Protective Material - Paints & Varnishes

Objectives: At the end of this lesson you shall be able to
- **define timber**
- **classify trees**
- **explain and indicate the parts of structure of trees**
- **describe the process of seasoning**
- **list out the qualities and uses of timber**
- **explain wood based products.**

Protective Material

Introduction

One of the broadly classfication of building Materials is protective materials. Protective of a structure is a main necessity. Apperance is also main factor. Final finishings are required for all surfaces such as walls, ceilings, wood works, metal works etc.

Definition

The Materials are used for the protective the surface of structure are known as protective materials.

Types of Materials used

Paint

Varnish

Distemper

White wash

Colour wash

Termite proof materials

Paint

The paint are coating of fluid material and they are applied over the surface of timber and metal.

Characteristics of an ideal paint

It should posses good spreading power

It should be fairly cheap and economical

It can easily and freely applied

It should dry in reasonable time

Colour should last for a long time

It should hard and durable

Ingredients of oil borne paints

A base

A vehicle or carrier

Drier

Colouring pigment

A solvent

Base

A base is a solid substance is a fine state of division and it forms the bulk of paint. It determine character of paint and it imparts durability to painted surface.

Commonly used bases are

White lead	Red lead	Zinc white
Oxide of iron	Titanium white	Aluminium white
Lithophone	Antimony white	

Vehicle or carrier

Vehicle are liquid substance which hold the ingredients of a paint in a liquid suspension.Vehicles employed are

Linseed oil Poppy oil Tung oil Nut oil

Driers

These are substance accelerate the process of drying. Drier absorb oxygen from air and transfer it to linseed oil which gets hardened. Some of the driers

a)Litharge b)Red lead c)Sulphate of Manganese

Colouring pigments

Colouring pigments gives desired colour besides the base.

Pigments are Graphite lamp black

Indigo Pressian blue

Umber

Chrome green

Copper sulphate

Solvent

The function of solvent is to make the paint thin so that it can easily applied on the surface. It helps the paint to penerate through the porous surface. The most commonly used solvents is spirit ot turpentine.

Types of paint

Aluminium - Gas tank, hot water pipes , radiater oil tank

Anti corrosive paint - An corroisive metal - iron

Asbestos paint - Acidic gases and steam

Bituminous paint - Iron work under water

Cellulose paint- Surface contact with high cold and heat

Cement paint- Plastered surface

Colloidal paint - Walls

Emulsion paint - Wood, metal, plastered surface

Enamel paint- Wall surface, wood, metal

Graphite paint- Iron surface contact with ammonia, clorine sulphar gas etc, mines and under ground railway

Inodorous paint

Luminous paint - Dials of watch

Oil paint - Redecorate the surface

Plastic paint- Show room auditorium

Varnish

The term varnish in used to indicate the solution of resinous substance prepard either in alcohal, oil or turpentine.

Characteristics

It should not shrink or show cracks after drying

The protecting film develped by varnish should be tough , hard and durable

It should dry rapidly

It should not fade

Ingredients

Resins or resinous substance

Driers

Solvents

Resins- Copal, lac or shellac and rosin amber mastic gum, dammar etc.

Driers - Litharge, white copper and lead acetate

Solvent - boiled oil, spirit of wine, turpentine wood naphta

Types of varnish

Depending upon solvent varnishes are :

Oil varnish

Spirit varnish

Turpentine varnish

Water varnish

Distemper

The main ingredients are whiting or chalk and water and glue or casein. It provides a smooth to plastered surface. They are available in market under different trade names and varity of colours. They are cheaper than paint and varnish.

White wash

It contains fresh lime, water, and gum lime is toxic for germs. It reflects light and increase brightness of surface. It is used interior wall and ceilling.

Colour wash

It prepared by adding colouring pigment to white wash.Applied on outer wall and inner wall.

Termite proof materials

Termite are white ants found in abundance in tropical and subtropical countries. They are very fast in eating wood, cellulosic and non-cellulosic materials. The treatment which is given to prevent or control the growth of termites in a building is known as termite proofing.

Type of Termites

Dry Wood termites - in humid coastal regin.

Subterranean termites - in connection with soil.

Metal and alloys

Objectives: At the end of this lesson you shall be able to
- **state Types of steel reinforcement.**
- **describe steel for pre-stressed concrete**
- **identify the types of rolled steel sections.**

Metals and Alloys

Introduction

Metals are employed for various engineering purposes such as structural members, roofing materials, damp proof course, pipes, tanks, doors, windows etc.

Definition

The substance which are extracted from ores through various refining method are called metals

Classification of metals

Metals are classified into two

Ferrous metals

Non ferrous metals

Ferrous metals

Main element of ferrous metals iron, the iron ores are compound of iron with non-metallic elements and certain impurities such as carbon, manganese, phosphorous, silicon and sulphur. Important varities of iron ore are Haematite, limonite, magnetite pyrite and siderite.

Non-ferrous metals

The metal which do not contain iron ores as main constituent are called non ferrous metals.

Types of ferrous metals

- Pig iron
- Cast iron
- Wrought iron

- Steel

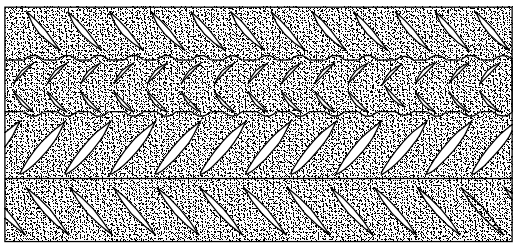
TYPES OF STEEL REINFORCEMENT:

Steel rods used for reinforcement concrete work should be of specified tensile strength, and they should develop good bond strengths with concrete. There are different types of steel, like, mild steel, tor-steel, TMT bars, etc.; and one should be able to identify them by sight. Steel rods of different diameters are used for R.C. work. In order to identify the sizes easily, only standard sizes should be used in building units. The following types of bars are commonly used in reinforced concrete construction.

1 Hot rolled bars, there are four types, (i) Hot rolled plain round mild steel bars (MS bars); (ii) Hot rolled ribbed mild steel bars (generally not recommended for use);(iii) Hot rolled high strength deformed bars (bars like Tistrong bars by Tisco) also called as HYSD bars (high strength got by micro alloying).(Fig 1)

2 Hot rolled cold twisted deformed bars like Tor steel (CTD) bars (high strength got by cold twisting) (Fig 2)

Fig 1



HIGH YIELD STRENGTH DEFERMED BARS

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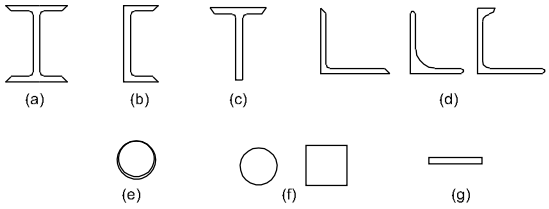
Fig 2



ROLLED STRUCTURAL SHAPES

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Market forms of Steel

SNo.	Form of Steel	Types	Uses
1	Angle section	Equal angle section unequal angle section	Structural steel work
2	Channel section	Junior channel (ISJC) Medium channel(ISMC)	Structural member
3	Corrugated sheets	G.I. Sheets	Roof covering
4	Expanded sheets		Reinforcing concrete in foundations, roads, floors, bidges lathing material partions
5	Flat bars	Width 10mm to 400mm and thickness 3mm to 40mm	Steel grill works
6	I Sections	Junior beams (ISJB) Light beams (ISLB)medium beams (ISMB)wide flange beams (ISWB)Heavy beams (ISHB)	Suitable for beams lintels, columns etc
7	Plates	Thickness 5mm to 50mm	Structural steel work
8	Ribbed torsteel	Dia 6mm to 50mm	Reinforcement in concrete structure
9	Round bars	Dia 5mm to 250mm	Reinforcement in concrete structures and for steel grill work
10	Square bars	Side 5mm to 250mm	Construction of steel grill work
11	T Sections		Steel roof truss and for built up section
12	Miscellaneous section	Acute angle sections, Obtuse angle sections, rail section, trough section, Z section	Structural steel work.

3 Thermo-mechanically Treated (TMT) bars (high strength got by controlled cooling)

4 Cold drawn steel wire fabric (welded wire fabric)

Types of non ferrous metals

Following are the right non-ferrous metals which are sued in engineering field are

- Aluminium
- Cobalt
- Copper
- Lead
- Manganese
- Nickel
- Tin
- Zinc

Alloys

Definition

Alloys is an intimate mixture of two or more metals

Process of making alloys

- The more infusible metal melted fast in fire clay crucible
- The other metals then added subsequently in order to their infusibility.
- The contents are continuously stirred to form a homogeneous mass
- The molten mixture is cast in suitable moulds and allowed to cool.
- The product obtained is called alloy
- The metal which is present in the alloy in largest proportion is called base material and the other metals are called alloying elements.

Important Alloys

Duralumin : This is the important alloy of aluminium

Aluminium	- 94%
Copper	- 4%
Manganese	- 0.5 %
Magnessium	- 0.5 %
Silicon	- 0.5%
Iron	- 0.5%

Brass : This is an alloy of copper and zinc

Copper		- 60%
Zinc		- 40%

Bronze : This is an alloy of copper and tin

Bell metal	Copper	- 82%
	tin	- 18%
Gun metal	Copper	- 88%
	Tin	- 10%
	Zinc	- 2%

Dow metal

Magnesium	- 88%
Aluminium	- 12%
Manganese	- 0.1%

Nickel silver or german silver

Copper	- 50 to 80%
Tin	- 10 to 30%
Zinc	- 20 to 30%

Steel Alloys

Chrome - molybdenum steel

Chrome - nickel stainless steel

Chrome - nickel steel

Chromium steel

Chromium - vanadium steel

Cobalt steel

Copper steel

Manganese steel

Molybdenum steel

Nickel - chromium- molybdenum steel

Nickel steel

Tungsten steel

Vanadium steel

Nickel -molybdenum steel

Plastics

Objectives: At the end of this lesson you shall be able to

- **explain briefly the history of plastic**
- **state the composition of plastic**
- **define polymerization**
- **state the classification of pasties and explain**
- **state the moulding compounds of plastic and fabrication process involved in the fabrication of plastics**
- **explain properties of plastics**
- **state the use of plastics**
- **pvc pies and pipes of other materials and advantages of PVC pipes.**

Brief history of plastic

Plastic is one of the recent engineering material which is available in the market all over the world. After the long research by the scientists the birth of plastic in industry took place in the 19th century.

The development of plastic industry may be grouped into three stages.

1 The main objective of the first stage of development was mainly to initiate or copy the natural plastics. In 1865 camphor and alcohol mixed with nitro-cellulose, and the result of the product is known as parasite, which is the name of the scientist. This is used for gear wheels, dory knobs etc.

2 The second stage is comprised in first twenty years or so of this century. In this stage the plastic industry scientifically scrutinized and local foundation for further

scientific development in this field. In 1909 Dr.L.Bakeland invented a product named as Bakelite which was found to be strong and hard material.

3 The final stage includes present trend and its main aim was improving the old plastic and producing new varieties of plastics. In 1924 the scientist pollats prepared a produce from urea and formaldehyde. It was transparent like glass, and it was un breakable. The same was produced in different attractive colours.

Composition : Plastic is organic substance and it consists of natural or synthetic benders or without moulding compounds. In general plastics are compounds of carbon with other elements like hydrogen, nitrogen of carbon and oxygen.

The finished product of plastic is rigid and stable at normal temperature, plastics are organic substances and they can flam when required heat and pressure are applied at the same stage of manufacture.

Polymerization : The substance containing of one primary chemical are known as monomers or monoliths. They are synthesized to form polymers by the process known as polymerization. The properties like strength, rigidity, elasticity are unproved by polymerization.

The following are the two methods of polymerization.

1 Addition polymerization

2 Condensation polymerization.

1 Addition polymerization

In this method, different molecules join together, and the molecular weight of the resulting polymer is equal to the some of the molecular weight of the reacting molecular. This process involves three stages.

i Beginning of the process

ii Expansion of the chain

iii End process

The polymers obtained in this method are polyethylene, polypropylene, polyvinylchloride, polystyrene, polyarcylates etc.

2 Condensation polymerization

In this method, low molecular substances are removed from high molecular substances formed from a large number of identical or different molecular. The reaction proceeds with an evolution of ammonia, hydrogen chloride and similar other low molecular substances.

The polymers obtained by this method are phenol formaldehyde, carbonate, melamide*, melamine formaldehyde etc.

Classification of plastics

They are classified according to their:

1 Behaviour with respect to heating

2 Structure and

3 Physical and mechanical properties

1 Behaviour with respect to heating

According to this classification plastics are divided into two groups.

1 Thermo plastic

2 Thermo setting

1 Thermo- plastic

The thermo plaster or heat non - convertible group is the general term applied to plastics which become soft when heated and hard when cooled. The process of softening and hardening may be repeated for an indefinite time, provided the temperature during heat is not so high as to cause chemical decomposition. So it is possible to shape and reshape these plastics by means by heat and temperature. The advantage of this variety plastics is that the scrap obtained from old and worn-out articles can be effectively used again.

2 Thermo setting

The thermo setting or heat convertible group is the term applied to plastics which be come rigid when moulded at a suitable temperature and pressure. When they are heated in temperature ranging 127° to 177°C, It sets permanently and further application of heat does not alter their from or soften. But at 343°C charring occurs. This charring is a peculiar characteristic of organic substances.

The thermo setting plastics are soluble in alcohol and in certain organic solvents, when they are in thermo plastic stage. This property is used for making paints and varnishes.

The thermo plastics are durable strong and hard. They are available in many beautiful colours. They are mainly applied in engineering application plastics.

2 Structure : As per classification, plastics are divided into two groups.

1 Homogeneous plastic

2 Heterogeneous plastic

1 Homogeneous plastic

The plastics of this group contains carbon atoms and they exhibits homogeneous structure.

2 Heterogeneous plastic

In this plastic it contains carbon and oxygen, nitrogen and other elements and they exhibit Heterogeneous structure.

3 Physical and mechanical properties

According to this, plastics are divided into four groups.

i Rigid plastics

ii Semi- rigid plastics

iii Soft plastics

iv Elastomers

i Rigid plastics

These plastics possess a high modulus of elasticity and they retain their slope under exterior stresses applied at normal or moderately increased temperature.

ii Semi-rigid plastics

These plastics have a medium modulus of elasticity and the elongation under pressure completely disappears when pressure is removed.

iii Soft plastics

These plastics have a lam modulus of elasticity and the elongation under pressure disappears sonly when the pressure is removed.

iv Elastomers

These plastics are of soft and elastic materials having low modulus of elasticity. The deformation is in tension and the deformation disappears rapidly at room temperature.

Resins

The plastics are grouped in to two groups, based on their behaviour according to heating, resins or benders are also broadly divided into the following groups.

1 Thermo plastic resins

2 Thermo setting resins

1 Thermo plastic resins

i Alkyd

These resins are made from glycerin and ophthalmic anhydride. The cool slowly and possess electricity properties. They are used for preparing this felons of plastics.

ii Celluloses

These are derived from various cellulose compounds like cellulose acetate, cellulose nitrate etc. Plastics made from this are like glass. They are tough, strong and posses electrical properties. Possible to obtain all types of colours.

iii Coumarone - indene

These resins are soft in very small temperature. They are brittle and used for floor tiles, rubber manufacture etc.

iv Methyl methocrylate

This is known as acrylic. It is derived from coal petroleum and water. It transmits ultra-violet waves of light. It can be acts, sawn or turned it acts as good electrical insulator. Plastics prepared from this are used for safety glass, artificial jewels, roof lights, lightening fittings, bath and sink units etc.

v Styrene

This is the product form ethylene which is made from petroleum . It is light an weight and transmits ultra- violet waves of light. It possess very high electric resistance. It is used as emulators at radio frequencies in wireless and television industry.

vi Vinyl

It is prepared by passing acetylene gas through acetic acid or dry hydrogen chloride. It is used for wire and cable for coatings polyethylene is a vinyl resin which is tough and flexible and used for cable causing.

2 Thermo setting resins

i Casein

Casein is a phosphor protein and is derived by the precipitation of milk with acids. If has bright attractive appearance but not strong. It is used for buckles, buttons, etc.

ii Melamine -formaldehyde

It is obtained from calcium carbide, melamine when reacted with formaldehyde, forms this resin. It possess excellent resistance to electrical arcs. It is used for electrical insulators, glass reinforced plastics etc.

iii Phenol formaldehyde

Phenol is a carbolic acid it is extracted resin prepared from this lightly resistant to heat. It possess both mechanical and electrical properties. It is used for paints, varnishes, preparation of laminated products, electrical fitting, w.c. seats etc.

iv Phenol farfuraldehyde

Farfuraldehyde vapours when reacted with phenol, from resin. It is darie colour and resists very high temperature.

v Urea formaldehyde

Urea is prepared from calcium cyanamide or a mixture of liquid carbon dioxide and liquid ammonia. Urea reacted with formaldehyde produce this resin. It is not easily attached by dilute acids and alkalies oil, chemicals, water etc. Plastics made from this resin are unidely* used for making adhesives for wood, lighting fixtures, like lamps, reflectors etc.

To give desired finished plastic articles, certain moulding compounds are to added to plastics. Following are the such moulding compounds.

1 Catalysts

2 Fillers

3 Hardeners

4 Lubricants

5 Pigments

6 Plasticizers

7 Solvents

In plastic fabrication following are the process involved in the fabrication of plastic articles.

1 Blowing

2 Calendaring

3 Casting

4 Laminating

5 Moulding (compression moulding - extrusion moulding)

Properties of plastics

1 **Appearance :** Some plastics are completing transparent in appearance.

2 **Chemical resistance :**Plastics are great resistance to moisture, chemicals and solvents. Many plastics are found to be corrosion resistance and hence they are used to convey chemicals.

3 **Dimensional stability :**This property of plastic is very satisfactory with that of other common engineering materials.

4 **Ductility :** It is lacks in ductility and may fail with out warning.

5 **Durability :** Plastic and are quite durable. It possess sufficient surface hardness.

6 **Electric insulation :** Plastics are for superior to ordinary electric insulators

7 **Finishing :** Any surface treatment can be given to plastics. It is easy to have technical control during manufacture. It results to man production with uniformity of surface finish.

8 **Fire -resistance :** Plastics are organic in nature and hence all plastics re combustible. Cellulose acetate burns slowly. Polyvinyl chloride plastics are non - inflammable. Phenol formaldehyde and urea formaldehyde resist fire and they are used as fire - proofing materials.

9 **Fixing :** Plastics can be fixed easily in position and they can be bolted, clamps, drilled, glued, threaded simply push fitted in position.

10 **Humidity :** The properties of plastics are governed to same extent by humidity, plastics which do not contain water attracting groups like polyvinyl chloride plastics offer great resistance to moisture.

11 **Maintenance :** It is easy to maintain plastic surfaces and they do not require any protective coat of paints.

12 **Melting point :** Most of plastics have low melting point and some of plastics have 50°C. In general it can be said that the co-efficient of thermal expansion of plastics is ten times than that of steel.

13 **Optical property :** Several types of plastics are transparent and translucent .

14 **Sound absorption :** This material has absorption coefficient of about 0.67

15 **Strength :** Plastics are reasonably strong. Plastic members can be used as tensile members.

16 **Thermal property :** The thermal conductivity of plastics is low and it can be compared with wood. Foamed or expanded plastics are among the loading thermal insulators.

17 **Weather resistance :** Only limited varieties of plastics can be exposed to weather.

18 **Weight :** Plastics, whether thermoplastic or thermo setting have low specific gravity, the a usage being 1.30 to 1.40. The light weight of plastic reduces the transport cost and easy to fixing .

Uses of plastics

The typical uses of plastics in building are summarized as follows.

1 Bath and sack writs

2 Cistern ball floats

3 Corrugated and plain sheets

4 Decorative laminated and mouldings

5 Electrical conduits

6 Films for water proofing, damp - proofing and concrete curring

7 Electrical insulators

8 Floor files

9 Foams for thermal insulation

10 Joint less flooring

11 Lighting fixtures

12 Over heads water tanks

13 Paints and varnishes

14 Pipes to corry cold water

15 Roof lights

16 Safety glass

17 Wall tiles

18 Water resistant adhesives etc

The advantages of PVC pipes

1 They have good insulating properties and hence the water passing through this is not affected by the out side temperature.

2 The have no problems of incrustation .

3 They permit high smooth and undionanished flam of water.

4 They possess high Hazen Williams constant.

5 They prove to be economical as compared to other pipe conventional materials.

6 They provide resistance to a variety of chemicals.

Disadvantages of PVC pipes

1 They are liable to creep phenomena, when installed above ground level.

2 They can not be used in high temperature.

3 They do not have same strength as cost iron or galvanized iron pipes.

4 They possess higher co-efficient of expansion.

Precautions to be taken in the design and installation of PVC pipes.

1 The design of PVC pipes should accommodate adequate provisions of air vents etc.

2 The fittings such as tees, elbows, caps etc used in PVC piping system fit well with the pipes.

3 After installation the PVC pipes should be tested.

4 The turbulent flow of water through PVC pipes should be avoided.

5 The trances for laying PVC pipes should be as narrow as possible.

6 They are available in different colours. It is advisable to avoid red and black colours.

7 Should be used freely to eliminate external stresses

8 They should not be used at places likely to be heavy loading.

9 The should not be bent too much.

- The properties of various types of plastics make them suitable for wide range of engineering applications. The development of plastic industry is very recent and have much scope for research.
- Most of plastics possess low heat resistance
- Plastics are not very low
- Plastics exhibits high creep
- Plastics have high co-efficient of thermal expansion
- It varies from 25×10^{-6} to 120×10^{-6} as compared to 10×10^{-6} of steel.