Construction Materials

It is a material prepared for all the information needed in Construction Materials. I believe you will like this online content. If you don't have this information, I will also download it for you at the end. You can make good use of this material during your free time.

What are the Construction materials?

The different types of materials used in the construction industry such as Stone, Bricks, Cement, aggregate, Lime, Mortar, Timber, Steel, Paint, Plumbing, Electrical, Varnish, Plastics, Glass, Tiles, etc... and Other insulation materials are called construction materials.

Stone

The stone is derived from Rocks which form the earth's crust and have no definite shape or size. That is called natural materials.

The crushing strength of Good Building Stone is not less than 100kg/cm^2.

The Crushing Strength of Building stone is always 1000 kg/cm^2.

Stone	Heavey stone	Light stone	Soft stone
Suitable	Retaining wall	Masonry Wall	ornamental work

Application of stone

Classification of Stone/Rocks

Based on Formation/ Geological Classification

Ingenious Rock

Igneous Rocks are formed by the solidification of molten mass of silicates below or at the surface of the earth. Which is formed by the cooling of magma. For example: syenite, gabbro.

Main Constitutent- **Silica**

Intrusive Rocks are formed by the cooling of magma below the surface of the earth. It is two types:

Plutonic Rock	Depth 3- 8 km	Granite	Pegmatite
Hypabyssal Rock	Depth 2-3 km	dolerite	diorite

Extrusive Rock: If the cooling of magma at the surface of the earth. This rock is also called **volcanic rock.** For example: basalt, obsidian, trap, pumice, dacite.

Sedimentary Rock

Sedimentary rocks are formed by the Gradual deposition of material. like sand, silt, clay, and debris, etc.

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Main Constitution: sand, silt, clay, debris, gravel etc.
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It is also known as aqueous rock. The process of formation of the rock is **petrification**.

They are also satisfied due to the nature of this rock formation. This rock is formed in layers of materials. For example: Limestone, sandstone, gypsum, chalk, dolomite, kankar, conglomerate rock, diatomite, tripoli, chert etc.

Metamorphic rock

Metamorphic rocks are formed by the change in texture or mineral compaction or both of igneous or sedimentary rock due to high temperature and heavy pressure. For example: Marble, gneiss, quartzite, slate, schist, serpentine.

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Main constitution: Ignious rock and sedimentry rock.
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Igneous or sedimentary rock	Metamorphic Rock
Granite	Genesis
Sand Stone	Qurtezite
Shale	Slate and schist
Limestone and dolomite	Marble
Canglomerate	Genesis

Physical Classification

Stratified Rock

Stratified rocks are those which give distinct layers which can be separated. for ex all the sedimentary rock, marble, and quartzite.

Unstratified rock

Unstratified rocks do not show signs of strata and can't be easily split into slabs. For eg, all igneous rocks.

Foliated rock

Foliated rocks tend to split in a certain direction. For eg, all metamorphic rocks but marble and quartzite are excluded.

Chemical Classification

Rock	Main Constituent	Example

Argillaceous	Clay or alumina	Slate, Laterite, Koatine
Silicious	Silica	granite, genesis, basalt, sand stone, quartizite
Calcareous	lime or calcium oxide	Siliceous

Characteristics of Good Building Stone

1. Appearance and Colour
2. Wight
3. Water absorption less than 5%
4. Fire resistance
5. Electrical resistance
6. Hardness
7. Easy to working
8. Durability
9. Toughness
10. Soluble salt of 0%
11. Minimum crushing strength is 100 kg/cm^2.
12. Specific Gravity is not less than 2.4.
13. Heaviness

Test of stone

Test of Stone	Used
Absorption	To determine the amount of water absorbed in 24 hr.
Acid Test	To check whether resistance
Crushing Test	To determine the strength of the stone.
Hardness Test	To determine the hardness of the stone
Impact Test	To determine the toughness of the stone
Smith Test	To find dirty materials in stone
Attrition Test	To check resistance to abrasion
Brard Test	For Frost resistance
Microscope Test	Find out grain size, and existing of pores.

what are the tests of stone?

Important Terms of Stone

Quarrying

The process of removing stone from the natural rock is known as quarrying. The open part of the natural rock from which useful materials are obtained is known as a quarry.

Quarry Sap

The process of removing quarry sap from stone is called seasoning of stone. Which process is complete within 6-12 months. Tool for quarrying pick axes, crowbar, Jumper, wedge, etc.

Method of Quarrying

Now we discuss what are the methods of stone quarrying. There are many types of methods used for stone quarrying. But, I have discussed it from a Technical terms point of view.

Digging or Excavation

It is carried out with the help of a tool such as a pick axe, Crowbat, hammer, shovel, etc. The tools are useful for the soft stone.

Heating

The top surface of the rock is heated by placing wood with fuel on it. Fire will be allowed for some hours. Then after heated which separated from the rock.

Wedging

This method is applicable when the rock contents cracks or joints on it. steel wedges or steel points are put in those cracks and hit with a hammer.

Blasting

In this method, explosives are used to separate the stone from the parent rock. This method is used when rock is hard and without any cracks.

The holes are drilled in the rock and explosives are arranged in the holes and blasted with proper safety.

Tools for blasting

- Steel jumper of 1.8- 3 m long and 40 diameter with chisel.
- Tamping needle.
- Scraping spoon

Explosives used in blasting are gun-power, Dynamite, Guncotton, Cordite, etc.

Gunpowder is not used for blasting underwater.

Dressing

It is the process of giving proper shape, size, and Finish. It is done either manually or mechanically. Artificial Stone is made of cement and natural aggregate with the required shape and size.

Tools used in dressing

- Soft stone chisel
- Crwo chisel
- Punch chisel
- Drafting Chisel
- Mason Hammer
- Scrubbing Hammer
- Fare Hammer
- Spalling hammer

Minerals in Rock

Minerals may be defined as Organic substances, Having usually have a definite chemical composition that can be expressed by a chemical formula and physical properties.

The properties of rock mainly depend on the types of minerals present in rock. For eg, Quartz, Felspet, Calcite, alumina and, Mica.

Properties of Minerals

- **Cleavage** Tendency of Minerals to break with *smooth flat surface.*
- **Texture** Arrangement Constituent mineral grain is available in stone.
- **Luster** Shine Surface of mineral. It *appears under reflected light*.
- **Color** is the main *characteristic* of minerals.
- **Streak** color of powder form of minerals.
- **Weathering** effect of *atmospheric condition*.

Moho's Scales

It was created in 1812 by the German geologist and mineralogist **Friedrich Moho**. That is used to determine the hardness of stone.

Moho's Scale (hardness)	Minerals
a. Soft stone	Talc
b.	Gypsum
c.	Minerals
d.	Flurite
e.	Apatite
f.	Feldspar
g.	Quartz
h.	Topoz
i.	Sapphire
j. Hard stone	Diamond

Suitability of Stone

Parts of Structure	Stone
Building Construction	Laterite
Cement Concrete	Basalt and trap
Roof Covering, Flooring, Damp proofing, sill, and window	Slate
Interior decoration of the Building	Serpentine
Railing Ballast	Granite, Gneiss, Trap
For fire resistance	Compacted sandstone
Road metal	Granite and basalt
Bridge, pier, docks	Granite and Gneiss
Ornamental work in building	Red and yellow type basalt and trap
Partitions in Urinals and bathroom	Slate
Ornamental buildings, Monuments, Statue,s and curved works	Marble

Flag Stone

This is a rock from the sandstone composed of feldspar and quartz. **Sedimentary rock**.

Graine Size=0.16-2 m dia.

Use paving slabs, roofing, and memorials.

Properties of Special Stones

Stone	**Type**	**Nature**	**Color**	**Uses**
Granite	Igneous	Hard and strongest	Gray, Green, Browness to black	Pier, Bridge, abutment, lighthouse, road pavement
Salt Trap	Igneous	Hard and Heavy	Gray, bluish, Black	Roda metal, paving, concrete
Pumice	Igneous 4th	light	Gray, Brownish	Lightweight aggregate
Sand Stone	Sedimentary	Stratified and soft	white, gray, yellow, Brown	Building element
Limestone	Sedimentary	Stratified	white, gray, yellow, black	steel manufacturing, paper, and plastic production
Shale	sedimentary	Laminated soft	greenish gray	tile and brick manufacturing
Conglomerate	sedimentary	Granular	Light colour, black	building stone
Gneiss	Metamorphic	Hard	Light color, Black	Paving, Road metal

Marble	Metamorphic	Stratified	white, black mixed	Ornamental work statue
Slate	Metamorphic	Laminated hard	Gray, black, blue, purple	Roofing, DPC, Flooring, Bathrooms
Schist	Metamorphic	Weak	greenish, yellows, brownish black	used for structure
Moram	Metamorphic	Hard		Dressing of metal road
Laterite	Argilleeous	Soft	red, yellow, brown, black	light road, inferior tye building.

Availability of stone in Nepal

1. Slate: Sindupalchoke, Nuwakot, Dhading, Tarhatum, Citawan, Ramechhap and Dolkha.
2. Gravel: Lalitpur, Palpa.
3. Talc: Sindupalchoke, Makawanpur.
4. Sandstone: Kathmandu, Lalitpur, Kaski, Palpa, Dang.
5. Marble: Kathmandu, Lalitpur.
6. Berril: Taplejung, Sankhuasabha.
7. Turmalin: Sankhuwasabha, nuwakot.
8. Granite: Sankhuwasabha and Nuwakot.
9. Limestone: Kathmandu, Dhankuta, Chitwan, makawanpur and terhatum.

Cement

Cement can be defined as a material with adhesive and cohesive properties which makes it capable of bonding material fragments into a compact whole. cement is one of the best and essential construction materials that help to improve the strength of structure.

It provides a good bond between two materials and provides good strength.

It is obtained by mixing limestone and clay burning them and grinding to fine powder.

Ordinary Portland cement (OPC) is the most popular cement.

The specific gravity of Cement is 3.15.

Water absorption is not more than 5%.

The density of cement is 1440 Kg/m^3.

What are the Raw Materials of Cement?

Ingredients	Composition %	Function	Excess

Lime [cao]	60-65	Control strength, Sound, strong	Unsound, expand, and disintegrate
Silica [Sio_2]	17-25	Give strength	Slow setting
Alumina [Al_2O_3]	3-8	Quick Setting	Lowers the strength
Iron Oxide [fe_2O_3]	0.5-6	Give hardness, strength, and fusion	discolor
Sulfur trioxide [Sio_3]	1-2	make sound	Unsound
Magnesium oxide [Mgo]	0.5-4	give color hardness	cracks in mortar and concrete
Alkalies	1-8	Small quantities	Efflorescence

Composition of Cement Clinker-Bouge's Compound

Compound	**Composition %**	**Function**
Alite [C_3S]	25-50	It generates more heat of hydration. Develop early strength and hardness.
Belite [C_2S]	25-40	It generates less heat of hydration. Develops unlimited strength.
Celite [C_3A]	5-11	It reacts rapidly with Water. It generates more heat of hydration. Help to setting of cement.
Felite[C_4AF]	8-14	Less cementing value. React very slowly. Increasing volume of cement. Reduce Cost.

All the above components undergo some chemical composition during the manufacturing process and from clinker. The constituents of the end product are called **Bouge Compound**.

A high % of Alite and a Low % of Belite in cement

1. Rapid Harding
2. High early strength
3. The high heat of hydration
4. Less Resistance to chemical attack.

A Low % of Alite and a High % of Belite in cement

1. Slow Harding
2. High ultimate strength
3. Less heat of hydration
4. Greater Resistance to chemical attack

Note: The sum of % Alite and Belite for Portland Cement is 70-80%.

Types of Cement

I have already discussed the type of cement on my website. But today I will give General information in this post. Perhaps you can learn something from this article. OPC, PPC, and RHPC are the major types of cement available for different applications and different situations.

Ordinary Portland Cement (OPC)

- Common Properties of OPC
  - Sufficient resistance shrinkage and cracking less resistance to chemical attack.
  - Medium Rate of development strength and heat of hydration.
- Uses
  - General construction
  - Small Structure

Portland Pozzolana Cement (PPC)

Pozzolana Material 10-25%.

- General Properties
  - Gain Strength slower than OPC
  - Ultimate strength more than OPC
  - Less heat of hydration
  - Grater resistance chemical attack
- Uses
  - Under construction of water
  - Sewage works
  - suitable for small concrete works

Rapid Hardening Portland Cement (RHPC)

- General Properties
  - Early strength greater than OPC
  - Content lime more than OPC
  - Heat of hydration Higher than OPC
  - C_3S more than OPC
  - 3 days Strength of RHPC is equal to 7 days' strength of OPC
- Uses
  - Emergency Work
  - Road Construction

Note: *RHPC is not used for Mass Concrete Construction*.

Extra Rapid Hardening cement

Obtain by Mixing $CaCl_2$ with RHC that is used for Road works

Sulfate Resistance Cement [SRC]

- Manufacture by 80-85% granular slag, 10-15% Burnt gypsum and 5% OPC Clinker
- Highly Resistant sulfate attack
- Use in marine work

Low Heated Cement [LHC]

- Properties
  - C_3S and C_3A less and C_2S is More
  - Strength is gained at a slow rate
  - Ultimate strength same as OPC
- Uses
  - Mass concrete,
  - Dam,
  - Retaining Wall,
  - Bridge,
  - Boutment.

Blast Furnace Cement

- Properties
  - Obtain by mixing Portland cement clinker, Gypsum, and Granulated blast furnace slag.
- Uses
  - Mass concrete due to low heat of hydration.

Quick Setting Cement

- Properties
  - Cement is obtained by adding Al_2So_4 and $Cacl_2$ with OPC.
  - Less amount of Gypsum
- Uses
  - Underwater Construction

High Alumina Cement

The amount of Alumina and Calcareous material is high.

Cement can withstand high temperatures.

Cement is used in Refractory concrete.

Resident Cement

Hardening time is 8-10 minutes.

Cement is used in very cold areas and winter season.

Colored Cement

Cement is prepared by china clay and chalk.

The amount of pigment is 5-10%

Cost 2 times of OPC

Used for architectural Purposes.

High Strength Cement

This cement is one of the special types of OPC cement. Compressive strength is higher than OPC.

Hydrophobic Cement

Cement is obtained by mixing OPC clinker with a repellent from a substance like acetic acid, stearic acid, etc.

Masonry Cement

Oil Well Cement

Expansive Cement

- The temperature at the time of Testing is (25-29) degrees Celcius.
- Maximum Pigment percent in the color of cement is 10%.
- The weight of magnesia should not be greater than 5%

Note

Test of Cement

Fineness test

Check proper grinding of Cement and cementing value.

Sedimentary residue of OPC cement should not be greater than 10% of the sample in IS sieve no 90 microns. **[1mm=1000 micron]**

- Method

- Sieve method
- Air permeability method

Consistency Test

Find the proper amount of water to be added to the cement

Performed by Vicat's apparatus consists, of a plunger diameter of 10mm and length 40-50mm.

Soundness Test

Find the presence of uncombined lime and magnesia in cement which causes the expansion of cement.

This test is done by LE-Chatelier's Apparatus.

According to IS Expansion is not exceed 10mm

Setting Timetest

Types of Cement	Initial setting time(min)	Final setting time (min)
Ordinary Portland Cement	30	600
Portland Pozzolana Cement	30	600
Rapid Hardening cement	30	600
Sulfate resisting cement	30	600
Super sulphate cement	240	270
Low Heat cement	60	600
Blast furnace cement	30	600
quick setting cement	5	30
high alumina cement	30	600
white portland cement	30	600

Vicat's apparatus data

Tensile Strength Test

Tested by Briquette testing machine.

Cement and sand ratio 1:3 (mortar)

Average tensile strength after 3 days of curing is not less than 20 kg/cm^2 and after 7 days is not less than 25 kg/cm^2.

Compressive Strength Test

Standard cube made of good Portland cement and sand mortar in a ratio of 1:3.

The size of the cube mold is 7.05 cm.

This test is done by a compression testing machine.

Compressive strength after 3 days is not less than 115 kg/cm^2 and 7 days is 175 kg/cm^2.

Cubes should be kept at a temperature of **27 degrees Celsius**.

Note: *Three cubes should be tested.*

Loss of Ignition Test

Loss of weight of cement 1 gram of sample is heated at standard temperature. Loss of ignition is not more than 4%.

Manufacture of cement

Dry process

Limestone and clay are ground separately into fine powders by a grinding mill and mixed in the desired proportion.

Water (about 12%0 is then added and the resulting product is dried and burnt in **kilns**.

Clinker obtained after burning is added 3-5% of gypsum and ground to fine powders.

This final product is **Cement**.

Wet Process

The limestone is ground separately.

Clay materials are mixed with water in wash mills and stored.

Now crushed are mixed with water in wash mills and stored.

Now crushed dry limestone and wet clay are mixed correctly.

Dry Process	**Wet process**
Slow and Costly	The quick and easy
size of the kill needed to manufacture the cement is smaller.	size of the kill needed to manufacture the cement is bigger.
More economically	Less economically

The moisture content of these pellets is 12%.	The moisture content of these slurry is 30-50%.
The amount of heat required is lower. So required lower fuel.	The amount of heat required is higher. So required higher fuel.
Steps	**Steps**
a. Treatment of raw materials	a. Collection of raw materials
b. burning of dry mix	b. preparation of slurry (crushing grinding and mixing of raw materials)
c. Grinding of clinker	c. Buring
d. Packing and storage	d. Grinding of clinker

Specific surface

Types of cement	OPC and PSC	PPC	LHPC	RHPC	SRPC
Surface area (cm^2/gm)	2250	3000	3200	3250	4000

Flash set

It is the property of concrete by which the upper surface of the concrete becomes hard without setting the inner portion.

This effect is found due to the presence of Tri-calcium aluminate.

Setting and hardening of cement

The chemical reaction between concrete and water is called the hydration of cement. The phenomenon under which the plastic cement changes into a solid mass is known as the setting of cement.

The phenomenon under which the elements paste sets and develops the setting is known as the hardening of the cement.

Strength of cement

After months	3	6	12	24
Strength Reduce	20%	30%	40%	50%

Freshness of cement

- The color of cement is uniformly **Greenish gray**.
- A handful of cement, Through into a bucket of water, floats.
- The hand is trusted into a bag of cement, it feels cool and smooth.

Specification of Storage and transport of cement

Height of cement bag=18 cm

Area of Cement bag= 3000 cm^2

Space between piles= 1.6 m

Space from the wall is a minimum of 30 cm

The height of the ground surface is 20 cm.

We are packing weight bag 50 kg per bag.

No bag should not be more than 15 in horizontal and 10 in vertical.

Transport with the help of a truck, lorry, and tractor. it depends on the market.

Admixture

The admixture is the materials other than the basic ingredients of cement concrete added to the concrete mix to improve certain properties—like strength, durability, and workability.

The addition of admixture is done immediately before or during mixing.

Available both power and aqueous solution

The function of admixture

improves workability, strength, and durability.

Increase bond strength between concrete and reinforcement.

improving the waterproofing properties.

Reduce shrinkage during the setting of mortar.

reduce bleeding and segregation effect of concrete.

To produce the color of concrete.

To decrease the weight of concrete.

Types of Admixture

- Accereporor
    - Added up to 2% by weight of cement.
    - Concrete set and hardened quickly

    - Used in Construction in cold climates.
    - Reduce ultimate strength and initial setting time of concrete.
    - eg, Aluminum fluoride.
- The retarder
    - added 2-3% weight of cement.
    - Increase the initial setting time and hardening time of the concert.
    - For long-distance site locations.
    - eg, calcium sulfate, Gypsum, sugar, glucose, cellulose.
- Plasticizer
    - Water-reducing admixture
    - added to the concrete mix to make more plastic without any further addition of water.
    - added below 0.5%
    - eg, salt of hydroxyl arty acids.
- Air-entering agent
    - resin,
    - fatty acids
    - oils
    - aluminum
    - zinc powder
- Bleeding Agent
    - paraffin wax
- Colour Agent
    - Red Oxide
    - Ferrous oxide
    - Chromium Oxide

Clay And Clay Product

Now we will discuss clay and clay products. One of the best and most usable clay products is Brick. So many articles published on my website. You have to checkout. Now in this complete construction materials guide main points are covered with clay products.

Brick- No 1 Construction Materials

Bricks are small solid structural units of rectangular shape and convenient size made from suitable types of clay hardened by heat or chemical action. The standard size of brick is 230 x 110 x 55 mm.

Difference Between Stone and Brick

Brick	Stone
Lighter Than Stone	Heavier than Brick
Made of Clay	Obtained from rock
Specific gravity Is 1.8	Specific gravity Is 2.6

Water absorption is less than 15%	Water absorption is less than 5%
Less durable than stone	High durable than brick
Uniform color and shape	No-Uniform color and shape
Absorbe lesser heat	Absorbe higher heat
The overall cost of manufacture is less	The overall cost of manufacture is high

Brick Earth

Brick earth is a mixture of clay and sand which when mixed with water becomes plastic and can be easily molded. It is also dried without cracking and warping.

Ingredient of Brick Earth

Ingredients	Composition %	function	Excess
Silica	50-60	main ingredients Reduce shape imparts durability prevent shrinkage and warping	Brittle and weak
Alumina	20-30	Provides plasticity makes brick hard on drying	Crack and warp
Lime	Less than 10	Reduce shrinkage	Melt and loose its shape
Iron oxide	Less than 7	Give red colour	Dark blue color
Magnesia	less than 1	Reduce warping and shrinkage	yellow color, decay
Alkalies	<10	For quick setting Help to melt the brick	Efflorescence

Harmful Ingredients

Ingredients	**Causes**
Carbonaceous matter	Brick black
Iron Pyrite	Split the brick into pieces
Organic Matter	Brick Porous
Peebles and gravels	Difficult to mix (non-homogenous brick)
Sulfur	Brick discolor
Water	Shrinkage during burning

Manufacture of Bricks/Preparation of brick earth

Un-Soiling: It is the process of removing of top layer of earth to get the soil tree from pebbles, gravel, and roots.

Digging: It is the process of excavation of soil by adding fly ash, sandy, loam rice husk, etc.

Weathering: It is the process of exposing soil to open weather after mixing a small amount of water to improve plastic and strength.

Blending: It is the process of mixing the appropriate constituents of bricks such as sandy earth, and calcareous earth.

Tampering: It is the proof of leading the soil either by the feet of men or pugmills. The operation of tampering with the pug mill is known as plugging. In tampering with water other substances are mixed to improve the plasticity and durability of bricks.

Molding: It is the process of making the bricks of required shape and size from tampered or plugged clay. Molding is done by either hand or machine.

Drying: It is the process of removing the moisture to control shrinkage and save fuel and time during drying. Drying is natural and artificial.

Buring: Three-stage

- Dehydration (400-650) degree Celcius
- Oxidation (650-1000) degrees Celcius
- Vitrification (900-1100) degrees Celcius

Classification of Bricks

There are many classes of brick available in the market but three are main. 1st, 2nd and 3rd class brick. I have classified three major classification based:

Based on field practices

First-class Brick

- No 1 construction materials
- They are well brunt and regular shape and size.
- Have uniform texture and color (deep red cour)
- Sufficiently hard and sound
- Minimum crushing strength is 15 kg/cm^2 {10.5 N/mm^2}
- Specific Gravity is 1.8.
- Metalic sound
- Water absorption capacity is not more than 15% {24 hr}
- Not Break, dropped from height 1-2 m
- Size of brick [NS=230 x 110 x 55]
- Used in masonry, Flooring, facing works

Second Class Bricks

- They are well brunt but irregular in shape and size.
- Does not have uniform texture and colour.

- Not so hard
- Ringing Sound
- Minimum Crushing strength is 70 kg/cm^2 [7N/mm^2]
- Water absorption capacity is less than 20%.
- Used in interior wall construction.

Third Class brick

- They are burnt and irregular in shape and size
- Does not have a uniform texture and yellowish colour.
- Soft
- Dull sound
- Minimum Crushing Strength = 35-70 kg/cm^2 [3.5 -7 N/mm^2]
- Water absorption capacity =<25%.
- Used in inferior and temporary structures.

Overburnt or Jhama Brick

- They are overburnt and irregular in shape and size
- Dark in color
- Brittle in nature
- Product metallic ringing sound
- Hard and strong
- Crushing strength = >15 N/mm^2
- Used in aggregate for concrete, road metal, and filling materials.

On the Base of Use

Common Brick: Used for filing, and backing.

Facing Brick: Used in front of the building wall, good appearance.

Engineering Brick: Strong, Impermeable, Smooth, and Hard.

Based on Finish

- Sand Face Brick
- Rustic Brick

Based on Manufacture

- Hand made
- machine made

Based on Buring

Pale Brick Body Brick Arch brick

Unbrunt Well Burnt Over Burnt

Some other types of bricks

Fire Bricks/ Refractory Bricks

- It is made of fire clay of high temperature in a special kiln.
- Crushing strength=125 kg/cm^2
- Water absorption =5-10%
- used combustion chamber
- Chromic Natural refractory brick
- Dolomite and Bauxite basic refractory brick
- Unit weight= 2400 kg/m^3

Hollow Bricks

- Volume not less than half of gross volume
- Used non-load-bearing wall and Ornamental works

Testing of Brick

Compressive Strength Test

- Minimum no of specimen=5
- Specimen brick is **immersed us water for 24 hr**.
- Forg of brick is filled with **1:3 cement mortar** and stared in damp jute bags for 24 hrs.
- Immersed in water for **3 days**
- **Specimen** placed on compression testing machine.
- Load is applied at a **uniform rate of 14 N/mm^2 per minute**.
- Maximum load is recorded.

$$\text{Compressive strength} = \text{Maximum load at failure} / \text{Loaded are of Brick}$$

Water Absorption Test

- 3-5 samples of brick are taken
- It is done at a temperature of **27 degrees Celcius**.
- The specimen brick is first weighted dry W_1
- Then immersed in water for 24 hrs
- It is weighted again W_2

$$\text{Water absorption} = \{(W_2 - W_1) \div W_1\} * 100$$

Efflorensces Test

Measure white patches

Efflorescence	Nil	Slight	Moderate	Heavey	Serious
Deposit	Not Found	<10%	10-50%	>50%	Exposed area

Warping Test

Check the bend and twist of the brick.

Dimension Test

Nepal Standard	230 mm x 110 mm x 55 mm
Indian Standard	19 cm x 9 cm x 4 cm

No Brick is Required for 1 m^3

- Hand made 530-560 (as wastage %)
- Machine made 530-500 (as wastage %)

Defect of Brick

- Buring brick absorbs water reducing the strength
- Over-burning brick products soften the mass loose shape
- Chuff hot brick with cool water formed cracks and deformation
- Black core
- **Crack or checks**- excess of water and lumps of lime.
- **Efflorescence**- white and gray salt is deposited in brick due to the **alkalies present** in the soil.
- **Bloating**- Brick swelled due to carbonaceous matter and sulfur
- **Lamination**- Reduce weak strength due to Entrapped **air in brick**.
- **Spots**- Dark sulfur spots due to iron sulfides.

Other Important Terms

Terracotta

- It is a type of fired clay or earthenware made by mixing clay with water shipping.
- Burnt in special klin (**Muffie Furnace**)
- Temperature= 1100-1200° C
- Used=Pottery, decorated objects, building materials (roof tile, Bricks).

Surkhi

- Form of powdered Brick
- Made by finely grinding burnt clay bricks
- Mixed with cement to create Mortar
- Substitute for sand
- Improve strength and durability of concrete and mortar reduce shrinkage and cracking.

Fly ash

- Fine powdery substance
- Produce during the combustion of coal
- Used as a partial replacement for cement in concrete.
- Improve strength and durability.
- Used Production of Brick

Porcelain

- Type of ceramic material
- made by the heating material, typically including clay in combination with other minerals at high temperatures.
- Properties: white, Hard, translucent, and glazed surface.
- Used: Dinnerware, Voses, figurines, and decorative.

Bricks Bond

→ pattern in which bricks are laid to form a wall or other Structure.

Types of Bond	Explanation
Stretcher Bond	→ Bricks are laid as stretchers on the face of the Wall. → Used For single brick walls or half brick Walls. → Also used for cavity wall as less cutting required
Header Bond	→ Bricks are laid as Header on the face of the Wall. → Used for one brick Wall
English Bord	→ Bricks are laid by alternate course of heoders & Stretchers. → Strongest bond and Carry heavy load → commonly used for all wall thicknesses,
Flemish Bond	→ Bricks are laid by each course alternate headers & Stretchers → More decorative.

Frog

→ Depression on the top of the brick.

→ Works as a key at the time of laying of bricks.

→ sizer 10cmx 4cm x (10-20) mm Used Advertisement of manufacture & reduce Weight.

Brick Nogging

→Construction techniques

→ Bricks are filled in a Wooden frame.

→Provide additional Strength & Stability to the building Wall or ceiling.

Quality of Good Brick

Shape & size → Uniform in size, uniform surface with well-defined edges.

Color → Copper Colour.

Structure → Fine Compact & uniform structure.

Hardness → Sufficienhy hard and hot be scratched by a fingernail.

Porosity → not absorb too much water,

Strength → sufficiently strong & hot Crack under loading.

Durability → Not damaged by the environment.

Resistance to Fire

Resistance to effiorescence

Note: Compressive strength

- Hand-made brick = 30-150 kg/cm^2
- Machine made brick = 450 kg/cm^2

→ Normally, Height of Chimney = 30m

→ Glazing is used to make earthenware impervious.

→ Damper → metal plate → Used close or open Chimney of kiln.

→Purpose Regulate the flow of air in the kiln during the firing process.

→ Internal size of mold take Slightly. (about 1th/10) greater the brunt brick

→ The height of the wall Can be raised in one day,

- Stone masonry = 60Cm•
- Brick masonry = 100cm.

→weigt of one brick = 2-3 kg

→ Volume of one brick = 1680 cm^3

Paints & Varnishes

paints and Varnishes are used to protect metals, and timber of plastered Surfaces from the corrosive effects of weather, heat, moisture, or gases. They are also used to improve their appearance.

Paint

It is the fluid paste prepared by a mixture of the base with Vehicle, pigments, thinner, drier, adulterants, extender, etc

Uses/Function of paint

- Decoration purpose
- Conservation purpose
- Hygienic purpose
- Prevents corrosion.

Ingredients of paints

Ingredients	Functions
Base	→ Body of paint. → Also called oxides of metal. → It gives a thin layer (film) That protects from weathering effect. → It has binding properties. → **Example** Used on Wooden surface - White lead, Zine White. Used on Metal surface - Red lead, Iron oxide. → Aluminium powder etc.
Vehicle	→ Also called Carrier, liquid, drying oil. → It binds based pigments together: → It spreads the base over the surface. →**Examples** Linseed oil （most used), Fish oil, Tung oil, Nut oil, Poppy oil, etc.
Pigments	→Gives Colour to the paint. →<10% → White color -White lead, zine oxide → Red color- Red lead, Rion oxide, Carmine, Vermillion →Blue color- Indigo, cobalt oxide.

	→Brown color- copper oxide, raw & burnt umber → Green Colour - Chromium oxide, copper sulfate → Black Colour - Lamp black, vegetable, and ivory black. → Yello Colour - Hello chrome, ochre, taw Siena
Drier	→ It helps to dry the Vehicle. →<8% → **Example** Letharge (mostly used), Zine sulfate, Lead acetate, Red lead, Magnesium.
Thinner (Solvent)	→ Also Called Volatile substance → Make its application easy, smooth, and thin. → Examples Turpentine (mostly used), Peltoleum, Kerosene, Sprit, Naptha, Water etc.
Adulterants (inert filler)	→ Increase Weight and durability. → Reduce Cost → **Examples** - Aluminium, Silicate, magnesium silicate, calcium Carbonate, Barium Sulphate,
Extender	→ Increase Volume Examples Silica, talc, gypsum

Note: more poisonous - Lead paint

Types of paint

Types of paint	**Uses**
Aluminum paint	→ Resist High temperature → Uses - oil and gas, Storage tank, hot water pipes, electrical, teléphone poles, silos, metal roof, etc.
Asbestos Paint	→Fire resistance → prevents leakages, →Uses -metal roof, gutter, and the outer surface of the basement wall.
Bronze Paint	→ High refrective **used**: radiator of vehicles.
Enamel paint	→ Used Timber, concrete, metal, etc.
Cenurose paint	→ Used in expensive materials. → Ducco paint
Oil paint	→ Used airplanes, ships, car eteriliboso → Ordinary paint, easily available, cheaper → used **Automobiles**.
Emulsion pant	→ Used concrete surface in a wet area.

Fluorescent paint	→ It has shinning property. → visible at Night
Cement paint	→ Based on white cement Thinner Water →Used concrete face, plastered surface
Plastic paint	→ Dense in Nature → Give very attractive Looks Used in Auditoriums, Showrooms, offices, etc.
Bitumen paint	→ It gives a highly protective layer → Used Underwater pipes
Casein paint	→ Used plastered surfaces, Walls, and Ceiling, etc.
Zine paint	→Used Illumination of maps

Preparation of paints

First of all, the base is finely ground with the help of a **muller**. Then mixed with the Vehicle. It gives a thick paste.

Then, this thick paste is mixed with thinner. It gives a Consistent/thin paste.

NOW, separately ground pigment & driers.

Then, all the above three pastes are mixed and give a paint.

Defects in paint

Blisterings: Swelling of paint

Chalking: Conservation of Paint in Power Form.

Checking → Formation of cracks on the surface of the paint.

- crazing → cracks produced in a small area
- Crocodiling → Cracks produced in Large areas.

Cracking: Cracks developed throughout the thickness of paint.

Alligatoring: One layer of paint slides over the other due to the Hard paint being applied over a soft one or Vice Versa.

Flaking: Detachment of paint film from the surface due.

Discoloration: Alteration in the original Color.

Varnish

It is a homogenous mixture of natural or synthetic resin with solvent & drier.

→Varnish dries off & leaves a transparent or semi-transparent Fim of resin.

→ It does not contain pigments.

The function of varnish

- Protect the painted surface
- Gives a shinning effect to the painted surface.
- Gives brilliance to the wooden surface, photograph, map, etc.

Ingredient of varnish

Resin → Principle Constituent → **Examples**: Copal, amber, gum, mastic

Solvent → **Examples** Linseed oil, turpentine oil, methylated spirit, or alcohol.

Driet → **Examples** Lead acetate, White Copper, lethargy.

Types of Varnish

Types of Varnish	**Explanation**
Dir Varnish	→ Resin + Linseed oil + Turpentine + drier → Dries DiP Very Slow. → Most durable. → Used Exterior & Interior surface.
Spirit Varnish	→ Resin + Methylated spirit → Brilliant appearance Dries of very quickly. → Less durable → Used/ Interior surface. → Eg French polish, lacquer
Flat Varnish	Give dull appearance. Used Timber for protection.
Spar Varnish	→ Sticky, in nature as temperature, rise →Used spars, Exterior part of ship, boat
Water Varnish	→ Hot water + ammonium etc. → used photograph, map.
Turpentine Varnish	→ Dries off quickly → Less durable than Oil Varnish → Used Metal painted surface → Not so tough
Asphalt Varnish	→ Fabricated steel Works.

Distempers

→ Also Called Water paint

→ Obtained Mixing. White Chalk and Water. Base Chalk Thinner Water Main principle constituents chalk. Removed by water

→ Less durable Use Temporary and Interior surfaces.

→ Not exposed to the atmosphere,

→ For color used to pigments

Bitumen

It is a binding material in a solid or semi-solid State.

Properties of Bitumen

Colour Black State semi- solid Sp•gravity 1.09 soluble in Carbon disulfide, Carbon tetra chloride, Chlorofurm, benzene

→ Non-Crystalline Solid

→ Viscous material

→ gets softened as the temperature rises.

→ Catch fire at 200°c

→ Ductile in Nature.

→ Chemical Compound Carbon & Hydrogen derived from petroleum crude oil

→ Bitumen is hot and affected by air, light, or water individually but in Combination, they can make brittle and porous.

Uses of Bitumen

→ Road pavement

→ paint formation

→ crack repairs

→ Heat insulation purpose

→ DPC, leakage prevention

→ Batteries

→ Root sealing

→ Joint fitter etc.

Classification of Bitumen

- General Classification
  - Cutback Bitumen
  - Obtained by Bitumen+ solvent (kerosene, petroleum, naphtha, gasoline, etc)
  - The solvent turns the bitumen from a semi-solid to a liquid state.
  - No heat is needed before using it.
- Used
  - Road pavement in cold areas,
  - Manufacturing of paint,
  - Soil Stabilization

- Bitumen Emulsion
  - Obtained by Bitumen + water + Emulsifier
  - It is an aqueous solution
- Used
  - Road pavement,
  - Soil stabilization.

- Blown or oxidized Bitumen
  - Obtained by passing air at high temperature & pressure.
  - Function Heat insulation used flooring, Roofing, Joint, etc.

- Plastic Bitumen
  - Obtained by Bitumen + Iner Firer (40-45%)
  - Inert firer Asbestos powder.
  - Used Crack repairs

- Rut or Straight run Bitumen
  - It is obtained after distilling a Crude oil having required penetration, and viscosity.
  - They were used without further treatment.

- Based on source
  - Natural Bitumen
  - Petroleum Bitumen.

- Based on consistency (at 18°c)
  - Solid Bitumen
  - Semi - Solid Bitumen

- Liquid Bitumen

Based on Application (Uses)

- Road ConStruction Bitumen
- Building Bitumen
- Roofing Bitumen

Test of Bitumen

Types of Test	Explanation
Penetration Test	Equipment: Penetrometer Measure: Softness and hardness of bitumen Needle allowed penetrates Time: 5sec. Standard Temperature: 25 sec
Softening Point Test	Equipment: Ball and Ring Measure: Softening point The temperature increase rate is 5 degrees c. Measure the Temperature from the ball drop from the ring. Good bitumen softening point =35° C-70° C.
Ductile Test	Equipment: Standard Briqutte testing machine Measure: Elongation before failure Pulling Rate: 50mm/min Ductile Value: 50cm (good bitumen)
Specific Gravity	Instrument: Pycnometer Measure: Specific gravity Sp= 1.09
Viscosity	Instrument: Orifice Viscometer Measure: Resistance to flow Measure in terms of time sec size of orifice= 4mm, 10mm
Flash and Fire point test	Equipment: Pensky martens tester measure: flash and fire point General value: 200° C
Loss of Ignition test	Equipment: Hot air Oven
Solubility test	Soluble in carbon disulfide, carbon tetra chloride, etc. Measure: Purity of bitumen. 99% soluble for good bitumen.
Water absorption	>0.2%

Tile

Tile is a manufactured piece of fired clay, Stone, or concrete, Used to cover Walls, floors, roofs & ornamental or architectural purposes. This is one of the best and most popular construction materials in the world. In modern technology, most of the people are used tile in the construction. Most of the tiles are manufactured in Square and Rectangular shapes.

Types of Tiles

- Based on Location
  - Wall Tiles are laid on the wall used Both inside and outside of the building.
  - In the Inside Bathroom, the Kitchen Wall outside is Used for cladding.
- Floor Tiles
  - Laid on Floor
  - Roof Tiles Laid on the Roof of a single-story house.
- Paver tiles
  - Laid in covering the parking area, driveway, and surrounding area of a building.

- Based on materials & Manufacturing process

- Ceramic Tiles
  - Ingredients clay, silt, sand of traces other
  - Commonly used Residential building in interior walls & Floors.

Types of Ceramic Tiles

Glazed Ceramic Tiles	**Unglazed Ceramic Tiles**
→ Liquid glass coating over the Top of tiles,	→ No coating
→ Appearance Infinite color, finishes, texture	→ Appearance Natural earthly
→ Water proof	→ No waterproof
→ Density Less	→ Density High
→ Waterproof	→ Thickness Thicker
→ Durability	→ Durability
→ Low Slip	→More slip
→ Cost Expensive	→ Cost Cheaper

Porcelain tiles

Similar to ceramic tiles Clay grain more finer and Fired at a higher temperature than ceramic tiles, it is also, Denser, Less porous, durable, and resistant to moisture the ceramic tiles. used Both residential And Commercial buildings.

Mosaic Tiles

Made of Ceramic, glass, stone, or metal. Decorative pieces used in the Bathroom, kitchen, swimming, pool, etc.

Clay Tiles

Made by pressing. & buthing Clay. used low-cost housing, the roof of the building.

Testing of Tile

Test	Explanation
General Quality Test	→ Well but not → Shape and Colour uniform or not → Cracks are present or not
Warping test	→ 2% in sides → 5% in diagonal
Hater absorption test	→ less than or equal to 24%
Dimension test	→ Requred dimension or not

Aggregates

Aggregates are inert materials mixed with a binding material (cement, lime) in the preparation of mortar or concrete.

Types of Aggregates

Based On Size

Fine Aggregates	Coarse Aggregates
→ Small size filer material in construction	→ Large size filer material in construction
→ pass 4.75 mm sieve	→ Pass 75mm Sieve
→ Retain 0.075 mm sieve	→ Retain 4.75 mm Sieve
→ example: Sand, Stone Screening surkhi, fly ash, etc.	→ example: Gravers, Pebbles, brick & stone chips, clinkers, etc.
Voids between the Coarse aggregate are filled up.	Acts as inert filler material For Concrete

Based On Shape

Types of Aggregates	Explanation
Rounded Aggregates	→ Voids 32-33% → Good workability. → Strength More Bond Strength Less. → Not suitable for strong concrete
Itegular Aggregates	→ Void generate 35-38% → Less Workability → Water and cement are more required for the Constant W/C Ratio

Angular Aggregates	→ Bond strength More than Rounded aggregates → Not suitable for strong concrete → Voids/ 38-40% → Less Workability then Rounded aggregate → Bond Strength More → Suitable High strength Concrete.

Based on moisture Content

Types of Aggregate	Pores	Surface
Very dry aggregate	No moisture	No moisture
Dry aggregate	Some moisture	No moisture
Saturated surface dry aggregate	Filled with water	Dry
Moist aggregate	Filled with water	Wet

Note: Size of Aggregate for concrete=20 mm, mass concrete=40mm or more, and flooring=10mm.

Quality of good Aggregate

Strength → sufficient strength to resist stress

Durability → Resistance to Weatheting, environmental factor

Shape and size → Uniform, compacted, interlocked effectively:

Water absorption → < 10 %.

Cleanliness → Free from organic matter; Clay etc.

Test of Aggregate	**Explanation**
Impact Test	Apparatus: Impact Testing Machine Find: Toughness
Crushing Test	Instrument: Los Angles Amchine
Abrasion Test	Find: Durability
Water Absoption Test	<10%
Bitumen Adhesion Test	Find: Striping Value
Shape Test	Determine by % of Flanky and elongated particles contained in it & by its Angularity

Timber

Timber is a wood that is used for construction purposes.

→ Freshly felled timber Consists of 100% moisture of dry Weight and 50% moisture of total weight. (Amount of moisture = Amount of timber)

Seasoning: The process of reduction of moisture from timber.

Method of seasoning

Natural Method

→ Water Air dried is done.

→ Time Consuming (6-8 month)

→ Less efficient (Reduce moisture up to 12-15 %)

→Economical

Artificial Method

→ controlled heat and humidity are used to reduce the moisture Content.

→ Fast

→ Reduce moisture up to 90%

Purpose of Seasoning

→ Make fire resistance

→ Waterproof

→ make light, Strong, and stable.

→ prevents warping, cracking, shrinkage.

→ resistant to decay by fungi, termites

→ resistance to electricity.

Classification of Timber

Based on the Growth Mode

Endogenous:-Growth endward

→ Example, Bamboo, Coconut, palm, hanut.

Exogenous:- Growth outward → Examptel sai, teak, deodar, Shisham

Types of Exogenous

Conifers → pointed leaves **Example** Deodar, chit
Deciduous Flat Leaves **Example** take shisham

Based oh Hardness

Hard Lood – Sal, teak, shisham, oak etc.

Softwood – deodar, walnut, kail, chai, etc

Internal Structure of Wood

Pith: Inner-most part or core of the tree. Also caned Meduna

Heart Wood: Innermost annuat ring. Also Called **Duramen** Responsible for strength, hardness color Darker.

Sap Wood: ***Living part of the timber***. **Color** Light → outermost annual ring → active & younger part. Function Transmits the Sap from roots to branches.

Bark: Outermost skin of the tree. Function protects an inner portion of the tree from external injuries. Inner bark → Live bork → Outer bark→ dead bark → Inner bark covering cambium layer.

Cambium layer: a layer of Woad between bark & sap Hood. → ***If the cambium layer is exposed to the atmosphere, the tree dies***.

Annual Ring: Ring Formed in timber. Determine the Age of the tree. → {**Total no of annual ring = Age of tree**}

Medullary rays → They extend radially from the pith to the cambium layer.

Function Binds all annual rings. → Carries nutrients outward.

Defects of Timber

Foxiness: Timber turning into yellowish pried around the pith.

Knots → Root of the branch → Annual ring perpendicular to stem.

Rind galls → swellere part of timber, due to improper cutting.

Bird eye → Small, Circular areas on Wood surface caused by indented Wined fibers.

Burl → **Uneven projection** on the body of the tree during its growth.

Reason sock of injury at its young age Due to hardening.

Druxiness → Top surface of timber indicates White spots. Reason Access of fungi.

Upsets → Fibers injured by Crushing of compression.

Rupture → Caused due to injury of impact.

Twisted Fibers → Caused by wind constantly turning the trunk of a Young tree in one direction.

Checks of Shakes → Lengthwise Separation of Llood is known While perpendicular to length is called sakes.

Wood Warping → Deviation from flatness Reason Uneven drying results from stress.

Preservation of Timber

Charraing: Burining of timber surface to protect from white ants and fungi.

Terring: Applying a coat of tar for a door frame.

Painting: Oil Paints are suitable to prevent form moisture.

Creosoting: Prepared by Distillation of tar. This color is dark brown.

Walman salt: **Contains 25% sodium fluoride**, 25 % disodium, Hydrogen arsenate, 37.5% sodium chromate.

Fire resistance of timber: The fire resistance of timber can be enhanced either by impregnating it with chemicals like phosphate of ammonia, ammonium chloride, a mixture of ammonium phosphate of ammonium sulfate, borax & boric acid, sodium arsenate, sodium tetra-borate or by designing wood to provide a slow-burning constituent.

PLY Wood

It is a combination of veneers. → Veneers are placed to each other by gluing. Veneers Thin sheet of wind sliced from log → Thickness = 0.4-6mm.

Some Key points of plywood

→ Density of timber = $1/12^{th}$ of steel.

→ strength of timber = $1/10^{th}$ of steel.

→ The strength of timber increases with an increase in the Medullary ring.

→ Timber is an organic material with having cellular structure

→ Defect due to imperfect seasoning = honey, Combing

→ Moisture Content of timber formwork= > 15%

→ Used Timber formwork →4-5 times Steel formwork→ upto 50 time

→ Good timber Sound = sonorous → Used for railway, Slipper = Sal, kail.

→ Board Thickness = <5Cm & Width = exceed 12cm

→ Strip Thickness = 5cm < Width = 10cm

→ Thickness of five play Sheet = 6-9mm

→ Thickness of lamin board = 12-25 mm •

Sawing Method

Ordinary Method /Flat Method

Tangential Method→ Less wastage. → Most economical.

Radial Method→ Maximum strength →' Maximum Wastages.

Quarter Method

Metals & Alloys

Metal Metal is a solid material That is typically hard, shiny, malleable, and ductile with a good conductor of heat & electricity.

Types of Metals

Ferrous Metals: The main Constituent, for Example, Iron, Steel is Widely used in Different engineering structures such as building frames, beams, columns, roofs, bridges, etc.

Non-ferrous Metal: The main constituent is Not iron. → They are hot magnetic, for Example Aluminium, copper, Lead, Zine, Tin, etc

Ore: Ore is a type of material used to extract metals.

Name of Ore	Iron Content	Chemical Formula
Magnetite	70-75%	Fe_3O_4
Hematite	70%	Fe_2O_3
Limonite	60%	$2Fe_2O_3.3H_2O$
Iron Pyrite	47%	FeS_2
Siderite	40%	$FeCO_3$

Types of Iron

Pig Iron

→ First and basic form → Manufactured in a blast furnace.

- Lowest quality
- Remove impurities
- Crude & impure iron.
- Carbon content = 3-4

Types of pig iron

Bessemer Pig is obtained from Hematite ore Free from sulfur, Phosphorus, and Copper. It is used to make Mild Steel.

Foundry |Gray pig Obtained from Furnace → sufficient fuel high-temperature → Used for making Cast iron.

Forge/white pig→ obtained from Furance → sufficient fuel at low temperature → Used for making Wrought iron.

Molted pig → property between foundry & Frog pig. Used for heavy Casting equipment.

Cast Iron

→ Obtained by melting pig iron Obtained from cupola furnace

→ Carbon Content = 3%

→ More pure than pig iron.

→ Hard & brittle.

→ Used Structural work & Cast iron pipes.

Wrought Iron

→ purest form of iron.

→ Carbon Content = 0.15%-

→ Soft & easily welded.

→ produced by Removing impurities of cast iron.

used plates, rivets, sheets, pipe tubes, railing, window guards, etc.

Steel

→ Most suitable building material

→ Unit weight of steel = 7850 kg/m2

→ Coefficient of thermal expansion = 11.5×10^{-6} per°c.

→ Intermediate form between **cast iron & wrought iron**.

Classification of steel

Types of Steel	Dead MS	Mild	Medium Carbon	High Carbon	Tool Steel
Carbon Content	<0.15	0.15-0.3	0.3-0.8	0.8-1.5	>1

Mild Steel

→ Low carbon, ductile, malleable & more elastic than wrought iron.

→ Ultimate comp. strength = 800-1200 N/mm?

→ Tensile strength = 600-800 Nimm'.

→ Rust quickly.

→ Can be permanently magnetized Uses construction work. huts, bolts, plates, reinforcement bars, toot covering, etc-

→ Sp. gravity = 78 → Tough → soft → Easily Froged

Medium carbon steel

→ stronger & harder than mild Steel.

→ Less ductile, tough, malleable.

Used metal ropes, wires, garden toots, automobile components,

High carbon steel

→ Hardest

→ Less ductile, tough, and Malleable

→ Better resistance to wear & tear, shocks, and vibrations. → More difficult forge & weld.

→ Ultimate comp, strength = 1350.Nmm^2

→ Tensile Strength= 1400 – 2000N|mm^2.

Used To make Chisels, hammers, drills, files, lathe tools, hacksaws, blades-

Alloys

An alloy is a combination of metals or other substances.

Name of Alloy	Elements	%
1. Brass	Copper+ zinc	60+40
2. Bronze	Copper + Tin	90+10
3. Invar	Steel+Nikel	64+36
4.Monel Metal	Copper + Nickel	60+40
5. Stainless steel	Chromium + Nickel	18+8
6. Solder	Lead+Tin	1:2
7. German Silver	Copper+ zinc + Nickel.	50:19:31
8. Brazing	copper+ Zine+ Tin	4:3:2

Note: →% of cobalt in, Carbon steel to make magnet = 45%

→ Vanadium steel is generally used for axle f springs.

→ Yield & tensile strength of low-carbon steel may be improved by the addition of vanadium.

→ Malleability Different shapes by heating.

→ Ductility Transferred into wire.

→ Minimum 40% of iron is available in blackbond.

→ Red short iron Cracks When bent due to the presence of sulfur.

→ Brittleness of cold is due to excessive phosphorous.

Lime

Lime is calcium oxide (cao). It is hot and found in nature in a free state. It is obtained by burning limestone at 800°c. or Calcination of limestone with Chalk, Kankat & other Calcareous Substance.

Cementing material → It is easy to work

→ provides strength to the masonry.

Used → plastering, the interior surface of the Wall, preparing, concrete Pot foundation, flooring of ordinary, building, washing the rooms, Stabilizing the soil & knotting of timber Wotks before painting.

Note: In Lime manufacturing fuel hot direct contact. With lime= flare kiln & direct contact = flame kiln sand mixed with time mortar to prevent shrinkage & Cracking •

Types of Lime

Based on source

Stone Lime: From Limestone (Uses Mortar, flooring

Kanker Lime: From Kankar. Uses Mortar (substructure)

Shell Lime: From Shels of sea animals. Uses Lime pinning, White blush & color wash.

Based on purity

Fat, rich, pure, high calcium & white time

→ Impurity >5% → Volume – 2-3 times after slaking.

→ Uses plaster, whitewashing, etc. A color milky White.

→ Sound produce Hissing

→ Contains 95%. Limestone 5% and other materials.

→ Soluble in water.

→ setting & hardening actions are Slow.

→ Slaking Complete = 3-4 hrs

Hydraulic Lime water Lime

→ Impurity 5-30%

→ Volume 2-3 times after slaking.

→ Uses for making mortar for heavy masonry works, lime concrete, Work under water & foundation.

→ Colour Grayish khite.

→ Sound produced Not hissing

→ **Slaking Complete 24-48 hrs**. Obtained by Burning Kankar.

Initial setting time = 120 min.

→ Contain 30 % of clay.

Types of Hydraulic Lime

Feebly Hydraulic Lime:

- Silica & alumina < 10%,
- Staking time = 5-15 min
- Setting time = 21 days.

Moderately Hydraulic Lime:

- Silica & alumina = 10-20%
- slaking time = 1-2 hrs
- Setting time = 7 days.

Eminently Hydraulic Lime:

- Silica + alumina= 20 – 30%
- Slaking time = 2-5 hrs
- Setting time = 2-48 hrs.

Poor or Lean Lime.

- Impurity > 30%
- Uses poor mortar & plaster
- Also carried Meager lime
- Colour Muddy White
- Contain >30% of clay
- Slaking Very Slowly
- Hardens Very Slowly
- Not set underwater

Based on purpose

Class A (Eminently hydraulic lime)

- Cao 60-70%.
- Clay 20-30%
- Setting time = 2-48 hrs.
- Use: Mortar & Concrete.

Class B (semi-hydraulic lime)

- Cao 70%
- Clay 15%
- Setting time= 7 days
- Uses: mortar, Flooring & concrete.

Class C (fat lime)

- Cao 93%
- Clay 5%
- Volume = 2-3 times after slaking.
- Uses plaster & Whitewashing.

Class D (magnesium lime)

- CaO and Mgo 85%.
- Uses plaster & White Lashin

Class E (Kankar Lime)

- Cao 20% → Mgo 5%
- Uses: mortar, plaster & Whitewashing

Note: Normal curing period for lime mortar = 7 days.

Terminology

Coarse stuff → material of rough or uneven texture.

Hydrated lime → dry powder → Obtained by Treatment of quick lime with Water → Also called Slaked Lime:

Quick lime → obtained by calcination of pure limestone.

Mik lime → Thin pourable solution of staked Lime with water:

Lump lime → quick lime as it comes from a kiln.

Calcination → process of heating limestone in contact with air;

Slaking → process of adding water to quick lime to form calcium hydroxide.

Lime putty → obtained by Slaking or mixing quicklime with water.

Test on Lime

Visual inspection → Examined for its. Color & lumps.

Hydraulic acid test, → Find the carbonate Content of lime. Soundness test,

→ Find the quantity of lime.

Workability, test → know the workmanship.

Balt test → Find expansion of disintegration of bail of lime.

Impurity test→ < 10% Good → 10-20% Fair → >20% poor

That is all for today. All the discussed are construction materials used in the construction. Maybe you will find all the information on construction-related materials. I hope you can select the best materials for the construction according to their type, uses, quality test, and technical terms. Thanks for visiting us.