Good Industry Practices - Waterproofing for Internal Wet Areas

Lesson 2 - MATERIAL SELECTION, DELIVERY, STORAGE & HANDLING

Waterproofing for Internal Wet Areas

2.1 Material Selection

- Suitability & Types of Waterproofing Systems
- Selection Criteria

2.2 Properties & Characteristics of Waterproofing Materials

2.3 Material Handling

- Delivery, Storage and Handling of Waterproofing Materials
- Safety Aspects of Storage and Handling

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- Surface Preparation
- Tests on Cleanliness & Dryness
- Pipes & Penetrations
- Priming

- Precast Panels

Waterproofing for Internal Wet Areas

2.1 Material Selection

2.1.1 Suitability & Types of Waterproofing Systems

Selection should be based on life-time cost-performance.

- initial performance and cost of the waterproofing system,
- also cost of replacing a waterproofing system failing prematurely and other costs associated with failure.

An experienced and qualified person should review the qualities of a recommended product in meeting existing standard test or specifications.

The selected system should be reviewed and agreed with the Designer.

Test certificates of the product should be submitted to confirm their compliance with the stated specifications.

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Typical Characteristics	Rubber based systems	Acrylic based systems	Polyurethane systems	Cementitious systems
Main characteristic	Highly flexible with excellent resilience to cyclic extension and contraction.	Good UV resistance, flexible and good tearing strength (due to fibreglass reinforcement).	Good flexibility, excellent adhesion to concrete and good tearing strength.	Easy application, excellent compatibility with concrete and good vapour permeability.
Dry film thickness	Generally Between 0.8 to 1.5mm recommended.	Minimum 1.2mm due to fibreglass reinforcement.	Between 1 to 1.5mm.	Between 2 to 3mm.
Application Method	Brush, roller or airless spray.	Application is normally by rollers, to work material into fibreglass reinforcement.	By brush, squeegee or broom. Vertical grade by brush or trowel.	Brush or spray followed by trowelling.

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Typical Characteristics	Rubber based systems	Acrylic based systems	Polyurethane systems	Cementitious systems
Method of curing & drying time	Air-drying. About 1 hour in exposed condition. 3 – 4 hours in enclosed areas. 72 hours before flood test.	Air-drying. Within 1 hour, but requires min. 4-5 coats due to reinforcement. Total system requires longer drying time. 48 hours before flood test.	Normally moisture-cured. Req. ventilation. Recommended 24 hours curing time. Most systems : 72h before flood test. For coal tar based systems, 7-10 days is req.	Normally 1-2 hours. Requires curing similar to concrete. Flood test within 24 hours to assist in curing.
Adhesion to concrete substrate and bedding mortar	Generally good adhesion. May be improved by appropriate priming.	Gd adhesion to concrete. Vertical application to exclude FG reinforcement for better bonding.	Solvent based is sensitive to moisture. Adhesion may be affected if applied onto damp substrate.	Excellent bonding to concrete for both slabs and vertical walls. Not affected by surface dampness.

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2.1.2 Selection Criteria

- Be able to bridge over cold joints
- Be compatible and easy to apply, especially at pipe penetration areas
- Be elastic to bridge over differing materials
- Have good adhesion and cohesion strengths
- Be able to receive screeding and plastering
- To a certain extent, be resistant to some mechanical damage prior to screed finish
- Be fully bonded to the substrates to isolate any leaks in future

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2.2 PROPERTIES & CHARACTERISTICS OF WATERPROOFING MATERIALS

	Flexible cementitious or other	Solvent-based elastomeric
Tensile strength (N/mm2)		
Condition as cast	≥ 1.5 N/mm^2	≥ 1.6 N/mm^2
Change in Strength (%)		
After ageing at 50°C for 14 days	≥ 1.2 N/mm^2	± 25% max
After 72 hrs chemical immersion at room temp:		
1. 0.5% (v/v) NaOCl	-ve change ≤40%	± 20% max
2. 1.25% (v/v) NH_4OH	no limit for +ve change	± 20% max
3. 3.7% (v/v) HCl	no limit for +ve change	± 20% max

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	Flexible cementitious or other	**Solvent-based elastomeric**
Initial hardness (Shore A)	≥ 40	≥ 25
Adhesion to substrate	0.3 N/mm^2	0.5 N/mm^2
Crack bridging	Condition as cast: no cracking at 2 mm width. No crack after 10 cycles of stretching and closing to a width of 1 mm	Able to bridge crack up to 2mm 1. Original sample 2. After 72h in i) 0.5% NaOCl ii) 1.25% NH_4OH iii) 3.7% HCl

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	Flexible cementitious or other	Solvent-based elastomeric
Elongation at break (%)		
a) Condition as cast	≥150%	≥500%
Change in Elongation (%)		
b) After ageing at 50°C for 14 days	≥120 %	± 25 % max
c) After 72 hrs chemical immersion at room temp:		
1. 0.5% (v/v) NaOCl	-ve change ≤40%	± 20% max
2. 1.25% (v/v) NH_4OH	no limit for +ve change	± 20% max
3. 3.7% (v/v) HCl	no limit for +ve change	± 20% max

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	Flexible cementitious or other	**Solvent-based elastomeric**
Chloride content	≤0.1%	NA
Resistance to water penetration 0.2 kgf/cm^2 for 6 hrs	No water penetration	NA
Water vapour permeability	NA	30g/m^2/day
Set to touch time	Within 2 hours	NA
Elastomer content	NA	min 25%
Volatile content	NA	max 25%
Flash Point	NA	min 40^{o}C

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2.3 Material Handling

2.3.1 Delivery

Waterproofing materials should be properly handled during delivery and storage. Products delivered to site should include the following information:

- General description of specified waterproofing product.
- Name of manufacturer / supplier / agent.
- Areas of application.
- Technical values for the specified product and related reference to any standards like ASTM, DIN, BS or SS.
- Shelf life and batch reference.
- Sealed & in original packaging

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2.3.2 Storage And Handling

- Waterproofing Specialist should provide the Material Safety Data Sheets (MSDS)
- readily available at every project
- Specific safety and handling requirements to ensure safe and proper material usage should also be included.
- All materials should be protected from the weather, sun, and heat, and stored in a dry and secured area. Products and materials that require protection against moisture should be stored on a slightly elevated level rather than directly on the ground

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For handling of adhesive and solvents ensure that:

- Work area is well ventilated and lighted. Use mechanical ventilation with exhaust fans if required
- Appropriate personal protective equipment are used
- No smoking

Awareness of other trades in the area. Acetylene, electrical welders and other flame or spark producing equipment may ignite vapour.

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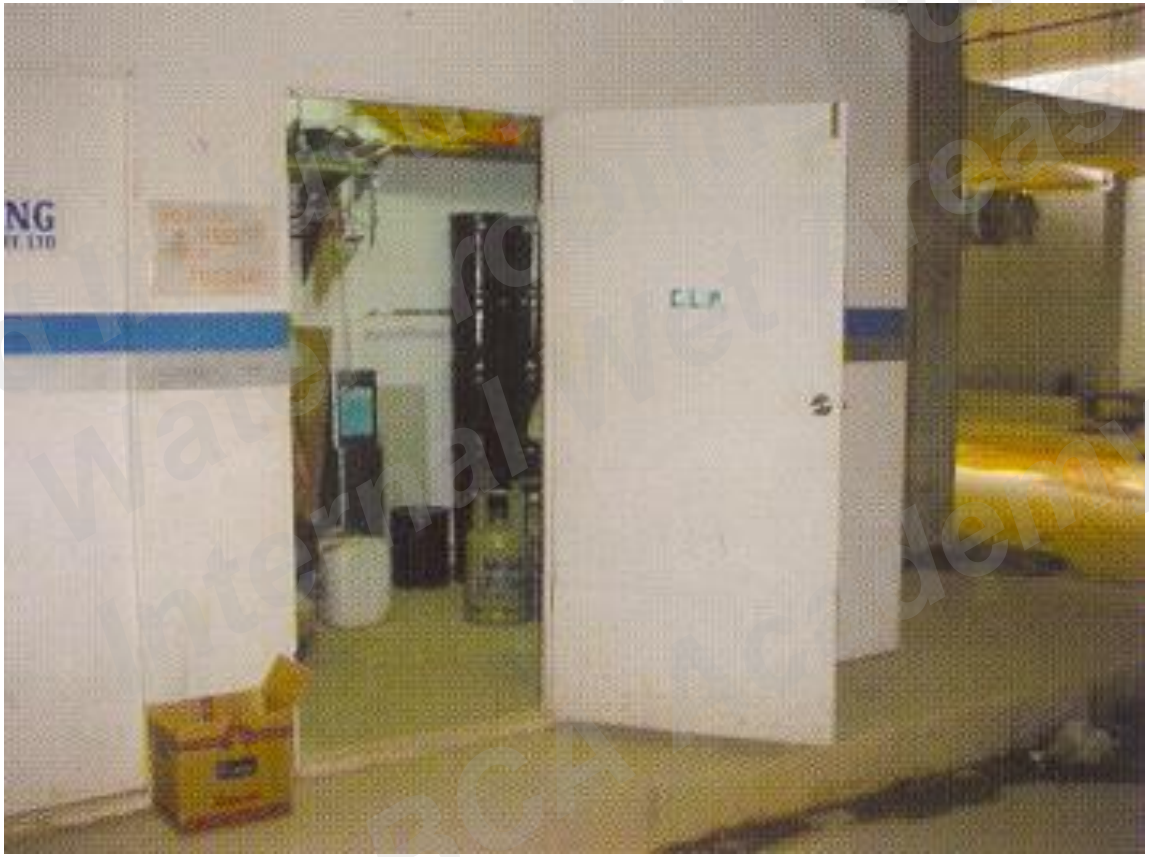

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2.4 PREPARATION WORKS

- approval of shop drawings by Designer
- meeting called by Main Contractor in early stages of construction to coordinate all activities.
- adequate time should be allowed for the waterproofing membrane to cure and dry.

The requirements that must be satisfied at each stage or phase of the process should be stated in an “Inspection and Test Plan (ITP)” prepared by the Contractor. See example.

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Contractor must ensure :

1. all pipes, ducts and works that penetrate floor slabs and walls to be completed before commencing the waterproofing works.

2. M&E clearance for plumbing and sanitary fittings should be obtained prior to concealing them. Pipes pressure and flow tested and free of leakage.

Waterproofing Specialist :

3. should complete a “mock-up” to demonstrate the substrate requirements and preparation, and all other works that must be completed by other trades before application of the waterproofing system.

4. Safety requirements, method of installation, ponding tests and protection of membrane must also be demonstrated.

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2.4.1 Surface Preparation

Proper surface preparation very important factor in ensuring good performance of the waterproofing system.

Adhere to manufacturer's recommendations prior to the application of the waterproofing system. For instance, blistering will occur if certain non-breathing materials are applied to wet substrates.

Concrete surfaces shall be cleaned and free from all forms of scale, laitance, dust, mould, form oils, wax, curing agents as well as any other foreign materials that may cause de-bonding of the waterproofing membrane from the substrate.

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Figure 2.4.1: Examples of foreign materials on concrete surface

Efflorescence

Surface Laitance

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Figure 2.4.2: Examples of surface defects on concrete surface

Voids & holes

Rough surface to be grinded smooth

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Two methods of cleaning may be employed

- Mechanical cleaning methods (i.e. compressed air, industrial vacuum cleaning, sweeping, abrasive cleaning, high-pressure water jetting and grinding)

  - effective in removing laitance, dust, efflorescence, loose plaster and weak surface materials.

- Chemical cleaning methods are effective in removing oil, grease and dirt. Efflorescence or leached salts should be removed from masonry surfaces with approved cleaning agents, according to the masonry surface type.

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Figure 2.4.3: Examples of concrete surface cleaning methods

Using scraper to remove laitance and protrusions

Using vaccum cleaner to remove dust & loose particles

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Defect	Method	Tool
Holes / voids	1. Clean out all dust, dirt and loose stones etc. 2. Plaster back to original profile using non-shrink grout or a sand / cement / polymer mix.	Clean using brush, broom or vacuum cleaner.
Cracks (non-structural)	1. At the crack, "V" or "U" out to a minimum depth of 25 mm. 2. Remove all loose debris from affected area. 3. Plaster back to original profile using non-shrink grout or specified patch repair plaster.	"V" or "U" using a hammer and chisel or a mechanical hacker. Mixing of patching compounds using drill & mixing attachment and mixing bucket.
Honeycomb areas	1. Hack back to sound concrete. 2. Plaster back to original profile using non-shrink grout or recommended repair plaster.	Hack using a hammer and chisel or a mechanical hacker. Mixing of patching compounds using drill & mixing attachment and mixing bucket.

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Defect	Method	Tool
Rough surfaces	1. Grind to a smoother profile. 2. Apply sand/cement screed over affected area. 3. Apply recommended layer of plaster topping over affected area.	Grind using electrical grinder or concrete grinder. Apply screed using a steel float and finish off with a wood float.
Sharp protrusions	1. Grind off.	Grind using electrical grinder.
Sharp external corners	1. Grind off to a smooth radius	Grind using electrical grinder.
Dirt / oil / grease / loose plaster etc	1. Remove with high pressure water jet.	

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Defect	Method	Tool
Internal corners and around penetrations	1. Apply a sand /cement fillet or as specified by manufacturer, to all internal corners and penetrations. 2. Alternatively, install reinforcement at these areas	For mixing small quantities of sand/cement plaster, patching compounds etc. use diamond point trowels. For constructing coves and fillets, use margin & coving trowels.
Brick surfaces	1. Proper pointing to the joints. 2. Apply cement sand render to the height of the upturn or to specified height of the waterproofing membrane.	

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Detailing

- continuous angle fillet (25 x 25 mm) can be installed at junction of wall & floor.
- fillet material 1:3 cement sand mixture with 1:4 bonding agent and water.
- serves to make the joints more gradual for the membrane to sit on.
- Alternatively, using a reinforcement fabric (e.g. fiberglass mat) of 150mm width

For brick walls, the mortar joints should be flush pointed and rendered with cement/sand mix to receive the membrane (see Fig 2.4.4). Ensure that rendering at shower areas, long baths and areas around wall hung basins, water cisterns, etc are applied to the required heights.

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Flush pointing of mortar joints

Walls rendered to 300mm with fillet installed at corners

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Walls rendered to required height at shower area

Surface preparation at sunken bath with fillet installed at corners

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Repair of surface defects:

1. Use tools that will not further damage adjacent areas.
2. Repair material should be compatible with the concrete substrate.
3. A bonding agent can be applied on the concrete to have better adhesion to the repair material.
4. Wet curing during the first 24 hours is strongly recommended.
   (Due to the relatively small volume of dry pack repairs and the tendency of the existing concrete to absorb moisture from new material, water curing is a highly desirable procedure, at least during the first 24 hours). Spraying of curing compound is not recommended unless the curing compound is compatible with the waterproofing membrane.

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2.4.2 Tests on cleanliness and dryness

Certain types of membrane require a dry surface

- good ventilation to enable the substrate to dry sufficiently
- moisture meter test should be carried out by the applicator to check the dryness of the substrate before membrane application.
- meter should be correctly calibrated to the substrate type before use.

On the other hand, cementitious membrane systems require a damp surface to improve the adhesion of the membrane to the concrete surface.

For application of such systems, remove all lying water from the concrete surface, then pre-saturate or dampen the substrate with clean water prior to application of the first coat of the waterproofing membrane.

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Figure 2.4.5: Preparation of substrate to receive cementitious membrane system

Using a sponge to soak up excess lying water

Dampen wall surface with wet roller

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Table 2.4.2: Applicable tests for various membrane systems

	Type of tests to use		
Systems	**Cleanliness**	**Dryness**	**Laitance**
Rubber based	✓	✓	✓
Acrylic based	✓	✓	✓
Polyurethane	✓	✓	✓
Cementitious	✓	-	✓

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Table 2.4.3: Test Methods

Cleanliness of Surface
(a) Dusty Condition: - Wipe surface with dark cloth. - If there is excessive white powder on the cloth the surface is too dusty. (b) Oily Condition: - Sprinkle water on surface. - If standing droplets appear, the surface is oily.
Dryness of Surface:
- Use moisture meter. - Check if surface is adequately dry for membrane application.
Test for Laitance:
- Scrape surface with knife. - If loose powdery material is observed, excessive laitance is present.

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2.4.3 Pipes & Penetrations

To reduce the risk of water leakage at floor penetrations:

- Ensure that the portion of the pipe in the slab does not have joints.
- Create a slight upward sloping profile surrounding pipe protrusions (fillet for membrane upturn) (see Fig 2.4.6). Alternatively, reinforcement could be installed.
- Provide additional protection at these areas. The waterproofing used to treat the pipes should adhere and be compatible with the pipe material and the subsequent membrane applied on to it. For water outlets, ensure pipes are cast to flush with floor level to facilitate membrane dress down.

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Fillet around pipe penetration

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2.4.4 Priming

Primers are applied before the application of the actual waterproofing material, to seal the substrate surface and enhance adhesion properties of the waterproofing system, e.g. polyurethane system.

Ensure that the concrete substrate is sufficiently cured before applying a recommended vapour barrier as a primer to the substrate. Primer should always be brush applied.

Check application procedures as some membranes must be laid onto wet primer.

The primer should also be applied to the skim coat on the brick wall, ensuring full coverage and allowed to dry, prior to application of membrane.

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2.4.5 Precast Panels

Joint treatment

- loose materials, debris and weak concrete that may inhibit the sealant from adhering to the joints to be removed.
- Backer rods of appropriate sizes should be inserted into the joint as backing for the sealant material.
- The sides of the joint are taped before gunning the sealant into the joint. The joint is then tooled to achieve a smooth even surface, and the masking tape removed to allow the sealant to cure.

Insufficient surface preparation at the concrete surfaces receiving the membrane material can cause de-bonding of membrane near the joints.