→ Clay bricks are commouly used since it is more economical and easily available.

→ The L, B, H of bricks are inter-related

→ Length of Brick = 2x width of Brick + thickness of mortar (1cm)

→ Height of Brick = width of Brick.

Size :→ Standard / modular Size = 19 x 9 x 9 cm

Nominal Size :- 20 x 10 x 10 cm
(Size with mortar)

Size of conventional / Traditional → 9" x 4.5" x 3" / 230 x 114 x 76 mm.

Note :- Weight of the brick is in range of 3 – 3.5 kg

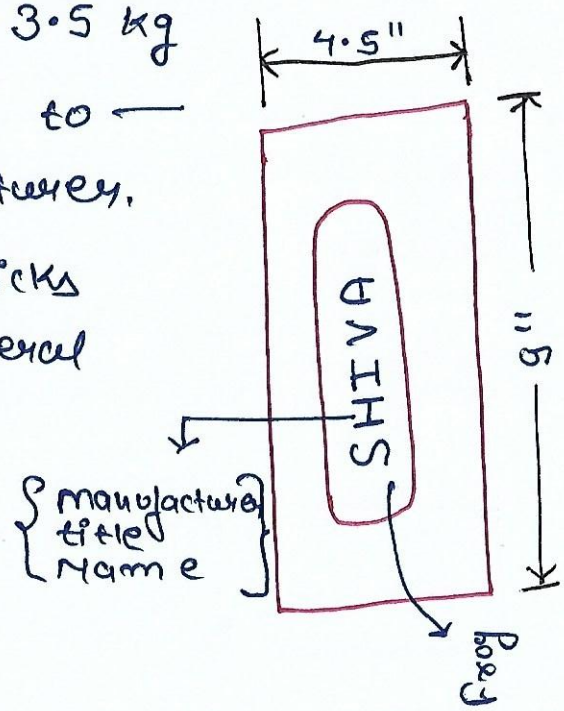
→ An indent called frog is placed over the brick to —

(a) indicate the trade Name of manufacturer.

(b) act as a shear key b/w the two bricks there by increase its strength in lateral direction.

(c) Size of the frog → 10 x 4 x 1 cm.

→ It is not provided in 4cm high bricks or extruded Bricks.



Classification of Brick :— Bricks can be classified on the basis of following :—

(i) On the basis of field practic :-

(a) 1st Class brick :—

→ These are throughly burnt deep red in colour.

→ They have smooth & rectangular surface with sharp edges.

→ They should free from cracks, stones, flaws.
→ They should have uniform texture.
→ They must not absorb more than 20% water their dry weight; when immersed (डुबाना) in cold water for 24 hour.
→ They must posses crushing streugth of 10 N/mm²
→ They find their application in painting work, exposed face work, flooring, reinforced, brickwork.

(b) Second Class brick :—
→ Their specification are same as first class brick except :—
→ Small cracks are permitted
→ Water absorpation are about 22% of dry weight of Bricks.
→ Crushing Streugth 7 N/mm²

(C) 3rd class brick :—
→ These are underburnt brick, soft, light-coloured, producing a dull sound when stick again each other.

→ Water absorbation is about 25% by dry weight of bricks.
→ They are used in tempary structure.
→ Crushing Strength 3.5 N/mm^2.

(d) Fourth Class brick :-
→ These are overburut, badly distored in shape and size ared brittle in nature
→ It is used for ballast work or for floor work.

Properties of Good Brick :-

(a) Shap and Size :- Bricks should have uiform shape and size, rectagal surface with parallel sides and straight edges.

(b) Colour :- Brick should have uniform depth, red cherry colour which indicates uniformily in chemical compositions.

(c) Texture and compactness :- Surface should not be too smooth to cause sliping of mortar, the brick should have precompact and uniform textured free from cracks.

(d) Hardness :— Brick should be hard that when scratched with finger nail, no impression is made.

(e) Soundness :— When bricks are struck together a clear metalic ringing sound be produced.

Field Testing of Bricks :—

→ About 50 pieces of bricks are taken at random from different parts of the struck to perform various tests :—

(a) Dimension Test :— 20 pieses out of selected pieces are taken and

→ Tolerance on the size of bricks are fixed by giving maximum and minimum dimensions not on individual bricks but on baches of 20 bricks chossen at random.

→ It follow from the method of measurements that batches are likely to contain brick outside the prescribed limit of tolerence.

→ Such log should be rejected to avoid variation of properties.

(b) Water absorption test:— (a) 24 hour Immersion in cold water test.

→ Dry bricks are put in an oven at temp of 105°— 115°c & weight (W_1) of bricks is recorded after cooling at room temperature.

→ Then bricks are immersed in water at 27°c ± 2°c for 24 hours and again weight (W_2) after removing it from water.

$$\left[\% \text{ Absorption} = \frac{W_2 - W_1}{W_1} \times 100\right]$$

→ The average water absorption shall not be more 20% by weight upto class 12.5%. and 15% by weight of heigher class.

(b) 5 Hour Boiling water test

→ Here W_1 is recordes as same.

→ Then the specimen is immersed in water and boiled for 5 hours followed by cooling down for Next 16-19 hour's at temp of 27°±2°c.

→ And its weight is noted again (W_3)

$$\left[\% \text{ Absorption} = \frac{W_3 - W_1}{W_1} \times 100 \right]$$

Manufacturing process of burnt clay Bricks :-

Step 1 :- Preparation of Clay :-

→ The process of preparing clay involves six steps such as unsoiling, digging, cleaning, blending, weathering and tempering.

→ The upper soil surface is removed upto a depth of 200mm to eliminate impurities and other earthy particles.

→ The clay is then mixed manually or mechanically and heaped over the ground surface.

→ The collected clay is removed & cleaned for stones, pebbles, & other vegetables using a filtering screen.

→ The filtered clay is mixed with sand and straw to improve the quality of Brick.

→ The blended clay mix is spread on an open surface for direct exposure to the natural weather conditions for several weeks or even a month to allow plasticity & durable properties.

→ Adequate water is added to the weathered/ seasoned clay, which is then kneaded with the help of labour or cattle two to three times and battered with shovels. to make it a homogenous mix, ready for moulding.

Step 2:— Moulding →

→ The prepared clay is transferered to a mould and crepsed to eliminate gaps to acquire a good texture and finish, either manually or mechanically using high-powered compressing machines.

Step 3 :— Drying :-

→ The moulded clay bricks are racked and kept under the sun for drying.

→ usually, the drying process takes around 3 — 10 days, depending on the climatic conditions.

Step 4 :— Burning :-

→ The bricks are burnt in fire chambers (or kilns) at very high temperature (1100°C) for 10 — 40 hours to gain maximum strength & hardness.

→ Bricks are ready to use.

Clamp Burning of Bricks :-

→ A piece is selected.

→ Its shape in plan is generally trapezoidal.

→ The short end of a floor is slightly deep and wider end is at angle of 15°.

→ The brick wall in mud is constructed on the short end a layer of fuel is laid on the prepared floor.

→ This thickness of this layer is about 700 mm to 800 mm.

→ A layer of 4-5 courses of raw bricks is then put up.

→ A small spaces b/w the bricks are availed for the circulation of air.

→ A second lay fuel and raw bricks are placed again.

→ The thickness of fuel layer decreases as a height of clamp increases.

→ The total height of clamp is abad 3-4m

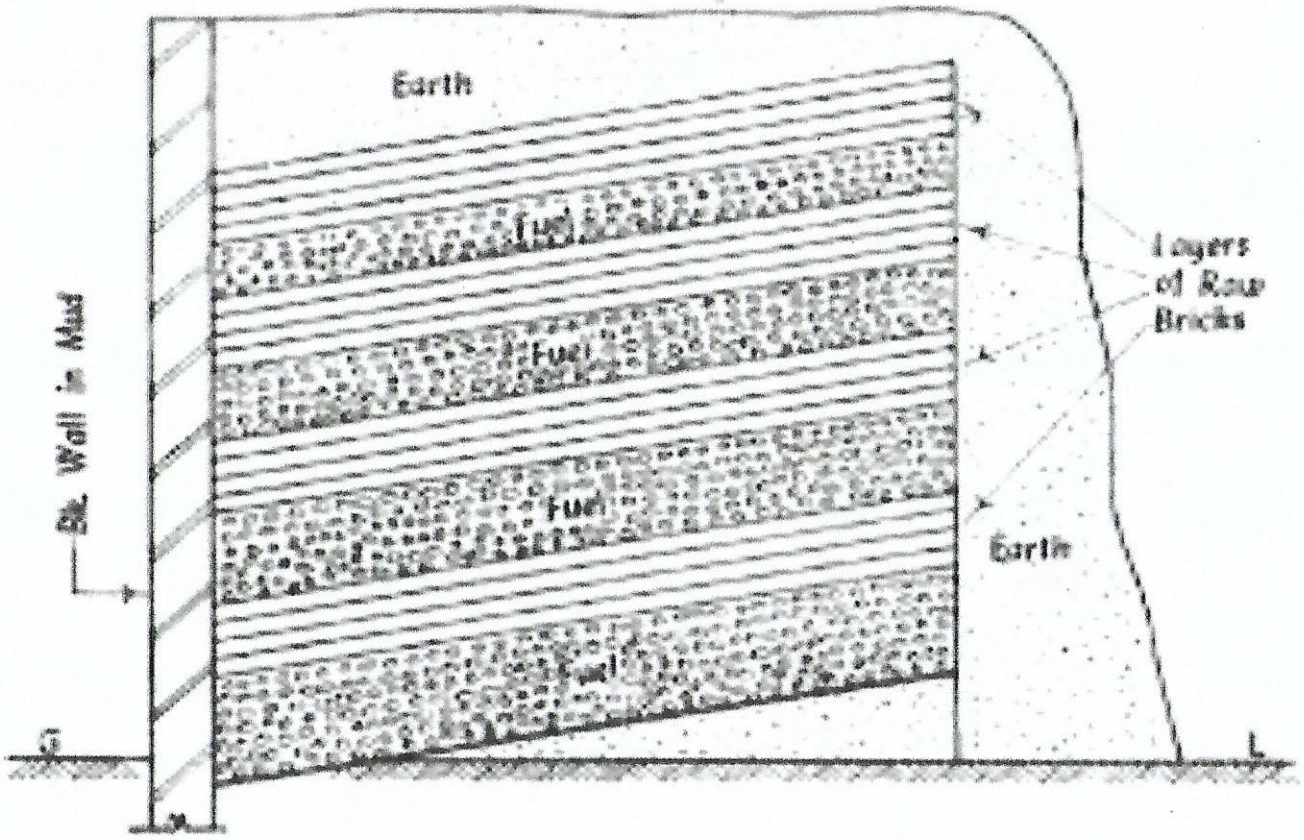
→ When nearly 1/3rd height is reached, the lower portion of clamp is ignited.

→ When it is fully constructed with all of these materials, it is plastered with muds on sides and top for heat.

→ The clamp is allowed to burnt for a period of about 1-2 months.

→ It is then allowed to cool for more or less the same period as burning.

→ The burnt bricks are taken out from the clamp.



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HAND WRITTEN NOTES BY ER. ABHISHEK RAI (7654596461)

Hoffman Kiln's :-

→ Hoffman Kilh's is continuous Kiln's and Modern Type Kiln.
→ It is some times known as flame Kiln. Its shape is circular in plan & it is devided into a number of compartments of chamber.
→ fuel inserted in the Kiln is covered with the soil.
→ From this Kiln 25,000 bricks are produced in a day and about 75 lakh bricks annually.
→ Advantages of this Kiln is that percent of high quality bricks 80-90%.
→ When bricks are not required in demand the extra money is required to maintain all cabinet of Kiln.
→ Performance of chamber will be as follows:-

- Chamber 1 → Loading
- chamber 2 – 5 → Drying & pre heating
- chamber 6 – 7 → Burning
- chamber 8 – 11 → cooling
- Chamber 12 → Unloading.

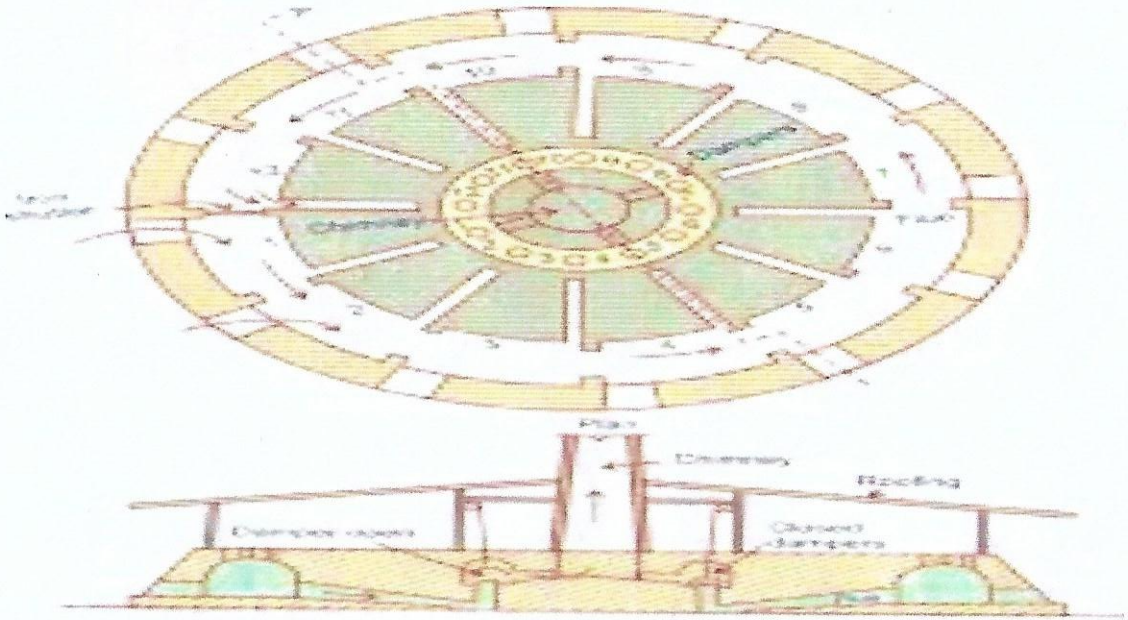


FIG. 2.10 Hoffman's Kiln

AAC Blocks :-

→ It is also known as Autoclaved Aerated Concrete Blocks.

→ It represents a new era in construction materials, offering unmatched strength, light weight design, & eco-friendliness.

→ It is manufactured by using fly ash, cement, lime and aeration agent. Our autoclave aerated blocks → IS - 2185 (Part-3 standards)

→ It is suitables for Residential, commercial, Industrial, Institutional projects / Ambitions.

→ Size - 75mm / 100mm / 125mm / 150mm / 200mm / 225mm.

→ Density 550 - 650 kg/m^3 (oven dry)

→ Comp Str → 4N/mm^2

→ Water absorption → 8% (at equilibrium.

→ Fire resistance → 4 hrs (150 mm wall).

Properties of Aerated Concrete Blocks :-

1. Light weight
2. Thermal Insulation
3. Sound Insulation
4. Fire Resistance
5. Workability
6. Eco - friendly
7. Precision & uniformly
8. Low - water absorption.

Floor tiles :-

→ It may be square or hexagonal in shape.
→ These are flat tiles and their thickness varies from 12mm to 50mm.
→ The size of square tiles varies from 150mm to 300mm.
→ They are available in an endless range of colours and designs.
→ They are easier to lay as they are small in size.
→ They are scratch, stain and damp-proof as well as anti-slip.
→ They donot require polishing and the floor is ready for use the very next day.

Characteristics of good tiles :-

→ It should be free from any cracks, flows or bends.
→ It should be regular shape and size
→ It should be sound, hard and durable.
→ It should be well burnt.

→ It should give a clear ringing sound and when struck with hand or with one another or with one hammer.

→ It should fit in properly, when placed in position.

→ It should give an even and compact structure when seen on its broken surface

→ It should posses uniform colour.

Tera-cotta (Galvanized Tiles) :—

→ The tera cota means the baked earth.

→ It is a type of earthenware or porous pottery made from local clays and glazed with glazes containing galena.

→ It is manufactured by the process of preparation of clay, moulding, Drying, Burning.

→

Ceramic Tiles .....

Composition → Primarily made of clay and water.

Manufacturing → Baked at hight temperature in a kiln.

Porosity → More porous than Vitrified tiles

Durability → Less durable than Vitrified tiles, more prone to chipping and Cracking.

Appearance :- Can be matte, rough or glossy depending on the glaze applied

Price → Generally cheaper than Vitrified tiles.

Vitrified Tiles .....

→ Composition :- A blend of silica, clay, feldspar & Quartz.

→ Manufacturing :- Fused at high temperatures. Untill they become glass like, a process called Vitrification.

→ Porosity :- Very low porosity, making they water-resistant & stain resistant.

→ Durability :- Stronger & more durable than ceramic tiles. resistant to wear and tear.

→ Appearance :- Typically glossy and smoother than ceramic tiles.

→ Price :- more expensive than ceramic tiles due to higher Quality and manufacturing process.

Manufacturing Process of Cement

① Dry process

② Wet process.

Dry process :- (modern technology) → Following reasons are as follows:-

(a) competition :- Dry process are competing with each other. The cement consumers in general and the practising civil engineers in particular are greatly benefited by such competition.

(b) Power :- The blending of dry powder are now perfected & the wet process, which required much higher consumption of power, can be replaced with confidence.

(c) Quality of Cement :- It is found that Quality of the production no longer dependend on the skilled operators & workmen because

of temperature control & proportioning can be done automatically though a centralised control room.

(d) Technology :- The application of the modern technology has made the production of cement by dry process more economical & of superior quality

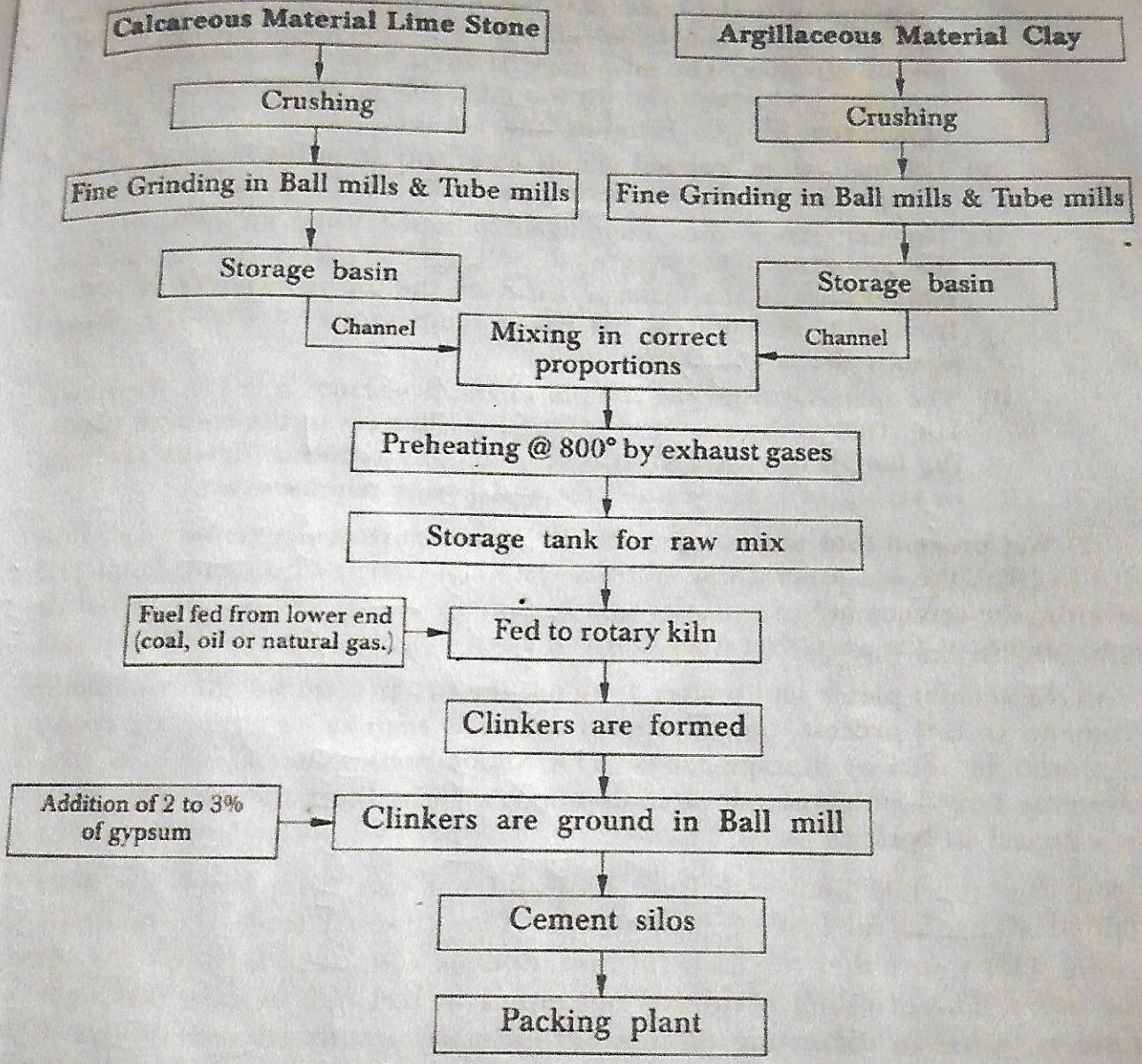
Procedure :- Following are as :-

(1) The boulders upto 1.2m size are transported in huge dampers upto 300kN capacity & dumped into the hopper of crusher.

(2) The crushed limestone now of 75mm size is moved from the crusher by a series of conveyors for stacking.

(3) The argillaceous or clay materials found in the quarry are also dumped into the crushers & stacked along with the limestone.

and stacked along with the limestone.



Flow diagram of dry process

FIG. 6-1

flow chart of dry process.

#

Uses of Cement :- Following are the various possible uses.

(1) Cement mortar for masonary work, plaster, pointing etc.

(2) concrete for laying floors, roofs, and constructing lintels, beams, weather, sheds, stairs, pillars, etc.

(3) Construction of important engg structures such as bridges, culverts, dams, tunnels, storage reservoirs, light houses, dock, etc.

(4) Construction of water tank, wells, tennis courts, septik tank, lamp post, roads, telephone cabins etc.

(5) making joints for drains, pipes, etc.

(6) manufacture of precast pipes, piles, garden seats, artistically designated etc.

(7) Preparation of foundation, waterright floors, foot paths, etc.

Varities of Cement :-

Date:- 29/04/25

1. Acid Resistant Cement.
2. Blast Furnace Cement.
3. Coloured Cement.
4. Expanding Cement
5. High alumina Cement
6. Hydrophobic Cement.
7. Low Heat Cement.
8. Pozzolana Cement.
9. Quick Setting Cement
10. Rapid hardening Cement
11. Extra Rapid hardening cement.
12. Sulphate resisting cement
13. White Cement.

Low Heat Cement :- (IS: 12600 – 1989)

→ It is a Volcanic Powder
→ The considerable heat is produced during the setting action of cement.
→ In order to reduce the amount of heat, this type of cement is used.
→ It contains lower percentage of tricalcium aluminate (C_3A) of of about 5% and higher percentage of diacalcium silicate C_2S of about 46%.
→ It posses less compressive strength.
→ The initial setting time is about 1 hour & final setting time is about 10 hours.
→ It is mainly used for mass concrete.
→ It had an IS code no of i.e. **IS: 12,600 – 1989**

Pozzolana Cement :- I.S: 1489 - 1991.

→ It is a volcanic powder.
→ It is found in Italy near Vesuvius.
→ It resembles in Surkhi which is prepared by burning bricks made from ordinary soil.
→ It can also be processed from shales and certain types of clays.
→ The percentage of Pozzolana material should be b/w 10 - 30.
→ It imparts plasticity & workability to the mortar & concrete prepared from it.
→ It offers great resistance to the expansion.
→ It possesses higher tensile strength.
→ It is also used in sewage works & for laying concrete under water.

Quick Setting Cement :-

→ It has small %ge of aluminium Sulphate and by finely grinding the cement.

→ The %ge of gypsum and retarder for setting action is also greatly reduced.

→ The addition of aluminium Sulphate & fineness of grinding are responsible accelerating the setting the action of cement.

→ The initial setting time of cement is 5 minutes after addition of H_2O.

→ The final setting time of cement is lessthan 30 minutes or so.

→ This cement is used to lay concrete under static water or running water.

Rapid Hardening Cement :- (IS : 8041 - 1990)

→ The initial and final setting times of this cement are same as those of ordinary cement.

→ It attains high strength in early days.

→ It contains high percentage of tricalcium silicate C_3S to the extent of about 56%.

→ It is light in weight

→ It is not damaged easily.

→ This cement requires short period of curing.

→ The formwork of concrete can be removed & it can be therefore be used frequently.

→ As it sets rapidly, the construction work may be carried out speedly.

White Cement :- (IS: 8042 - 1989)

→ Factory → Kottayam, Kerala by Travancore Cement Limited (TCL) in (1956)

→ The cement was sold under the brand name Vembanand Cement.

Codes of Cement :-

Hollow Concrete Block :-

Properties :-

→ Lighter weight : Typically 40-50% lighter than solid blocks due to hollow cores.

→ Hollow cores : Generally have one or more cavities (usually 25-50% of the blocks volume).

→ Better Insulation :- Air in the hollow sections improves thermal & sound insulation.

→ High compressive strength :- Usually ranges from 3.5 to 7.5 N/mm^2.

→ Can be reinforced :- Hollow cores can be filled with reinforcement and grout for load bearing walls.

→ Ease of handling :- Light weight air faster construction.

Uses :- Non-load-bearing and load-bearing-walls.

→ Partition walls

→ Retailing walls (when reinforced)

→ Multi-Storey buildings (when reinforced)

→ Sound & heat insulated walls.

Solid Concrete Blocks :-

Properties :-

→ Heavier & denser :- Made with high density aggregate.
→ Greater strength :- Suitable for heavy load bearing applications.
→ Less Insulation :-
→ Higher load bearing capacity :- More suitable for high load app.
→ Better resistance to Impact :- Offers Improved Structural stability.

Uses :-

→ Load bearing walls in highrise building.
→ Foundation walls.
→ Retaining walls.
→ Paving and floor construction.
→ Industrial & ware house walls.
→ Underwater or heavy load applications
(when specially treated)

Properties of Pavement blocks :-

High Compressive Strength :- Typically ranges from 30-50 MPa, making them suitable for both pedestrian & vehicular traffic.

Durability :- Resistant to weathering, chemicals & wear from traffic.

Slip Resistance :- Textured surface help prevent slipping, even when wet

Asthetic Variety :- Available in different colours, shapes, patterns & finishes.

Permeability :- Some types (Permeable pavers) allow water infiltration to reduce runoff.

Low maintenance :- Available.

Permeability :- Some types are porous, allowing water to through to reduce run off.

Modular Design :- Uniform shape & size allow for easy installation and replacement.

Uses of Pavement Blocks:-

① Driveways & parking lots:- Durable surface for vehicles.

② Sidewalks & pathways :- Common in Urban planning for pedestrians.

③ Patios & courtyards:- Enhances outdoor living spaces.

④ Public Parks & plazas:- Durable surfaces for high foot traffic

⑤ Industrial yards:- Suitable for areas with frequent heavy vehicle movemet.

⑥ Road Shoulders & Medians:- Used in Urban Infrastructure.

⑦ Parking Lots :- Especially permeable pavers for eco-friendly designs.

Types of Artificial / Industrial Timber:-

① Plywood:- Made by gluing together thin layes (veneers) of wood with the grain at right angles.

② Particle Board:- composed of wood chips & particles bonded with compressed.

③ MDF (Medium density fiberboard):- Made from wood fibres glued under heat & presure; smooth & uniform.

④ Blockboard:- Contains a core of softwood strips glued together & sandwiched b/w veneers.

Date:— 03/05/25

#Laminated Boards:- These are engineered wood products made by bonding layers of wood, veneer or paper together with adhesives. They often have a decorative surface layer & cost effectiveness.

Uses:-

(1) Furniture:- Tables, cabinets, wardrobes, & office desks.

(2) Flooring:- Laminate flooring mimics wood or stone finishes.

(3) Wall panels:- Decorative wall cladding.

(4) Kitchen & Bathroom Surfaces:- countertops & cabinet faces due to moisture resistant.

(5) Doors:- Particularly flush doors with decorative laminates.

(6) Construction:- LVL used for beams, headers & scaffolding.

Glass :-

(a) Soda lime Glass :- composition :- Silica (SiO_2), Sodium Oxide (Na_2O) and calcium Oxide (CaO)

uses :- Window panes, Bottles & Jars, Drinking glasses, Light Bulb, etc.

(b) Lead Glass (also called lead crystal) :-

composition :- Silica with a significant amount of lead oxide (PbO)

uses :- Decorative glass ware (vases, crystal glasses)
→ Optical lenses & prisms., Hospitals, Labs (X-ray protection)

(c) Borosilicate Glass :- Silica with boron trioxide (B_2O_3)

uses :- Laboratory glassware (beaker's, test tubes).

Cast Iron :-

Properties:-
1. Hight carbon content (2-4%)
2. Hard & brittle
3. Excellent compressive strength
4. Good wear resistance
5. Poor tensile stength & ductility
6. Low melting point.
7. Good machinability (for some grades)

Uses :-
1. Engine blocks
2. Pipes & pipefitting
3. Cookware (eg. pans)
4. Manhole covers
5. Machine tools frames
6. Stove & fireplace components.

Steel (General - include various types like carbon steel, alloy steel etc.)

Properties:- Low carbon content than cast iron (usually <2%)

- → High tensile strength
- → Ductile & malleable
- → Can be hardened & tempered

Uses:- construction (beams, rebar)

- → Automative & aerospace components
- → Tools & machinery
- → Cutlery & kitchenware

Aluminiums

Properties:—

1. Light weight (1/3 wt of steel)
2. Good corrosion resistance
3. High termal & electrical conductivity
4. Ductile & malleable
5. Non-magnetic
6. Recyclable

Uses:-

1. Aircraft & automotive parts
2. Beverage cans & food packaging.
3. Window frames & doors
4. Electrical transmission lines
5. Kitchen utensils.

Copper

Properties:—

1. Excelent electrical & thermal conductivity
2. corossion resistant
3. Ductile & malleable
4. Antimicrobial
5. Non magnetic

Uses:—

1. Electrical Wiring & motors.
2. Plumbing pipes & fittings
3. coinage & art.

Zinc.

Properties:-

1. Moderate Strength
2. Good corrosion strength (especially as a coating)
3. Low melting point
4. Brittle at room temp but becomes ductile when heated.

Uses:—

1. Galvanizing (coating iron/steel to prevent rust.)
2. Die-casting alloys.
3. Batteries (eg, alkaline, zinc)
4. Roof gutters & sheeting
5. Nutritional supplements.

Aluminium Alloy's.

Composition :-

1. Copper (Cu)
2. Magnesium (Mg)
3. Silicon (Si)
4. Zinc (Zn)
5. Mangauese (Mn)

Uses :-

1. Aerospace Industry
2. Automotive parts
3. Construction
4. Packaging
5. Electrical Trausission lines.

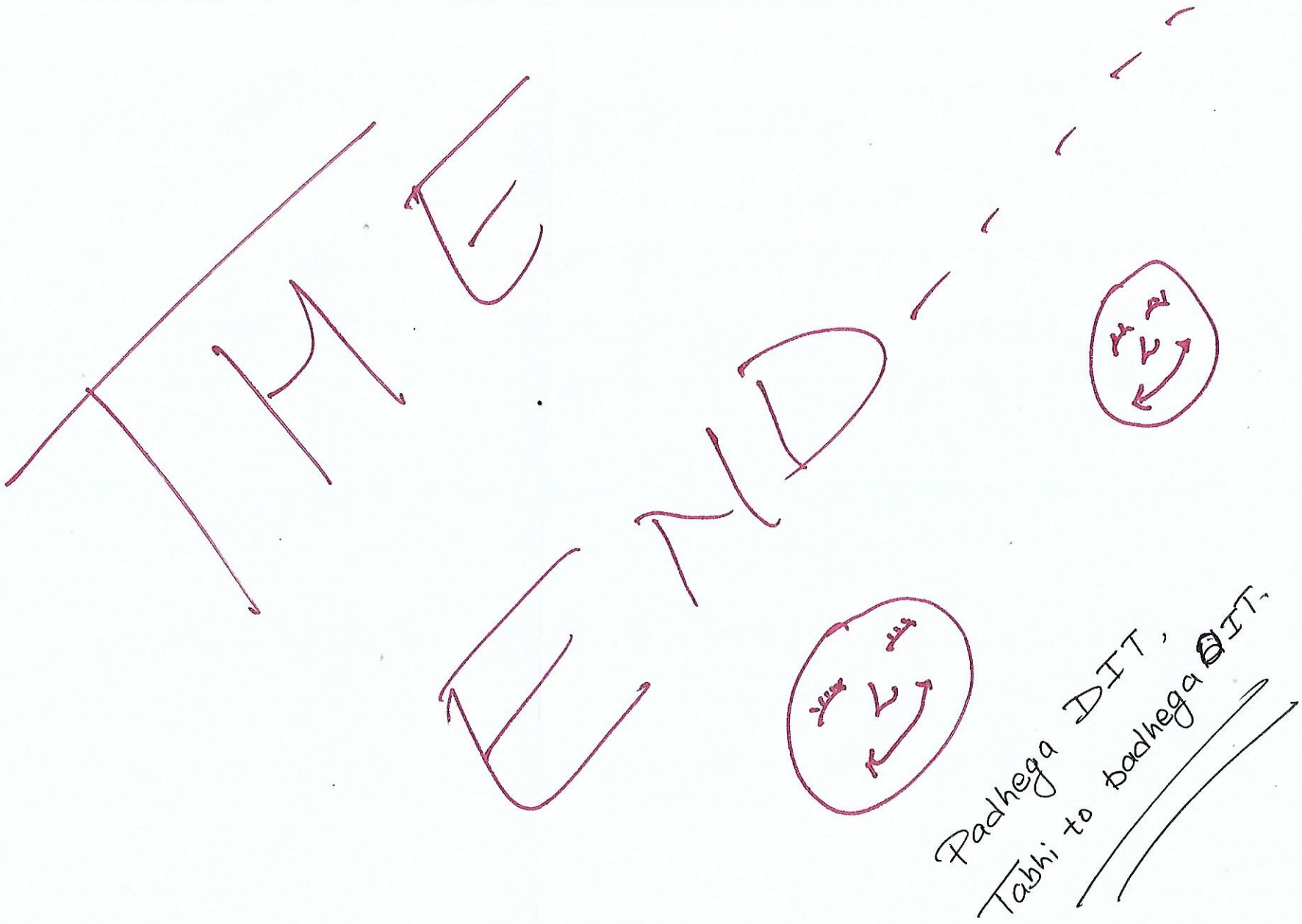
Steel Alloys.

Composition :-

1. Carbon (C)
2. Chromium (Cr)
3. Nickel (Ni)
4. Molybdenum (Mo)
5. Mangauese (Mn).

Uses :-

1. Construction
2. Transportation
3. Kitchenware & Medical Instruments
4. Pipelines & Preasure Vessels.



IMPORTANT QUESTION

1. Explain the constituents and characteristics of Bricks
2. Perform Field tests on Bricks
3. With a neat diagram able to explain manufacturing process of bricks
4. Write the properties of Aerated Concrete Blocks
5. Identify different varieties of Floor tiles and wall tiles, Glazed tiles and vitrified tiles
6. With a neat diagram able to explain manufacturing process of cement.
7. Identify different types of cement and mention their uses.
8. Explain properties and uses of precast hollow and solid concrete blocks and pavement blocks.

IMPORTANT MCQ QUESTION

1. Which of the following is an artificial construction material?A) Wood
B) Clay
C) Concrete
D) Stone

Answer: C) Concrete

2. Which material is commonly used in the production of Portland cement?

A) Limestone
B) Sand
C) Clay
D) Both A and C

Answer: D) Both A and C

3. Which of the following is NOT typically a component of reinforced concrete?A) Steel bars
B) Cement
C) Aggregates
D) Wood

Answer: D) Wood

4. Fly ash is a by-product of which process?

A) Oil refining
B) Coal combustion
C) Cement production
D) Steel manufacturing

Answer: B) Coal combustion

5. Which synthetic material is often used as an insulator in construction?

A) Fiberglass
B) Concrete
C) Brick
D) Asphalt

Answer: A) Fiberglass

6. What is the main advantage of using artificial construction materials over natural ones?

A) Higher cost
B) Limited availability
C) Consistent quality
D) Environmental friendliness

Answer: C) Consistent quality