Remedial Water Proofing of External Walls
[Excerpts from Dr. Fixit Healthy Construction Booklet, "Construct Your Ideas, 2012, pp.38]

1.0 Introduction
Walls are traditionally protected from rainfall by overhanging eaves fitted with gutters and downpipes. However, rain is often blown onto walls surfaces, the danger of penetrating dampness depending on the degree of exposure that is the total rainfall in relation to wind velocity. On a normal porous wall, the surface is wetted in this way during rainfall and the water is then absorbed by capillarity; the force drawing the water into the wall depends on the surface tension and the contact angle for water in relation to the pore size. With smaller pores the capillary force is greater, but in all normal porous walls the force is sufficient to ensure that water is absorbed into the wall rather than flowing down the external surface.

One method for reducing water penetration through walls is to increase their absorptive capacity, usually by the use of a thick porous render, a process that also significantly improves thermal insulation value. Unfortunately, this process is not generally understood; often thin dense or waterproof renderings are employed which are not usually sufficiently flexible to tolerate the seasonal thermal and moisture content changes in the structure so that eventually cracks develop. Water flowing down the wall is readily absorbed into these cracks, yet the remaining render obstructs evaporation so that the final result tends to be progressively accumulating moisture and the development of increasingly severe dampness internally.

Remedial treatment to reduce this dampness often includes the use of cement slurry or paint, or waterproof bitumen, oil paint or plastic coatings, but all these systems are unsuitable as they introduce severe interstitial condensation dangers; a permeable structure must never be sealed at the cold external surface as there is then a danger that interstitial humidity will condense immediately beneath the water-proof layer.

2.0 Remedial Solutions
Considering all the common defects their remedial solutions are provided along with symptoms and possible causes in Table 1.
<table>
<thead>
<tr>
<th>Common Defects</th>
<th>Symptoms/Phenomenon</th>
<th>Possible Causes</th>
<th>Remedial solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-structural cracks (usually in plaster or other finishes with cement sand rendering as base)</td>
<td>Hairline cracks Multi-directional cracks (shrinkage cracks) Debonding of render Dampness on internal wall surface.</td>
<td>Shrinkage of rich mix Excessive bleeding</td>
<td>Remedy the defect in the wall. Remove and replace with suitable mix. Use integral water proofing compound. Where surface is sound, coat with acrylic based waterproof coating after filling the surface cracks with flexible acrylic based crack filling material. Where render is loose, the options are: a) Patch repair b) Total removal c) Consider alternative external finish Replastering of minor areas may be possible if the defect source can be eradicated.</td>
</tr>
<tr>
<td>Water seepage from external wall</td>
<td>Water staining Peeling off of paint or wall paper Water dripping Growth of fungus Defective concrete, plaster or tiles Rust staining</td>
<td>External water seepage could be due to a variety of reasons including cracks on external wall, honey comb concrete. Defective waterproofing membrane at external wall surface, defective external water and drainage pipes, etc.</td>
<td>Fill the cracks in the external walls with ready to use polymeric crack filling material. Application of heavy duty elastomeric acrylic waterproofing coating on the external surface. Application of epoxy based breathable damp proofing coating on the internal surface.</td>
</tr>
<tr>
<td>Water seepage through window</td>
<td>Gaps have formed between window frame and masonry Through the crack between lintel beam and masonry Through the aluminium frame and window sill</td>
<td>Sealing with rigid cement mortar or putty. Defective sealant at window.</td>
<td>These gaps are required to be filled with UV resistant, flexible, permanent Silicone sealant. Before applying sealant, the excess gap can be filled with polymer modified mortar. The entire joint between cantilever chajja and masonry needs to be repaired with SBR based polymer modified mortar after applying bond coat. Extend the treatment over the wall atleast 300 mm above the chajja. Coat the entire chajja with a flexible cementitious product or acrylic based product. Check for the water outlet holes in the aluminium frame at the sill level. If the holes are missing then get it drilled. The marble sill can be fixed with tile adhesive.</td>
</tr>
<tr>
<td>Separation cracks</td>
<td>Cracks between panel walls and structural elements e.g. brick wall and beams/columns Leakage through the separation gap</td>
<td>Difference in thermal coefficient of expansion and contraction between masonry and concrete</td>
<td>Sealing the gap, more than 10 mm wide, with polymer modified mortar with SBR latex after applying a bond coat from both sides. Sealing the gap, less than 10 mm wide, with acrylic sealant in a neatly prepared joint.</td>
</tr>
<tr>
<td>Rising dampness</td>
<td>Damp patches from floor level till the raised level of dampness</td>
<td>Due to failure in the DPC. The problems becomes more severe if the ground water table rises</td>
<td>By injection of siliconate injection grouts into the brick masonry wall from inside/outside at floor level. For walls in concrete, inject with low viscous PU injections.</td>
</tr>
<tr>
<td>Structural cracks in external walls</td>
<td>Cracks that penetrate through finishes into the concrete or bricks Long, continuous cracks across width of wall Diagonal cracks at corners of window or door Cracks with rust staining</td>
<td>Caused by many factors, such as excessive movement of the building structure, unwanted ground settlement, serious overloading, weaknesses caused by corrosion/deterioration of materials, or damage by accidents, or poor design/construction, etc.</td>
<td>Repair the structural crack in RCC with low viscous epoxy injection grouts. Repair the structural crack in brick masonry with polymer modified mortar with SBR latex. For wider cracks, stitching can be additional done. Strengthen the structural members with structural grade cementitious repair mortar/ micro concrete after treatment of corrosion and applying bonding agent. Apply a heavy duty elastomeric acrylic waterproofing coating on the external surface.</td>
</tr>
<tr>
<td>Defective external wall finishes / mosaic tiles/ ceramic tiles/ stone cladding/ curtain wall</td>
<td>De-bonding of finishes/tiles from wall structure resulting in “hollow sound” when tapped with a hammer. Cracking of wall surfaces Bulging with hollow base Falling off, Cracks Loosening of parts</td>
<td>Ageing, structural movements, defective workmanship during installation, thermal movement, defective or missing expansion joints. Damage by external factors, ingress of water into the gap between the finishes or tiles and the structure, etc. Fixing the tile with white cement.</td>
<td>Fix the tile with tile adhesive and grout the tile joints.</td>
</tr>
</tbody>
</table>
3.0 Remedial Treatment for Cracks in External Plaster

Cosmetic shrinkage, cracks in plaster or other forms of finishes will affect the appearance only and does not pose any safety concern. They are small hairline cracks developed within the finishes layer, not penetrating down to the reinforced concrete structure. Such shrinkage cracks develop in the cement mortar only and should be sealed with epoxy putty, which has good adhesion to ceramic surface and is not affected by acids and chemicals. The various types of cracks like plastic shrinkage, thermal shrinkage cracks occurs during pre-hardening stages of concrete which has to be filled in with suitable polymeric materials. A schematic diagram of remedial waterproofing system on external wall is given in Fig. 1.

3.1 By Polymeric Crack filling material For (cracks up to 5 mm width)

A single pack, ready to use flexible acrylic putty is very much suitable for filling the non-structural cracks in plastered surfaces.

Features & Benefits
• Paste form, easy to apply
• Flexible, therefore does not crack and accommodates minor movements in cracks
• Water based, hence eco-friendly
• Can be applied on damp surfaces but not on cracks with running water
• Over-coatable after 24 hours
• Non-staining
• Excellent adhesion with cementitious surface
• UV resistance
• It can be tinted using water-based stainers

Method of Application
• Surface must be free from dust, oil, grease, and loose particles etc. Moisten the surface before applying crack filling material
• Fine hair line cracks must be widened up to 1 mm minimum and then filled
• For porous surfaces, apply primer coat prepared with crack filling paste and water in 1:1 proportion over the crack
• Fill the cracks with the paste when the surface is tacky and not dried completely
• Press it firmly into the crack with a spatula or putty knives and level with the surface.
• Care must be taken to avoid formation of cavities or bubbles during application
• Allow it set for 24 h and then apply another coat of crack filling material
• Further POP or painter’s putty application can be taken up once it is fully dry
• For best results allow it to cure for 7 days

Precautions & Limitations
• Should not be used for cracks more than 5 mm thick
• Not for application in cracks in structural members, expansion joints & separation gaps
• Not for cracks in POP or painter’s putty
• For application in temperatures below 10°C, drying time will be delayed

3.2 By Flexible putty (For Cracks up to 10 mm width)

A single pack, ready to use, fast drying flexible putty used for filling the non-structural cracks in plastered surfaces in internal and external plastered brick masonry wall cracks of up to 10 mm width.

Features & Benefits
• Does not shrink after curing
• One time application
• Non-saging
• No sanding required
• Non-staining
• Excellent adhesion with cementitious surface
• UV resistance

Method of Application
Surface must be free from dust, oil, grease, and loose particles etc. Moisten the surface before applying flexible putty. Fine hair line cracks must be widened up to 10 mm minimum and then filled with flexible putty. The material should be pressed firmly into the crack one time only with a spatula or putty knives and level with the surface. Care must be taken to avoid formation of cavities or bubbles during application. Allow it to dry in ambient conditions for 5-6 h. Further, POP or painter’s putty application can be taken up once it is fully dry. For best results allow it to cure for 7 days.

Precautions & Limitations
• Not for cracks in POP or painter’s putty
• External application must be over coated with coating
• Jet or power washing on walls not advisable prior to application
• For application in temperatures below 10°C, drying time will be delayed
• Container to be tightly closed after application
• Incase the filler compound is too dry, add 1 teaspoon of potable water to 250 ml of flexible putty
• Clean tools and hands with soap and warm water
• Not to be used as a skim coat
• Cannot be tinted
3.3 Prevent leakage from separation gaps
Leakage arising between RCC members and masonry can be prevented by taking care following steps:

- Avoids dampness due to ingress of water.
- Crack-free by high flexibility of mortar.

Methodology

- Make a U groove, and blow off all laitance and loose material.
- Apply a polymer modified mortar in saturated surface dry condition, prepared with:
  - Polymer modified mortar with SBR based, (10-12%) by weight of cement (cement: washed sand in 1:3) adjusting appropriate consistency as per water demand.
  - Cure by sprinkling water 3-4 times a day for 2 days.

4.0 Damp-Proofing Treatment
The treatment against rising dampness involves pressure injection of non-aqueous water-repellent solutions into tubes sealed into holes in the masonry.

Surface Preparation
Remove paint up to bare masonry surface from affected area by wire-brushing or any other suitable means. Wipe surface with wet cloth to remove loose particles from cement plaster.

Fixing of nozzles

- Drill the holes with a 12 - 15 mm drill bit at 45° angle, penetrating ¾ width of the wall. Start from skirting level with 300 mm distance between each hole horizontally and 300 mm to 400 mm vertically from ground level, at centre to centre. A zigzag pattern needs to be formed to cover the entire area to be injected for effective result.
- Fix the perforated PVC nozzles and seal them secure with instant leak plug material and allow it to set for one day before starting next work.
- Use grouting pump with minimum 2 Bar (2 kg/cm²) pressure capacity to pump the siliconate based grout.

Dilution of Grouts
Dilution of siliconate based injection grout depends upon the severity of problem, from 1:1 to 1:5 with clean water.

Rising Dampness Injection

- Inject diluted siliconate based injection grout through the nozzles till the back pressure is felt. Move to next nozzle and complete the process by injecting through all fixed nozzles in the affected area. Then cut off the nozzles at the surface level and seal the holes using SBR based polymer modified mortar.
- Level the surface with plaster and allow the surface to dry completely before proceeding for painting.
5.0 Treatment for Internal Dampness
Two component epoxy based damp proofing material has
 to be used for remedial treatment. The detailed application
is as given below:
• On the internal side of the wall, ensure complete surface
  preparation prior to application.
• Chip off the plaster in the affected area to expose the
  masonry.
• Wire brush the surface to remove all the loose laitance and
  wash with clean water.
• Blend a putty using epoxy based damp proofing material
  and cement in the ratio 1:1:2 (Base: Hardener: Cement) and
  apply the putty on the masonry surface to level out all the
  undulations.
• Allow the putty to dry for a period of 4-6 hrs.
• Now, blend a mixture of epoxy based damp proofing
  material and water in the ratio 1:1:1 (Base: Hardener: Water)
  and brush apply 2 coats over the leveled surface in a span
  of 4hrs.
• Air cure for 24 hrs prior to re-plastering mixed with SBR
  based polymer modified mortar.

6.0 Conclusion
After remedial treatment for cracks, voids, dampness
and other defects the external waterproofing coating
has to be provided on a properly prepared surface as
discussed earlier.

Waterproofing of External Wall
of Hostel Blocks of IIT Guwahati
- A Case Study
[Excerpts from Dr. Fixit Achieves of Case studies]

1.0 Introduction
In the IIT Guwahati expansion project, the authorities
had constructed 10nos G+4 student hostel buildings
in the 1st phase. For their exterior walls, they were
planning to give a long, durable coating which can give
protection to the exterior surface from the rain lashing
condition of the North East region, where the average
rainfall is more than 2400mm per year. The project
requirement was to use a durable, long lasting exterior
coating for the newly constructed hostel buildings
which can give at least 5 years service life and protect
their surface from the rain. After an in-depth inspection
and assessment of the exterior surface it was proposed
to the Dean, Institute of Internal Works, IIT Guwahati,
to have an integral solution by an elastomeric acrylic
coating consisting of the following steps.

2.0 Application
• The initial condition survey was carried out to check the
  surface cracks on the exterior surface.
• Surface preparation was done to remove all the loose
  material.
• Application of Primer: - Recommended acrylic based
  primer was used.
• Apply the coating, without any dilution, in two coats by
  brush, roller or spray with an interval of 5 to 6 h (Fig. 1).
  The coating which was applied 6 years before is still
  performing satisfactory.

Product used: Dr. Fixit Raincoat with Dr. Fixit Primeseal as primer
Project Consultant: - IIT - Civil Department & Dean Institute of Internal
Works.
Contractor: - M/s Bright Construction, Guwahati

Fig. 2: Injection grouting for raising dampness

Fig. 1: View of the external surface after application of the
waterproofing coating