Unit 4

Wall Finishes - Plastering, Paintings, Purposes, Methods, Defects and their Solution,
Glass- Types and Uses
Green building materials and finishes& Smart coatings and self-healing materials.

Wall Finishes - Plastering, Paintings, Purposes, Methods

Plastering

Plastering is the process of covering rough surfaces of walls, columns, ceilings and other building components with thin coat of plastic mortars to form a smooth durable surface. The coating of plastic material (i.e. mortar) is termed as plaster. Plastering on external exposed surfaces is known as rendering.

Objects of plastering

Plastering is done to achieve the following objects :

1. To protect the external surfaces against penetration of rain water and other atmospheric agencies.
2. To give smooth surface in which dust and dirt cannot lodge.
3. To give decorative effect.
4. To protect surfaces against vermit.
5. To conceal inferior materials or defective workmanship.

Requirements of good plaster

The plaster material should fulfill the following requirements :

1. It should adhere to the background, and should remain adhered during all variations in seasons and other atmospheric conditions.
2. It should be hard and durable.
3. It should possess good workability.
4. It should be possible to apply it during all weather conditions.
5. It should be cheap.
6. It should effectively check penetration of moisture.

Types of mortars for plastering

The selection of type of plaster depends upon the following factors :

1. Availability of binding materials.
2. Durability requirements.
3. Finishing requirements.
4. Atmospheric conditions and variations in weather.
5. Location of surface (i.e. exposed surface or interior surfaces.)

Following types of mortars are commonly used for plastering :
(i) Lime mortar. (ii) Cement mortar. (iii) Lime cement mortar.

(i) Lime mortar:

Lime used for plastering may be either fat lime or hydraulic lime. However, fat lime is preferred since it yields good putty after slaking. Hydraulic lime contains particles which slake very slowly as it comes in contact with atmospheric moisture. Such slaking may even continue for 6 to 8 months. If unslaked particles remain in such a plaster, blisters are formed during the process of slow slaking. Thus the plastered surface

gets damaged. Hydraulic lime yields harder and stronger surface. If hydraulic lime is used for plastering, it should be ground dry with sand. It is then left for 2 to 3 weeks and then reground before use. Fat lime on the other hand, is slaked wet. The mix proportion (i.e. lime : sand) varies from 1 : 3 to 1 : 4 for fat lime and 1 : 2 for hydraulic or kankar lime. The binding properties of lime mortar can be improved by adding gugal at the rate of about 1.6 kg per cubic metre of mortar. The adhesive and tensile properties of lime mortar can further be improved by mixing chopped hemp at the rate of about 1 kg per cubic metre of mortar. Such a treatment prevents the formation of tensile cracks on the plastered surface.

(ii) Cement mortar:

Cement mortar is the best mortar for external plastering work since it is practically non-absorbant. It is also preferred to lime plaster in both rooms etc., and in damp climate. Cement mortar is much stronger than lime mortar. The mix proportion (i.e. cement:sand) may vary from 1 : 4 to 1 : 6. Sand used for plastering should be clean, coarse and angular. Before mixing water, dry mixing is thoroughly done. When water is mixed, the mortar should be used within 30 minutes of mixing, well before initial setting takes place.

(iii) Lime-cement mortar:

Lime-cement mortar contains properties of both the lime mortar as well as cement mortar. Cement mortar as such does not possess sufficient plasticity. Addition of lime to it imparts plasticity, resulting in smooth plastered surface. Mix proportions generally used are 1 : 1 : 6 (cement : lime : sand), 1 : 1 : 8 or 1 : 2 : 8. Generally, fat lime is used.

Terminology used in plastering work

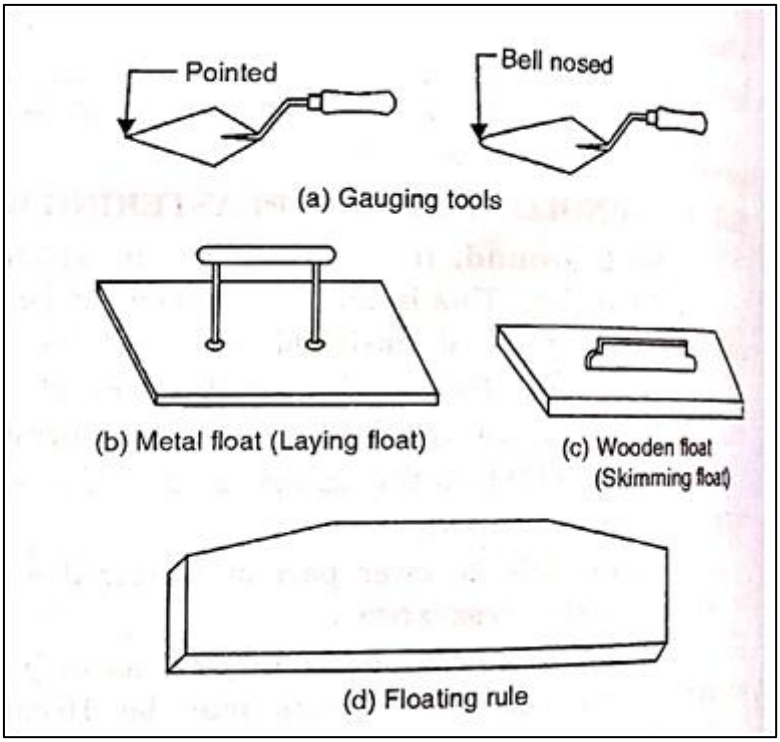
1. **Back ground:** It is the surface to which the first coat of plaster is applied.
2. **Blistering**: This is the development of local swellings on the finished plastered surface, due to residual unslaked lime nodules.
3. **Cracking:** This is the development of one or more fissures in the plaster due to movements in the back ground or surrounding structure.
4. **Crazing:** This is the development of hair cracks, usually in an irregular pattern, on the finished surface.
5. **Dado:** This is lower part of plastered wall, where special treatment is given to make it better resistance.
6. **Dots:** These are small projections of plaster, laid on background for fixing screeds etc. The size of dots may be 15 cm × 15 cm.
7. **Dubbing coat:** This is the process of filling up hollow spaces in the solid background, before applying the main body of the plaster.
8. **Finishing coat:** It is the final coat of plaster. Such a coat is also known as setting coat or skimming coat.
9. **Flaking:** It is the process of scaling away patches of plaster of previous coat, due to lack of adhesion with the under-coat.
10. **Gauging:** It is the process of mixing various constituents of plaster.
11. **Grinning:** It is the reflection or appearance on the surface of plaster, of the pattern of joints or similar patterns in the background.
12. **Grounds:** These are the wooden strips fixed to the back-ground to which primary finishing may be secured.
13. **Hacking:** This is the process of roughening the background to provide a bond or key for plastering.
14. **Keys**: These are openings or indentations or corrugations on the background or surface of under-coat, to which plaster will form mechanical bond.
15. **Laitance:** When freshly laid concrete or mortar is subjected to excessive trowelling a screen consisting of thin layer of fine cement particles is formed. This layer is known as laitance.

16. Peeling: This is the term applied to the dislodgment of plaster work from the background.
17. Under-coats: These are the coats of plaster applied under the finishing coat.

Tools for plastering

The following tools are commonly used for plastering work:

1. **Gauging trowel:** (Fig. a). A gauging trowel is used for gauging small quantities of materials and for applying mortar to mouldings, corners etc. The end of the trowel blade may be either pointed or bull-nosed.
2. **Float:** A float is used for applying and spreading mortar on the surface. It is made of either metal or wood. Metal float, made of thin tempered steel, is known as laying trowel (Fig. b). The laying trowel is used for laying the plaster material and for trowelling so as to get desired finish. The blade size is generally 10 cm × 30 cm. For good work, two types of laying trowels are used. The first type having stiff plate is used for applying and trowelling the plaster, while the second type having thin plate possessing slight springing action, is used for finishing coat. The wooden float, commonly known as skimming float (Fig. 19.1 c) is used for the finishing coat of plaster. The size of the float varies from 10 cm × 30 cm to 11 cm × 33 cm with thickness of 10 to 12 mm. Sometimes, a devil float, having nail projection of about 3 mm from the surface is used for making zig-zag lines on the plastered surface so as to form key for the subsequent coat.



Tools for plastering

3. **Floating rule:** (Fig. d). It is used for checking the level of the plastered surface between successive screeds.
4. **Miscellaneous Tools:** These include plumb bob, spirit level, set square, straight edges brushes, scratchers etc.

Methods of Plastering

Preparation of background: In case of new surfaces, the joints of masonry shall be raked out to a depth of 10 mm in brick masonry and 15 mm in stone masonry. All mortar droppings, dust and laitance shall be

removed by brushing with a stiff wire brush. The surface shall be levelled up wherever necessary before rendering is done. For finishes in three coats, the projections on the surface shall not be more than 10 mm and depressions not more than 20 mm. For two coat plaster, the projections and depressions shall be limited to 5 mm and 10 mm respectively. The surface shall then be washed with clean water and kept damp uniformly. Care shall be taken to see that the surface is not soaked with water or kept too dry. In either case, proper suction will not be obtained.

In case of plastering on old surface, all dirt, oil, paint etc. shall be cleaned off and the surface roughened. All loose and crumbling plaster shall be removed and joints raked out. The surface shall then be washed and kept damp to ensure optimum suction.

1. Lime plaster: Lime plaster is applied either in three coats or in two coats. Before the application of plaster, the background is prepared as described above.

(a) Application of rendering coat: The mortar is forcibly applied with mason's trowel and pressed well into joints and over the surface. The thickness of coat should be such as to cover all inequalities of the surface; normal thickness is 12 mm. This is allowed to slightly harden, and then scratched criss-cross with the edge of trowel (or with devil float); the spacing of scratches may be 10 cm. The surface is left to set atleast for 7 days. During this period, the surface is cured by keeping it damp and then allowed to dry completely.

(b) Application of floating coat: The rendering coat is cleaned off all dirt, dust and other loose mortar droppings. It is lightly wetted. Patches 15 cm × 15 cm or strips 10 cm wide are applied at suitable spacings to act as gauges. The mortar is then thrown with mason's trowel, spread and rubbed to the required plain surface with wooden float. The surface so obtained should be true in all directions. In case of lime-sand plaster, the finishing coat is applied immediately. In the case of lime-surkhi plaster, the floating coat is allowed to slightly set and then lightly beaten criss-cross with floats edge at close spacings of 4 cm. It is then cured to set completely for atleast 10 days and then allowed to dry out completely. In either case, the thickness of coat varies from 6 to 9 mm.

(c) Application of finishing: In the case of lime-sand mortar the finishing coat is applied immediately after the floating coat. The finishing coat consists of cream of lime (called neeru or plaster putty), having lime cream and sand in the ratio of 4 : 1) applied with steel trowel and rubbed and finished smooth. The rubbing is continued till it is quite dry. It is left for 1 day, and then curing is done for atleast 7 days. In the case of lime-surkhi mortar, the finishing coat is applied 7 days after the floating coat, after cleaning the surface of all dirt, dust and mortar droppings and after fully wetting the surface of previous coat. The finishing coat is rubbed hard and finished smooth.

Types of plaster finishes

Plastered surface may be finished in the following varieties:

1. Smooth cast finish: In this finish, smooth, levelled surface is obtained. The mortar for the finish may be made of cement and fine sand in the ratio of 1 : 3. Mortar is applied with the help of wooden float. Steel floats are not recommended for external renderings since they give a very smooth finish which is liable to cracking and crazing under exposure to atmospheric conditions.

2. Sand faced finish: This is obtained by plastering in two coats. The first coat is applied in 1 : 4 cement sand mortar for 12 mm thickness. It is provided with zig-zag lines. After curing it for 7 days, the second

coat is applied in the thickness of 8 mm. The mortar for the second coat is prepared from cement sand mix ratio 1 : 1. The sand for this is perfectly screened so that uniform size is obtained. Sponge is used in the second coat when it is still wet. The surface of final coat is finished by rubbing clean and washed sand of uniform size by means of wooden float. This results in the surface having sand grains of equal and uniform density.

3. Rough cast finish or spatter dash finish: In this, the mortar for the final coat contains fine sand as well as coarse aggregate in the ratio of 1 : 1/2 : 3 (cement : sand : aggregate). The coarse aggregate may vary from 3 mm to 12 mm in size. The mortar is dashed against the prepared plastered surface by means of large trowel. The surface is then roughly finished using a wooden float. Such a finish is water proof, durable and resistant to racking and crazing, and may be used for external renderings.

4. Pebble dash or dry dash finish: In this the final coat, having cement : sand mix proportion of 1 : 3 is applied in 12 mm thickness. Clean pebbles of size varying from 10 to 20 mm size are then dashed against the surface, so that they are held in position. The pebbles may be lightly pressed into the mortar, with the help of wooden float.

5. Depeter finish: This is similar to pebble dash finish in which the 12 mm coat is applied and while it is still wet, the pieces of gravel or flint are pressed with hand on the surface. Flints of different colours may be used to obtain beautiful patterns.

6. Scrapped finish: In this, the final coat of 6 to 12 mm thick is applied and after it has stiffened for few hours, the surface is scrapped in patterns for a depth of 3 mm. For scrapping, steel straight edge, old saw blade or such other tool may be used. Such scrapped surface is less liable to cracks.

7. Textured finish: This is used with stucco plastering. Ornamental patterns or textured surfaces are made on the final coat of stucco plastering, by working with suitable tools.

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Defects in plastering and their Solutions

The following defects may arise in plaster work:

1. Blistering of plastered surface: This is the formation of small patches of plaster swelling out beyond the plastered surface, arising out of late slaking of lime particles in the plaster.

2. Cracking: Cracking consists of formation of cracks or fissures in the plastered work resulting from the following reasons:

i. Imperfect preparation of background.
ii. Structural defects in building.
iii. Discontinuity of surface.
iv. Movements in the background due to its thermal expansion or rapid drying.
v. Movements in the plaster surface itself, either due to expansion (in case of gypsum plaster) or shrinkage (in case of lime-sand plaster).
vi. Excessive shrinkage due to application of thick coat.
vii. Faulty workmanship.

3. Crazing: It is the formation of a series of hair cracks on plastered surface, due to same reasons which cause cracking.

4. Efflorescence: It is the whitish crystalline substance which appears on the surface due to presence of salts in plaster-making materials as well as building materials like bricks, sand, cement etc. and even water. This gives a very bad appearance. It affects the adhesion of paint with wall surface. Efflorescence can be removed to some extent by dry brushing and washing the surface repeatedly.

5. Flaking: It is the formation of very loose mass of plastered surface, due to poor bond between successive coats.

6. Peeling: It is the complete dislocation of some portion of plastered surface, resulting in the formation of a patch. This also results from imperfect bond.

7. Popping: It is the formation of conical hole in the plastered surface due to presence of some particles which expand on setting.

8. Rust stains: These are sometimes formed when plaster is applied on metal laths.

9. Uneven surface: This is obtained purely due to poor workmanship.

Following are the remedies for minimizing the defects in plastering work:

1. The brickwork and plastering work should be carried out in the best workmanship manner.
2. The bond of brickwork should be properly maintained.
3. The brickwork should be washed with clean water. It should, however, be remembered that it is desirable to prevent efflorescence than to cure it. The building should be selected of superior quality and suitable methods of construction should be employed.
4. The water should not be used to wash the surface so as to remove efflorescence and the surface will appear again. It is advisable to postpone painting till efflorescence ceases. For this purpose, keep deposit of efflorescence as it appears and the surface is kept under observation. If after period of few days, if efflorescence appears again, it is removed with a dry brush and the process is repeated till all the soluble salts are removed under the conditions of normal drying.
5. The bricks of superior nature should only be used for the brickwork.
6. The water free from salts should be used for the brickwork and plastering work.
7. The surface to be plastered should be well-watered so that it may not absorb water from the plaster.

Paintings

paints are liquid compositions of pigments and binders which, when applied on the surface in thin coats dry to form a solid film to impart the surface a decorative finish. Paints are also used to protect the surfaces of wood, metals, plaster surfaces from weathering, corrosion and other chemical and biological attacks. Paints have life and hence they are required to be periodically applied at suitable interval. Painting on surfaces impart decoration, sanitation and protection.

In the calcareous surfaces, like lime and cement plastered surfaces, are highly alkaline and this alkalinity affects the oil binders of paints. The paints on such surfaces takes long time for the greater part of the water to evaporate even when the atmospheric conditions are favourable. In such cases, it is essential to take cognisance of the stored up moisture and also the alkalinity of the surfaces before painting. Hence the painting of surfaces imperfections, growth of moulds, mosses, lichens and algae. As these surfaces need special care on most of the surface cleaning materials.

Following are the objects of painting a surface:

1. It protects the surface from weathering effects of the atmosphere and actions
2. of other liquids, fumes and gases.
3. It prevents decay of wood and corrosion in metal.
4. It is used to give good appearance to the surface. The decorative effects may
5. be created by painting and the surface becomes hygienically good, clean,
6. colourful and attractive.
7. It provides a smooth surface for easy cleaning.

Characteristics of an ideal paint

Following are the characteristics of an ideal paint:

1. It should possess a good spreading power i.e. maximum area of the surface
2. should be covered by minimum quantity of the paint.
3. The paint should be fairly cheap and economical.
4. The paint should be such that it can be easily and freely applied on the surface.
5. The paint should be such that it dries in reasonable time and not too rapidly.
6. The paint should be such that its colour is maintained for a long time.
7. The paint should form a hard and durable surface.
8. The paint should not affect health of workers during its application.
9. The paint should not be affected by weathering actions of the atmosphere.
10. The paint should possess attractive and pleasing appearance.
11. The surface coated with paint should not show cracks when the paint dries.
12. When applied on the surface, the paint should form a thin film of uniform nature.

Types of paints

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

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

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

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

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

i. It is cheap.
ii. It lasts for a long duration.

iii. The appearance of the paint is black.

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

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

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

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

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

(8) Emulsion paint: A variety of emulsion paints is available. It contains binding materials such as polyvinyl acetate, synthetic resins, etc. This paint is easy to apply and it dries quickly in about 1 1/2 to 2 hours. The colour of the paint is retained for a long period and the surface of paint is tough and it can be cleaned by washing with water. There is absence of odour and the paint possesses excellent alkali resistance.

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

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

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

(11) Inodorous paint: No turpentine is used in this paint, but white lead or zinc white is mixed with methylated spirit. The white lead or zinc white is well ground in oil. The shellac with some quantity of

linseed oil and castor oil is dissolved in methylated spirit. The paint is not durable, but it dries quickly. The methylated spirit evaporates and a film of shellac remains on the surface.

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

(13) Oil paint: This is the ordinary paint and it is generally applied in three coats during its application. They are respectively termed as primes, undercoats and finishing coats. This paint is cheap and easy to apply and it possesses good opacity and low gloss.

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

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

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

(15) Silicate paint: This paint is prepared by mixing calcined and finely ground silica with resinous substances. The paint when dried forms a hard surface and it is durable. It can stand extreme heat and it adheres firmly to brickwork also. It is not affected by alkalies. No chemical action takes place on metals by this paint. The drier used with this paint should be of a special silicate drier type.

The silicate paint can directly be applied on brick, plaster or concrete surfaces. These surfaces should be made wet before the paint is applied.

The two or three coats of silicate paint are recommended and it is not necessary to have a priming coat. The tool which is used to apply silicate paint should be immediately cleaned with water after use. The surfaces should not be painted with silicate paint in hot weather.

(16) Synthetic rubber paint: This paint is prepared from resins. It has the following advantages:

i. It offers good resistance to the water and is not affected by heavy rains.
ii. It dries quickly.
iii. A uniform colour is maintained when this paint is applied on the surface.
iv. It is little affected by weather and sunlight.
v. It can be applied on surfaces which may not be completely dry e.g. fresh concrete.
vi. It is moderate in cost and covers a sizeable area.
vii. It is easy to apply on the surface.
viii. It possesses excellent chemical resisting property.

Notes for guidance in the process of Painting

(1) Brushes: The brushes used for painting should be good and they should be composed of bristles and not of horse hairs. The bristle brushes are elastic and they possess good paint-holding capacity. It is

preferable to use round brushes. The new brushes should be soaked in water for about 12 hours and then dried before use. The brushes should be used only for the paint for which they are meant. After use, the brushes should be cleaned with kerosene oil.

(2) Paints: The ready mixed paints of various brands are available in the market and they can be directly applied. These paints are expensive and they should be used soon after opening the container. Otherwise, due to volatilization, the paint becomes solid. The following procedure is adopted to prepare paint from stiff paint:

i. Take sufficient quantity of stiff paint in a pot and cover it with linseed oil.
ii. Mix linseed oil with stiff paint by means of a stick.
iii. Add other ingredients.
iv. Add suitable pigment, if colour is required.
v. Take a second pot and cover it with canvas.
vi. Allow the mixed paint to pass through the canvas.
vii. The paint is now ready for use. To prevent drying, a film of linseed oil or water may be spread over the paint.

(3) Knotting:

The knotting is used to cover or kill the knots in wood work. It prevents the exudation of resin from the knots. The following three methods of knotting are generally adopted:

(i) Ordinary or size knotting: This knotting is applied in two coats. The first coat consists of red lead ground in water and mixed with strong glue size in hot condition. It dries in about ten minutes. The second coat consists of red lead ground in oil and thinned by boiled oil and turpentine.

(ii) Patent knotting: This is applied in two coats. For both the coats, the varnish prepared by dissolving shellac in methylated spirits of wine is used.

(iii) Lime knotting: The knot is covered by hot lime and it is left for 24 hours. The surface is then scrapped off and then ordinary knotting is carried out.

(4) Stopping: The term stopping is used to indicate the rubbing down of the surface after the first coat of paint is applied. The rubbing is done by means of pumice-stone or glass-paper or both. Before rubbing is commenced, the holes, crack etc. on the surface are filled with ordinary putty made from whiting and linseed oil. The putty becomes hard when it dries.

The term hard stopping is used when instead of ordinary putty, an admixture of one-third white lead and two-third ordinary putty, is filled in holes, cracks etc. It is adopted for superior work.

(5) Coats: The paint is usually applied in three or four coats. The first coat is known as the priming coat, the second one as under coat and the remaining as finishing coat.

The priming coat creates a layer or film which provides adhesion of the paint with the surface. It also protects the surface from weathering actions. The suitable material for priming coat should be used, depending on the nature of surface to be painted. The under coat serves to provide foundation or support to the finishing coat. The surface is made even and all irregularities of the surface are removed by this coat.

The finishing coat or coats are then applied as per requirements.

(6) Spray painting: Instead of the ordinary brushes, a spraying pistol may be used for painting work. The pistol works under compressed air and the paint thrown through the pistol on the surface forms a thin uniform film or layer of paint on the surface. The spray painting is superior to painting by brushes. Following are the advantages of spray painting:

i. The speed of work increases considerably.
ii. An experienced painter can create artistic patterns or designs on the surface by spraying paints of different shades.
iii. It is found to be economical in material and labour. The two coats of spray would suffice whereas ordinary brush painting would require three or four coats.
iv. The mechanical equipment is such that the paint remains always in a state of motion. This ensures uniform mixing of ingredients of the paint.

Failure of paint

The failure of paint job on wall or wooden members or structural steelwork is not uncommon. The paint job, though an easy job, has peculiarities of its own. At the same time, a failed paint job involves substantial expenditure by way of scraping and repainting the surface and cost of new paint. Following are the major causes of failure of a paint job:

(1) Bad workmanship: The paint job demands a certain degree of skill. A careless person in the habit of thinning paint too much so that he can cover more area would do harm. The layer of paint can even be absent for portions of surface which are difficult to reach.

(2) Conditions for painting: The job of painting should be carried out under favourable conditions only. It should be seen that dirt, dust and moisture do not get accumulated during the process of painting. Also, very high or low temperatures and humidity during the application of paint can also seriously affect the performance of the paints.

(3) Moisture: The leakage through sanitary installations, floors, roofs, water pipes, etc. make the painted surface moist and in case of newly constructed building, the water used during construction activity may require time to evaporate. Whatever may be the reason, the presence of moisture accelerates the process of separating the paint layer from surface.

(4) Salts and alkalies: The movement of moisture can transport salts from either internal volume of masonry or new deposits. Such salts and alkalies saponify oil paints.

(5) Unsuitable surfaces: If the surfaces are not properly prepared or treated to receive the paint, it may lead to the failure of paint job.

(6) Wrong choice of paint: Depending upon the climatic conditions, nature of surface to be painted, and various other factors affecting the performance of paint, the paint must be carefully made. It is found that low quality paints are cheap in initial cost. But the durability of such painted surfaces is very poor.

Defects in painting

Following are the usual defects which are found in the painting work:

(1) Blistering: This defect is caused by the water vapour which is trapped behind the painted surface. The formation of bubbles under the film of paint occurs in this defect. It may occur from various causes such as imperfect seasoning of timber, excess oil used in final coat, etc.

(2) Bloom: In this defect, the formation of dull patches occurs on the finished painted surface. It is due to the defect in paint or bad ventilation.

(3) Fading: The gradual loss of colour is known as the fading and it is mainly due to the effect of sunlight on pigments of paint.

(4) Flaking: A small portion of the painted surface is sometimes seen loose. It is known as the flaking and is due to poor adhesion.

(5) Flashing: Sometimes the glossy patches are seen on the painted surface. This defect is known as the flashing and it is mainly due to poor workmanship, cheap paint or careless actions.

(6) Grinning: When the final coat of paint has not sufficient opacity, the background is clearly seen. This is known as the grinning.

(7) Running: The paint runs back and leaves small areas of surface uncovered. This defect occurs when the surface to be painted is too smooth.

(8) Sagging: When a vertical or inclined surface is too thickly painted, the defect of sagging occurs.

(9) Saponification: The formation of soap patches on the painted surface is termed as saponification and is due to chemical action of alkalies.

(10) Wrinkling: When a horizontal surface is too thickly painted, the defect of wrinkling becomes prominent.

Glass- Types and Uses

Different types of glasses:

1. Float Glass
2. Tempered Glass
3. Laminated Glass
4. Insulated Glass
5. Low-E Glass
6. Mirrored Glass
7. Tinted Glass
8. Wired Glass

1. Float Glass: Float Glass is the most common and widely used type of glass. It is manufactured by floating molten glass over a bed of molten tin, which gives it a perfectly flat, smooth, and uniform surface. This process ensures high optical clarity and consistent thickness across the sheet.

Use of Float Glass:

1. Windows and doors in residential and commercial buildings
2. Mirrors (after silvering)
3. Furniture tops (tables, shelves, cabinets)
4. Automotive glass (as a base before lamination or tempering)
5. Interior design elements like partitions and decorative panels

2. Tempered Glass: Tempered glass is primarily used where strength, safety, and durability are critical, such as in buildings, vehicles, and consumer products. It is up to five times stronger than ordinary glass and, when broken, shatters into small blunt fragments instead of sharp shards, reducing the risk of injury

Use of Tempered Glass:

1. Used as safety glass because it breaks into small, harmless pieces.
2. Used in doors and windows of buildings.
3. Used in automobiles (side and rear windows).
4. Used for shower enclosures and bathroom partitions.
5. Used in table tops, shelves, and furniture.
6. Used in glass facades and curtain walls.
7. Used in mobile screens and electronic devices.

3. Laminated Glass: Is a type of safety glass made by bonding two or more layers of glass together with an interlayer, usually polyvinyl butyral (PVB) or ethylene-vinyl acetate (EVA). This interlayer holds the glass layers together even when broken, preventing sharp fragments from scattering and reducing the risk of injury.

Use of Laminated Glass:

- **Safety glazing** – Used in places where impact resistance is important (doors, windows, skylights) because it does not shatter into sharp pieces.
- **Automobile windshields** – Prevents glass from breaking apart during accidents and protects passengers.
- **Sound insulation** – Common in airports, studios, and buildings near highways to reduce noise.
- **Security applications** – Used in banks, jewelry shops, display cases, and bullet-resistant glass when combined with multiple layers.
- **Architectural applications** – Glass facades, roofs, canopies, and balustrades for safety and aesthetics.
- **UV protection** – Blocks harmful ultraviolet rays, protecting interiors from fading.
- **Flooring and staircases** – Provides strength and safety in glass floors and steps.
- **Aquariums and showcases** – Offers durability and impact resistance.

4. Insulated Glass: Insulated glass (also called insulated glazing units or IGUs) is a type of glass made of two or more panes separated by an air or gas-filled gap, sealed around the edges to improve thermal and acoustic performance. It's widely used in modern architecture for energy efficiency, comfort, and noise reduction

Use of Insulated Glass:

1. Reduces heat transfer and improves thermal insulation.
2. Used in energy-efficient buildings to save electricity.
3. Commonly used in windows and doors (double-glazed units).
4. Reduces outside noise.
5. Used in air-conditioned buildings and cold storage.
6. Applied in curtain walls and building facades.
7. Used in skylights to allow light with insulation.

5. Low-E Glass: Low-E glass (low-emissivity glass) is a specially coated glass designed to improve energy efficiency by controlling heat transfer while allowing natural light to pass through. It reflects infrared heat and blocks harmful UV rays, making interiors more comfortable and reducing energy costs.

Use Low-E Glass:

1. Reduces heat transfer by reflecting infrared radiation.

2. Improves energy efficiency in buildings.
3. Used in windows and doors of residential and commercial buildings.
4. Helps maintain indoor temperature in air-conditioned spaces.
5. Reduces UV rays, protecting furniture and interiors from fading.
6. Used in insulated glass units (double or triple glazing).
7. Applied in curtain walls and glass facades.

6. Mirrored Glass: Mirrored glass is a type of glass that has a reflective metallic coating applied to one side, giving it a mirror-like appearance while still functioning as regular glass. It's widely used in architecture, interiors, and specialty applications for both aesthetics and privacy.

Use of Mirrored Glass:

1. Used for interior decoration in homes and commercial buildings.
2. Used in bathrooms, bedrooms, and dressing rooms.
3. Improves appearance and creates an illusion of larger space.
4. Used in wardrobes and wall paneling.
5. Used in shops and showrooms for display purposes.
6. Used in gyms and dance studios.
7. Used in elevators and public buildings for aesthetics.

7. Tinted Glass: Tinted glass is regular glass that has been treated with color additives or coatings to reduce glare, control heat, and enhance aesthetics. It's widely used in both residential and commercial projects for style, privacy, and energy efficiency.

Use of Tinted Glass:

1. Reduces glare from sunlight.
2. Controls heat gain and improves indoor comfort.
3. Used in windows and facades of buildings.
4. Commonly used in automobiles (side and rear windows).
5. Provides privacy by reducing visibility from outside.
6. Improves aesthetic appearance of buildings.
7. Protects interiors from excessive sunlight and fading.

8. Wired Glass: Wired glass is a type of safety glass that has a wire mesh embedded within it during manufacturing. It's known for its fire-resistant properties and ability to hold together when broken, making it useful in specialized applications.

Use of Wired Glass:

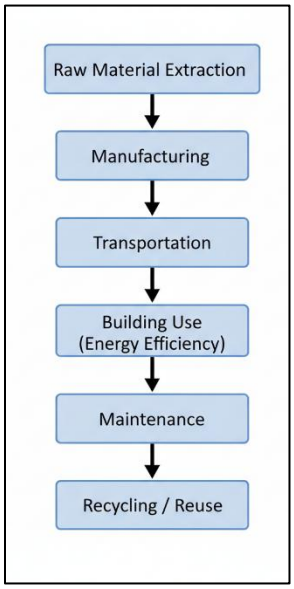
1. Used as fire-resistant glazing in buildings.
2. Prevents glass from shattering during fire or impact.
3. Used in fire doors and fire windows.
4. Used in staircases and corridors for safety.
5. Applied in industrial buildings and factories.
6. Used in skylights and roofs where fire protection is required.
7. Used in public buildings to meet fire safety regulations.

Green building materials and finishes& Smart coatings and self-healing materials.

Green building materials and finishes

Green building materials and finishes are environmentally sustainable materials used in construction to minimize the adverse impact of buildings on the environment. These materials are selected based on their low environmental footprint, efficient use of natural resources, energy conservation, and ability to improve indoor environmental quality throughout the life cycle of a building.

The use of green materials supports sustainable development by reducing carbon emissions, conserving energy and water, and promoting healthier living spaces.



Objectives of Green Building Materials

- To reduce depletion of natural resources
- To minimize environmental pollution and waste
- To reduce energy consumption during construction and operation
- To enhance durability and life span of buildings
- To improve indoor air quality and occupant comfort

Characteristics of Green Building Materials

- Green building materials possess the following characteristics:
- Low embodied energy
- Manufactured from renewable or recycled materials
- Low carbon dioxide (CO_2) emissions
- Non-toxic and low VOC (Volatile Organic Compounds)
- Durable, reusable, and recyclable
- Minimal waste generation during production and use

Types of Green Building Materials

1. **Bamboo**
    - Rapidly renewable natural material

- High strength-to-weight ratio
- Used for flooring, wall panels, partitions, and scaffolding
- Environment-friendly alternative to timber.

2. **Types of Green Building Materials**
   - 4.1 Bamboo
   - Rapidly renewable natural material
   - High strength-to-weight ratio
   - Used for flooring, wall panels, partitions, and scaffolding
   - Environment-friendly alternative to timber.

3. **Types of Green Building Materials**
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Green Building Finishes

Green finishes are eco-friendly surface treatments that enhance aesthetics while maintaining environmental sustainability.

1. **Low-VOC Paints and Coatings**
   - Contain minimal harmful chemicals
   - Reduce indoor air pollution
   - Improve health and comfort of occupants

2. **Natural Flooring Materials**
   - Stone, clay tiles, terrazzo, bamboo flooring
   - Durable, reusable, and recyclable
   - Require low maintenance

3. **Eco-Friendly Wood Finishes**
   - Water-based varnishes and sealants
   - Reduce toxic emissions
   - Enhance durability of wooden components

4. **Green Roofs and Green Walls**
    - Vegetation-based roofing and wall systems
    - Provide thermal insulation
    - Reduce urban heat island effect
    - Improve air quality and aesthetics

5. **Natural Plasters**
    - Lime and clay-based plasters
    - Allow walls to breathe and control moisture
    - Reduce cracking and improve durability

Advantages of Green Building Materials and Finishes

- Reduced environmental pollution
- Lower energy and water consumption
- Improved indoor air quality
- Enhanced durability and performance
- Reduced operation and maintenance costs
- Compliance with green building rating systems such as LEED, GRIHA, and BREEAM

Limitations

- Higher initial cost in some cases
- Limited availability in certain regions
- Requirement of skilled labor and awareness

Smart Coatings and Self-Healing Materials

Smart coatings and self-healing materials are advanced materials developed using nanotechnology and material science. These materials can sense environmental changes and respond automatically to improve performance, durability, and service life of civil engineering structures.

Smart coatings are functional surface treatments that react to external stimuli such as temperature, moisture, UV radiation, chemicals, or mechanical damage

Types of Smart Coatings

1. **Self-Cleaning Coatings**
    - Use photocatalytic materials such as titanium dioxide (TiO_2)
    - Break down organic dirt in presence of sunlight
    - Rainwater washes away loosened dirt

2. **Anti-Corrosion Coatings**
    - Protect steel structures from rust
    - Commonly used on bridges, pipelines, and marine structures

3. **Thermochromic Coatings**
    - Change color with temperature variations
    - Reduce heat gain by reflecting solar radiation

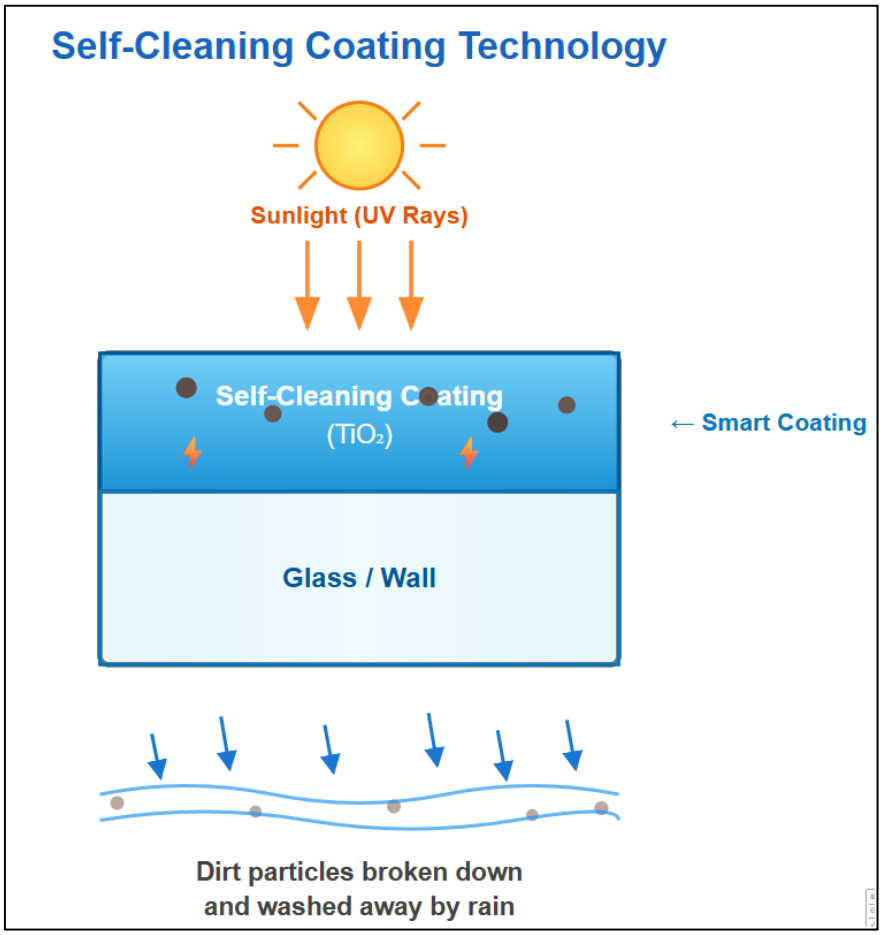
4. **Hydrophobic Coatings**
    - Repel water and prevent moisture penetration
    - Reduce efflorescence and biological growth

Applications of Smart Coatings

- Building facades and glass surfaces
- Bridges and steel structures
- Industrial buildings
- Marine and offshore structures

Self-Healing Materials

Self-healing materials have the capability to automatically repair cracks and damage without human intervention, thereby restoring structural integrity.



Self-Healing Concrete

1. **Bacteria-Based Self-Healing Concrete**
    - Uses bacteria such as Bacillus species
    - When cracks develop and water enters, bacteria produce limestone ($CaCO_3$)
    - Seals cracks and prevents further damage

2. **Capsule-Based Self-Healing Concrete**
    - Microcapsules filled with healing agents are embedded in concrete

- Capsules break when cracks form and release healing agent

Applications of Self-Healing Materials

- Bridges and highways
- Water-retaining structures (tanks, dams)
- Tunnels and underground structures
- Marine and coastal structures

Advantages of Self-Healing Materials

- Increases durability and service life
- Reduces maintenance and repair costs
- Prevents ingress of water and chemicals
- Enhances sustainability
- Improves structural safety