Introduction

• **Plasters**: provide a durable, flat, smooth, easily decorated finish to internal walls or ceilings.

• Traditionally based on *lime or cement*.

• in the last 40 years *gypsum* has become the most important binder.
Advantages of gypsum plasters:

1. Their setting time can be controlled.
2. Time delay between successive coats may be very small.
3. Various surface textures and surface hardness can be obtained.
4. If plastering technique is correct they will not shrink like cement based plasters.
5. Excellent fire-resistance. Contains 21% water of crystallisation which absorbs heat and minimises the rate of temperature rise in behind the plaster.
Disadvantage of gypsum plasters:

- not suitable for exterior uses except very effective permanent protection is provided.
Plastering Process:

Maximum 3 coats may be used.

- **Render coat**- levels the background.

- **Floating coat**- produces flat surface of uniform suction

- **Finishing coat**- provides a smooth, hard finish.
Classes of Gypsum Plasters:

*Class A-Hemihydrate (CaSO$_4$ .1/2 H$_2$O: Plaster of Paris)*

- Produced by heating to a temperature not in excess of 200ºC.

- Sets within 5-10 minutes of adding water, which is far too rapid to permit use in ordinary trowel trades.

- It is useful for decorative plasterwork.
Class B- Retarded hemihydrate (CaSO$_4$.1/2 H$_2$O)

- Produced by adding set retarder (keratin) to Class A plaster. The amount of retarder can be changed.

- Normally designed to be used with sand in ratios of up to 3:1 sand : plaster.

- Setting times are in the range of 2-3 hours.

- Addition of hydrated lime accelerates the set (1-1.5 hours) of plaster. This is normally 25% by weight of hydrated lime.

- Premixed plasters containing lightweight aggregates are now widely used.

- Board finish plasters are in this class.
**Class C-Anhydrate**

- Obtained by heating the raw material to a higher temperature than class B plasters.
- Slow setting is accelerated by adding alum.
- Initial set is fast and final set is slow.
- Used as finishing coat on a sand/cement backing.
**Class D- Anhydrate (Keens’s cement)**

- This is burnt harder than class C.

- There is higher proportion of anhydrate.

- The product has very high strength with superior smoothness and hardness.

- Applied on squash court walls where a durable finish is required.

- Ideal base for gloss finish.
Lightweight Aggregates in Plasters

- Low-density aggregates (expanded perlite-produced from siliceous volcanic glass and exfoliated vermiculite-produced from mica) are a most important ingredient of modern plasters, which are now almost always premixed.
Some advantages of these plasters:

• Transporting and handling costs of the plaster are reduced.

• The low-density fresh material requires less effort to mix and apply and can be used in thicker coats.

• The thermal insulation of walls or ceilings is improved and the internal surface temperature increased.

• Fire performance of structures is improved.
Lime in Plasters

• Lime may be used in quantities up to 5% of gypsum in finishing coat of ordinary class B and class C plasters.

• Improves the working properties of the fresh material and in class C plasters counteracts acidity due to accelerators.

• *Non-hydraulic* limes must be used and should be soaked in water for one day before use.
Factors affecting the choice of plaster

**Undercoat**

- Most important factor affecting choice of undercoat is background suction – the tendency of the background to absorb water from the plaster coating.

- Some suction is desirable, since it removes excess water from the plaster and therefore initiates stiffening.

- The pores which are responsible for suction also increase adhesion of the plaster by a mechanical keying effect.
• **Excess suction** is a disadvantage because it results in premature stiffening of the paster, giving too little time for levelling and may lead to poor adhesion.

• **Very low suction** is equally a problem, owing to lack of pores which improve adhesion.
• **Table 9.1** indicates plasters which may be used for backgrounds of varying types.

• The properties of premixed lightweight undercoat plaster can be varied according to function.

  – for example, “bonding” plaster contains vermiculite aggregate and produces a relatively dense plaster with good adhesion; “browning” plaster contains perlite; while “high-suction background” plaster contains, in addition, cellulose additives to improve water retention.
Table 1 Undercoat plasters and their applications.

<table>
<thead>
<tr>
<th>Suction</th>
<th>Examples</th>
<th>Lightweight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Dense concrete.</td>
<td>Bonding</td>
</tr>
<tr>
<td></td>
<td>No-fines concrete.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Engineering bricks.</td>
<td></td>
</tr>
<tr>
<td>Medium</td>
<td>Ordinary clay bricks</td>
<td>Browning</td>
</tr>
</tbody>
</table>
• Raking of joints in low-suction brickwork or hacking of dense concrete will improve adhesion to backgrounds in the low-suction group.

• Treatment with **PVA-bonding agents** both reduces water absorption of high-suction backgrounds and improves adhesion of low-suction backgrounds such as high-strength concrete.

• **Cement/sand/lime** plasters form an alternative group of undercoat materials, though these have the disadvantage that the finishing coat application must be delayed for some days to allow curing and shrinkage of the undercoat.
• One possible **advantage** of cement based plasters is that they form a barrier to efflorescent salts if these are present in substantial quantities in the background.

• It is important, when using cement-based undercoats, that their **strength does not exceed** that of the **background**, otherwise shrinkage may result in breakdown of the background surface.
Finishing coat

• Will be selected according to the surface hardness requirement.

• Depends on the situation within the building and the function of the building.

• The most demanding situations are projections in corridors and doorways of public buildings for which the hardest plasters are required.

  – Table 9.2 indicates the gypsum plaster type most appropriate to various situations.
Table 2 Finishing coat plasters and their applications.

<table>
<thead>
<tr>
<th>Function</th>
<th>Plaster type</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very hard smooth surface</td>
<td>Class D (anhydrate) finish plaster</td>
<td>Strong undercoat needed. Lightweight types not suitable.</td>
</tr>
<tr>
<td>Hard surface</td>
<td>Class C (anhydrate) finish plaster</td>
<td>Normally on cement/sand or class B/sand backing.</td>
</tr>
<tr>
<td>Ordinary purposes.</td>
<td>Lightweight class B plaster</td>
<td>Used on lightweight undercoat.</td>
</tr>
<tr>
<td>Maximum fire resistance and insulation</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
• Lightweight variety form the largest part of the current market.

• They do not have the hardness of dense plasters but are quite resilient, since impacts are absorbed by localized indentation of the lightweight undercoat.
One-coat plasters

- Plasters are now available which serve as both undercoat and finishing coat.

- A typical product consists of a white, high-purity Class B gypsum plaster combined with perlite and other additives.

- The material is best machine mixed.

- After application, the material is straightened and then left for about 1 hour to stiffen.
• The surface is then wetted and trowelled to bring fine material to the surface.

• After a further delay, the plaster can then be trowelled to a smooth finish.

• The cost of the material is considerably higher than that of the more common gypsum plasters but a saving in time can be achieved since `float` and `set` functions are obtained in a single coat.
• **The background** should be of **uniform suction** (that is, of the same material type) to avoid the difficulty of different areas of the material stiffening at different rates.
Plasterboards

• Made of aerated gypsum core sandwiched between and bonded to strong paper liners.

• one ivory-coloured surface for direct decoration and one grey-coloured surface for better adhesion properties for plastering.

• Foil backing for improved thermal insulation or polythene backing for improved vapour resistance.
• Can be easily fixed to timber.

• Can also be fixed to masonry.

• Aso available with polystyrene or glass fibre insulation bonded to it.
• A variety of sizes is obtainable (Table 3).

• Laths and baseboards are specifically designed for a plastered finish.

• They are less likely to result in cracks at joints.

• Various edges are obtainable according to function.
Table 3 Examples of thickness and sizes obtainable in gypsum plasterboards.

<table>
<thead>
<tr>
<th>Type</th>
<th>Length (mm)</th>
<th>Width (mm)</th>
<th>Thickness (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laths</td>
<td>1200</td>
<td>406</td>
<td>9.5 or 12.7</td>
</tr>
<tr>
<td>Baseboards</td>
<td>1200</td>
<td>914</td>
<td>9.5</td>
</tr>
<tr>
<td>Wallboard</td>
<td>2400</td>
<td>1200</td>
<td>9.5 or 12.7</td>
</tr>
<tr>
<td>Plank</td>
<td>2400</td>
<td>600</td>
<td>19.0</td>
</tr>
</tbody>
</table>
• All joints must be reinforced with some form of tape to prevent cracking.

• Where plastering is to be carried out, this may be in one or two coats and a neat class B board finish plaster is normally used.
• Provide good fire protection, being designed as `class O` on Building Regulations.

• In terms of impact resistance, they are not as good as traditional in-situ plasters.
Common defects in plastering

• Background problems,

• inadequate or incorrect surface preparation,

• incorrect use of materials,

• incorrect plastering technique.
The main problems are listed below:

**Cracking**

- Cracks occur when the plaster is subjected to movement in excess of its strain capacity.

• Gypsum plasters are non-shrinking but may still be subject to tensile stress if the background moves.

  **Examples are:**
  
  – *Background shrinkage*: may result if the background is very wet when the plaster is applied.

    **Solution**: fill the cracks with a suitable decorative finish.
Undercoat shrinkage.

Cement-based undercoats may form numerous hairline cracks if not given sufficient time to shrink before the finishing coat is applied.

An excess of lime in the finishing coat may have the same effect.

Solution: These cracks may be filled or simply obscured using a suitable wallpaper.
**Plasterboard finishes.**

- This type of cracking is widespread, usually following plasterboard joints.

- Reduced by use of laths or baseboard, movement then being spread over more joints than in large sheets.
  
  **Causes:**
  - undersized joists,
  - inadequately fixed or restrained joists,
  - poor nailing technique,
  - omission of scrim tape,
  - inadequate joint filling or
  - severe impact or vibration of the structure.

- Fine cracks can be covered by textured finish but deeper cracks should be cut out and filled.

- Where background movement is the cause of the cracking, it will be likely to reoccur.
**Structural movement:**
This leads to well-defined cracks which follow a continuous line through the structure, plaster cracking in the same position on each side of solid walls.

Cracks tend to be concentrated at weak points such as above doorways or windows.

Before cutting out and filling, it is essential to establish and rectify the cause of the movement.
Cracks due to structural movements

Total 39

9. Plasters
Loss of adhesion

• Results when a strong finishing coat especially if the backing is inadequately scratched to form a mechanical key.

• The problem is uncommon, except with sand/cement backings.

• Both coats must be replaced unless the problem is caused by a green backing; if this is the case it should be allowed to harden loose material removed and then the finishing coat reapplied.
• The problem will occur with plasterboard if too much lime is added, or

• in two-coat work if too much sand is used in the undercoat.

Solution:

– The plaster must be stripped off and replaced.
– If the exposed surface is damaged or uneven, the plasterboard must also be replaced.
Dry out

• Occurs if plaster dries before the water becomes chemically bound by setting.

• It occurs if thin coats are applied to dry backgrounds, especially in hot, dry weather.

• The result is a soft powdery surface which may be difficult to paint or paper.

• Salt deposits (due to aggregate) in wall may appear on drying of plaster, especially if the background is wet during plastering.
• The salts crystallize below the surface of emulsion paints, causing loss of adhesion.

• They can be removed by brushing once plaster is dry and will not recur provided the plaster does not become rewetted.