UNIT - III

MATERIALS FOR MAINTENANCE & REPAIRS
Select the relevant materials to repair the given type of damages with justification

Different types of materials -

- Cement/ Cement plaster – Commonly used for all plastering purpose
- Lime / Lime plaster – For Heritage building
- Concrete as a repair material – For RCC member
- Polymer
  - Polyurethane – For leakages
  - Styrene Butadiene Rubber (SBR) - Multipurpose use ie as repair mortar as we as coating
  - Acrylic Polymer – W/p coating
  - Pre packed / premixed polymer- Repairs of RCC members
- Epoxy Mortar – For RCC member
Select the relevant materials to repair the given type of damages with justification

- Micro concrete – For RCC member
- Fibre wrap - Member strengthening
- Mild steel sections – as structural steel
- Sacrificial anodes – Corrosion control
- Corrosion inhibitors – Corrosion control
- Shotcrete - Surface repair
- Crack sealant – For Plaster
- Grouts - For RCC
- Gunite – For RCC & masonry wall (Surface repair)
- ICCP system (Impressed current cathodic protection) – Corrosion protection
Explain the suitable materials for the anticorrosion, adhesives and mortar repairs

- Anticorrosion material
  - Corrosion removers — They convert porous and loose iron compounds to sparingly soluble adherent compounds, eg. Tannic acid, Phosphoric acid, Vinegar
  - Corrosion inhibitors – They consume oxygen thus inhibit formation of iron oxide hence slow down corrosion of steel, eg. Calcium Nitrite, Calcium, nitrate

  Available in following forms
  - Surface penetrator (Spray)
  - Admixture
  - Capsule form
An adhesive may be defined as a material which can join the surfaces together and resist their separation. Structural adhesive polymerizes to give stiff and strong adhesives to form a load bearing joints.

- **Adhesive material**
  - **Cementitious** – Cement with synthetic resin (Tile adhesive)
    - Glue type
    - Cement
  - **Acrylic** - These are most commonly used, can be applied at room temp. (Room temp. curing)
    - They have wide range of application
    - N-butyl-methacrylate (n-BMA), iso-butyl methacrylate (i-BMA), cyclohexyl methacrylate (CHMA), 2-hydroxyethyl methacrylate and 2-ethylhexyl methacrylate (EHMA)
  - **Epoxies** – Relatively dimensionally stable as low shrinkage after drying, higher bond strength hence best adhesive, process is little complicated than other systems
    - diglycidyl ether of bisphenol A (DGEBA) as a resin and polyamide as a hardener
## Explain the suitable materials for the anticorrosion, adhesives and mortar repairs

Broadly adhesives are categorised as follows -

<table>
<thead>
<tr>
<th>Epoxy</th>
<th>Acrylic</th>
<th>Urathane</th>
</tr>
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</table>
| • High surface activity and good wetting properties  
• For a variety of substrates  
• High cured cohesive strength  
• Minimized shrinkage  
• Low creep and superior strength retention under sustained load  
• Able to accommodate irregular or thick bond line 2500 – 3000 psi  
• Excellent environmental resistance  
• Fiber glass, stone, metal, ceramic, plastic, concrete  
• Non volatile | • Potentially suitable for structural joints  
• Capable of filling up gaps up to 5mm thickness with a usable time of between 10 and 60 min.  
• Inflammable in nature 2500-3000 psi  
• Minimum surface preparation  
• Room temperature cure | • Provides extremely strong bonding  
• Very flexible and durable, and they provide good impact resistance.  
• Able to bond many types of substrates, including glass, plastic, wood and concrete.  
• Bond strength - 3400 psi  
• Flexible  
• Odourless |
Explain the suitable materials for the anticorrosion, adhesives and mortar repairs.

- Repair mortar
  - Portland cement mortar -
  - Micro concrete
  - Drypack and bonded drypack – Suitable for grout hole, cores etc
  - Polymer concrete including epoxy mortar , etc.
Explain the relevant materials for waterproofing and joint sealants for the repairing of given structure

Traditional waterproofing methods

• Lime Concrete Terracing
  
  (Generally practiced in East India)

• Terracing With Brick Bat Coba

• Bituminous Surface Treatment - Tarfelt (Hessian cloth & Bitumen)
  
  (Generally practiced in West India)

• Mud fuska – This has insulation properties useful in dry climate
  
  (Generally practiced in North India)
Explain the relevant materials for waterproofing and joint sealants for the repairing of given structure

Recent / Modern waterproofing methods

• Polymerized Bitumen.
• Water proofing by APP (Atactic Polypropylene Polymeric) Membrane – It forms a uniform matrix in the blended asphalt. It increases the asphalt’s ultraviolet resistance, flexibility at high & low temperatures (though not as much as SBS), resistance to flow at high temperatures, breaking strain, and even waterproofing quality.
  (Method of application - Torsion method by heating & self adhesion tape)
• Water Proofing By Crystallization (Cement and Liquid Polymer)
• Fibre Reinforced Elastomeric liquid Water proofing membrane.
• Water proofing by nano technology
Explain the relevant materials for waterproofing and joint sealants for the repairing of given structure

Joint sealants

• Sealant are the material placed in joint opening for the weather proofing of a building, designed to prevent the passage of moisture, air, dust and heat through all joints and seams of the structure.
• Provides thermal and acoustical insulation.
• Smoothing and finishing.
• Flexible to withstand joint movement.
Explain the relevant materials for waterproofing and joint sealants for the repairing of given structure

Joint sealants

- Horizontal and vertical metal to metal and masonry to masonry expansion and control joints
- Dissimilar material joints eg. Metal to masonry, concrete to wood
- Joint between precast concrete facade panels
- Perimeter of the doors and fixed window frame
- Exposed exterior masonry control joints
- Expansion or control joints in curtain wall
- Joints in exterior wall
- Concealed masonry to floor structure joints
- Repair of larger cracks
Explain the relevant materials for waterproofing and joint sealants for the repairing of given structure

Joint sealants

<table>
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<tr>
<th>Type of sealant</th>
<th>Advantages</th>
<th>Disadvantages</th>
<th>Applications</th>
</tr>
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<tbody>
<tr>
<td>Silicone</td>
<td>Good adhesion to non porous material, excellent flexibility, UV resistance, water resistance, wide temperature range for application and service</td>
<td>Not paintable, may stain masonry, may require primer, require acetone or other suitable solvent for clean up</td>
<td>Sealing to glass, ceramics, most plastics, kitchen and bath wet location</td>
</tr>
<tr>
<td>Butyl</td>
<td>Strong adhesion to wide variety of material, very flexible, high resistance to water and UV radiation</td>
<td>Sticky consistency, tooling is difficult, incompatible with rubberized asphalt flashing membranes, Mineral spirit for clean up</td>
<td>Wood, metal, glass, ceramic tile, most of construction material</td>
</tr>
<tr>
<td>Acrylic latex</td>
<td>Easy to apply, tool and clean up, paintable, available in variety of colours</td>
<td>Less flexible, durable than other, less flexible in cold weather</td>
<td>Wood, metal, ceramic tile</td>
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Explain the relevant materials for waterproofing and joint sealants for the repairing of given structure

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<td>Polyurethane</td>
<td>Strong adhesion to wide variety of material, easy to tool, high resistance to water and UV radiation</td>
<td>Few colour choices, less flexible in cold weather</td>
<td>Sealing to wood, metal concrete, metal roof, masonry construction joints, best sealant for the hull-to-deck joint. It is also a good choice for through-hull fittings</td>
</tr>
<tr>
<td>Polysulphide</td>
<td>Excellent marine sealent, good adhesion, as a bedding compound it allows for movements associated with stress and temperature change, yet maintains the integrity of the seal by gripping tenaciously to both surfaces.</td>
<td>Mixing of the two components of sealant is critical, higher curing time</td>
<td>It is also an excellent caulking compound since it can be sanded after it cures and it takes paint well.</td>
</tr>
</tbody>
</table>
Explain the relevant materials for surface coating and grout for repairing of given structure

Surface Coating

Commonly used paints
- Oil paint
- Enamel Paint
- Emulsion paint
- Cement paint
- Bituminous Paint
- Aluminium paint
- Anti-Corrosive Paint
- Synthetic Rubber Paint
- Asbestos paint
- Heritage paint
- Anti carbonation paint

Industrial paints
- Epoxy Paint
- Polyurathane

Protective coatings
- Bituminous
- Epoxy
  (Varieties of epoxies with different composition are available, UV sensitive, sometimes PU coat is applied)
- Inorganic Zinc Primers
- Polyurethane
- Self leveling flooring epoxy
  (Moisture should not be greater than 4%)
- Water repellant coatings

Type of grout materials
- Cement & Cementitious grouts
- Expansion grouts
- Epoxy Grout
- Polymer grouts
- Polyurethane grouts
Explain the relevant materials for surface coating and grout for repairing of given structure

**Desired properties of coating**

- Good adhesion
- Resistant to alkalis (Concrete is alkaline)
- Resistance against CO2, sulphate and chlorides
- Good flexibility
- Breathability
- Excellent weathering resistance
- Resistance to UV
- Good resistant against growth of fungi, algae moss etc.

**Desired properties of Grout material**

- Low viscosity
- Low shrinkage
- High strength
- Durable
Type of paints

- **Oil paint** – Based on linseed oil as natural waterproofing agent. Generally interior
- **Enamel Paint** – for interior as well as exterior
- **Emulsion paint** - The emulsion paints are durable and have good color retention property for a longer period. The application of emulsion paint is on interior walls and ceilings. They don’t give a hard surface after drying as in the case of oil paints. There is a special form of emulsion paints that can be used for wood work.
- **Cement paint** - Cement paints are durable and waterproof, exterior application
- **Bituminous Paint** - waterproofing the concrete foundations, rust resistant for metals and cisterns, waterproofing the wooden surfaces, priming substrates before the installation of bituminous membranes used in ironwork under water.
- **Aluminium paint** - Finely ground aluminium particles in suspension, either in spirit or in oil varnish, mostly applied for gas tank painting, water pipes, radiators and oil tanks.
- **Anti-Corrosive Paint** - This paint is intended to resist the surface against corrosion and chemical attack
- **Synthetic Rubber Paint** - Dissolving chlorinated rubber in the solvent will form this paint, resistance to chemical attack
- **Plastic Paint** - The plastic paints consist of a variety of plastics as a base and the water as a thinner. This paint can be used for painting the walls and ceilings of the auditorium, showrooms etc.
- **Asbestos paint** - used for painting spouts, gutters. Also applied for damp proofing of surfaces in the basement walls.
- **Epoxy Paint** – Tough and chemical resistant, widely used in industrial flooring
- **Heritage paint** – Texture like stone etc
- **Textured paint** - Recently advanced in view of beautification
Types of Coatings

- **Inhibitive** - generally impart properties like hydrophobicity for the concrete but allow the water vapour transmission through them. Examples are Silane–siloxanes etc.
- **Bituminous** - Bituminous coatings are heavy-bodied materials applied with a cutback solvent. They have good moisture barrier resistance.
- **Epoxy, Amine** - Amine epoxies are two-component coatings that are catalyzed (hardened) by an amine curing agent to produce a hard, tightly bonded, chemical resistant (alkali, acid, and solvent) product, but they are moisture and temperature sensitive during application. Not resistance to UV light in sunlight.
- **Epoxy, Coal Tar** - Coal tar epoxies are generally an amine or polyamide epoxy modified with coal tar pitch resin to produce a high-build film that has good chemical resistance and excellent water resistance. They have a tendency to become brittle with age and delaminate between coats or beneath repair patches. They are specified for burial and immersion service exposures. Not resistance to UV light in sunlight.
- **Epoxy, Fusion-Bonded** - Fusion bonded epoxies (commonly called powder coatings) are complete coatings in powder form.
- **Inorganic Zinc Primers** – They are either solvent or water-based. Depending on the solvent and resins used, the coating may be a zinc-rich epoxy or urethane. These coatings are exclusively primers because they provide galvanic or cathodic protection to steel substrate.
- **Polyurethane** - These are the best of all coating. Exhibit properties like UV stability, Chemical resistance, Increased Impact and Abrasion Resistance, wide range of finishes.
Types of Grouts

• **Cement & Cementitious grout**
  - Widely used
  - Low cost
  - Sometimes with admixture  (To gain desired shrinkage properties)

• **Gas forming grout**
  - Expansion grout

• **Epoxy Grout**
  - Low viscous / normal
  - No/ reduced ability to bond in dampness

• **Polymer grouts**
  - Equipment bases or concrete repair,
  - useful in area of chemical exposure, freeze and thaw

• **Polyurethane grouts**
  - Tunnel lining/ Underground structure.
Choose the relevant materials for the repair of damaged structures with justification

Covered in Slide No. 2-15