Install the patch. Installation must be done as per the manufacturer's guidelines. Apply moderate pressure to the patch to insure proper adhesion to the existing membrane.

4.4.6 Thermoset Membranes

This is a rubber-like membrane. Application defects are the main problem faced in thermoset membranes.

Membrane Patch Procedure (Repair with adhesive): In the very first step of the repair procedure, surface preparation is required by removing debris, contaminants and ballast or removing the surface coating. Wash the area using a mild soap. Dust must be removed from the area. The cleaned area must be extended by a minimum of 152 mm beyond the defect area. Rinse thoroughly with clean water and allow the membrane to dry. Cut a piece of like membrane large enough to extend 103 mm beyond any part of the defects. Round corners of the patch to prevent peeling of the square corners. Apply appropriate manufacturer-recommended primer to both surfaces to be mated, and allow drying. Apply proper adhesive to the membrane and the patch as per instructions given by the adhesive manufacturers. Allow time for the adhesive to dry. When the adhesive is ready, mate the two surfaces and smooth out with pressure from a gloved hand.

4.4.7 Thermoplastic Membrane

This is mainly composed of polymers which soften when heated and harden when cooled.

Membrane Patch Procedure: The surface of the membrane should be free from debris, contamination and loose particles. Wash the area using a mild soap and ensure that dust is removed from the area. Rinse thoroughly with clean water and allow the membrane to dry. Cut a piece of like membrane large enough to extend 103 mm beyond any part of the defects. Round corners of the patch to prevent peeling of the square corners. Allow the surface of the membrane and patch to air-dry. Weld the patch in place. After the welded area has cooled, check application for voids with a round tip probe such as a screwdriver. Where patches are made with reinforcement membrane materials, application seals the outer perimeter with sealant compatible with the membrane.

5.0 Conclusion

The roof and terrace waterproofing is the most crucial for durability in case of the 'building envelope' concept of the waterproofing system. No single material or system seems to be ideal for all the different cases of remedial waterproofing. It is easier to design and achieve the desired service life of any new waterproofing system if all the detailing is made properly. But while designing any remedial waterproofing system, the success depends on the exact condition assessment of the existing roof substrate and selection of a more compatible new system with proper adhesion to the old system.

Case Studies of Remedial Waterproofing

1.0 Remedial Waterproofing with APP Torchshield Membrane

Durgapur Chemical Limited has more than 400 residential accommodations in their township. Majority of the roofs in the townships quarters have suffered water seepage in roof and parapet walls. For waterproofing initially PVC membrane was applied in roof, which was found in a brittle and water-soaked condition during the site investigation.

It was decided to do re-roofing for which the entire PVC membrane was removed from the roof surface. The proper gradient of the roof slab was made after repairing cracks and damages patched with polymer modified mortar followed by curing of the surface. After surface preparation, priming was done and torch-on application of APP preformed membrane of 3 mm thick on the roof was done after terminating it up to 300 mm on the parapet wall: (Source: Archives of doctor-fixit)

2.0 Remedial Waterproofing with Heavy-Duty Microfiber Reinforced Acrylic Based Liquid Applied Coating

2.1 Commercial Building of MAGENCO, Chandrapur

The present case study of MAGENCO at Chandrapur in Maharastra covers remedial waterproofing with liquid waterproofing coating. The structure has been started with construction since the year 2001 and completed in 2006. This 8-storey building is used as a commercial call centre. This site has a huge terrace of approximately 12000 m^2. The large terrace of this building is occupied with big chillers and A/C, pipes, water tank, etc and below this terrace there were well-furnished international call centre which was taken on rent. During monsoons, there were heavy leakages from all the sides of terrace and because of all this, the call centre unit was affected. Due to heavy chillers and A/C pipes on the terrace, it was difficult to do any kind of waterproofing treatment. During site visit, it was observed that the surface is uneven, surface cracks were observed in all parts of the terrace, due to heavy chillers and large obstacles. A heavy-duty microfiber reinforced acrylic based flexible terrace waterproofing coating was applied after proper surface preparation. (Source: Archives of doctor-fixit)

2.2 Canteen Building of an Engineering College

Bhagavan Mahaveer Jain College of Engineering under Jain Deemed University in Karnataka located at Bangalore Kanakapura Highway has leakage problem from the tiled roof, made out of Mangalore tile in their

student's canteen building, which was constructed in year 2007. The structure of the canteen building had all round columns; with inter connected beams at lintel level. The pitched roof structure made out of steel girders and beams covered with Mangalore tiles to make the building architecturally good, they made with hexagonal shape, because it is located near to the main gate and a view from the highway. During the inspection it was seen that the tile joints had cracks through which water was leaking. Sealing of tile joints were made with SBR based polymer modified mortar. The surface was cleaned and water based primer was applied over which a heavy-duty microfiber reinforced acrylic based waterproofing coating of pink colour was applied on the surface followed by placing a geo-textile cloth for sandwiching between two coats. The final white colour heavy-duty microfiber reinforced acrylic based waterproofing coating was applied on the surface. Since then no leakage has been reported yet.

3.0 Remedial Waterproofing with TPO Membrane

Roof Waterproofing over Precast Segment by TPO Membrane of Terminal Building at Bangalore International Airport

Refurbishment and waterproofing of an old roof was done without disturbing the existing substrate. The curve shape and complex detailing made the client choose most reliable waterproofing membrane which can be quickly installed and can last for the design period of the structure. Considering the complexity of the job and its life expectancy, 1.2 mm thick TPO membrane was selected which was polyester reinforced TPO membrane, manufactured by the latest tri-extrusion process. Considering the wind loading on the structure the fasteners were designed. On the diaphragm walls, the membrane was fully adhered to the substrate using special adhesive glue. (Source: NBMCW April 2009)

4.0 Remedial Waterproofing with TPO Membrane

Roof refurbishment with waterproofing of old RCC folded roof of the convocation hall of IIT-Mumbai which was about 35 years old structure was done using TPO membrane. The roof of the hall was made of RCC and has about 75 mm thick RCC folded panels. Over a period of time, various waterproofing systems have been tried to make the roof waterproof.

The system used earlier was from conventional IPS to brush applied polymer coating to bituminous felts. The water-tightness of the roof could not be achieved to satisfaction and with time and exposure to the elements, it resulted in leakages and seepage of water into the RCC roof slab. This seepage of water has added to the corrosion into the slab and the concrete was spalling and had become week. A system was looked into that could assure water-tightness to the roof and also one does not have to disturb the existing surface of the slab, to prevent damage to the structure. A 1.2 mm thick TPO membrane was selected which was polyester reinforced manufactured by the latest tri-extrusion process. Considering the situation of doing the treatment over the prevailing surface, the membrane was loosely laid over the roof with mechanical fixing at the end, terminations using fasteners with certain customised detailing. (Source: NBMCW April 2009.

5.0 Remedial Terrace Waterproofing of Dabar India Limited at Ghaziabad with Polymer Modified Bituminous Coating

5.1 Background

Dabur India Limited, Ghaziabad plant and the old Dabur Research Foundation Laboratories (previously known as FKOL Building) at Sahibabad in Uttar Pradesh were facing severe water leakage problems in their roof terrace. The area of the terrace was very large and approximately 24,000 m^2. After the site visit, it was found that the main cause of terrace leakage is the failure of existing waterproofing barrier of tar felt layer. The tar felt becomes brittle after exposure to the sun, and cracks formed in the layer providing passage for water ingress into the concrete structure. The present case study discusses the application of a polymer modified bituminous emulsion coating system which was applied on an old roof terrace in year 2010.

Fig. 1: Intrusions on terraces

5.2 Condition Survey

Mostly production plants have different assemblies or intrusion on their roof terrace. The same case was also with Dabur Ghaziabad plant. There were many intrusions (Fig. 1), cables, pipes and ducting (Fig. 2) as well as less floor clearance on the terrace. Usually, pre-fabricated

membrane is not recommended for waterproofing in such conditions, since intrusions make hindrance in placing the membrane and less clearance makes working very difficult. Due to the limitation of pre-fabricated membrane, it was recommended for polymer modified bituminous emulsion liquid applied waterproofing coating.

Fig. 2: Cables, ducting & pipes on terraces

5.3 Remedial Treatment

There were many areas in the terrace where the existing waterproofing layer had torn out (Fig. 3). The cooling tower area over the administrative block was one of the worst damaged areas where even existing treatment was torn out badly.

Fig. 3: Damaged existing tar layer

Before application of any other waterproofing coating in this scenario, one is required to take out existing waterproofing layer totally till the mother slab. In this case, the damaged tar layer was removed manually (Fig. 4).

Fig. 4: Removal of existing waterproofing layer in progress

This would ensure the proper bonding of new coating with the parent slab. After removal of the tar layer, the minor hairline cracks and wider cracks (Fig. 5) at some location were seen on the mother slab. Unsound patches and cracks on the parent slab must be treated properly for good performance of any coating. In this case, there were many cracks and unsound patches which were treated well with polymeric crack filling material and SBR based polymer modified mortar before priming the surface.

Fig. 5: Wider cracks on parent slab

All the tar felting layers from the parapet wall were also chipped off (Fig. 6). In case of parapet walls, where plaster was badly damaged, re-plastering was required. The mortar used for re-plastering contained an integral waterproofing admixture. On the finished plaster, a waterproofing coating was applied. Watta (Fig. 7) of same cement mortar was prepared and placed at the junction of roof and parapet wall and other places wherever required.

Fig. 6: Tar felting layer chipping off from parapet wall

Fig. 7: After surface preparation and making watta at junction

After patch repairs, the entire area had to be cleaned properly ensuring no dust particles and undulations remained on the surface. A good surface preparation is one of the key factors for effective performance of any coating system. After surface preparation, priming was

done for proper bonding between the substrate and the coating (Fig. 8). In this case, a bituminous based primer was chosen as primer since the recommended coating was bituminous emulsion, and the primer was allowed to be dried completely.

Fig. 8: Application of primer in progress

A cold applied polymer modified elastomeric bituminous waterproof coating was applied in four layers on the roof terrace. The number of layers is an important factor to achieve required dry film thickness of the coating. Manufacture of any coating material always prescribes the coverage of the product with a known thickness.

The first coat was applied with a brush (Fig. 9) and allowed to be dried completely over which fibr mesh (Fig. 10) – as reinforcement of coating – was sandwiched between first and second layers of elastomeric bituminous coating after which another two layers were applied. Altogether, it provided a thick layer of coating on the surface (Fig. 11).

Fig. 9: First layer of bituminous coating

Fig. 10: Fibre mesh being sandwiched between first and second coat

Fig. 11: View of the roof terrace after application of the four-layer coating

Screed on final layer of waterproofing coating is a good practice to avoid any damage due to foot traffic and enhance the performance of the coating. It also ensures proper slope of the surface. In this case, a screeding was done with M20 grade of concrete with proper slope by using an integral water proofing additive in the mix (Fig. 12). Slope of screed was between 1 in 100, with at least 50 mm thickness at the drain outlet. Screed was cured and dried completely and the roof was allowed for foot traffic.

Fig. 12: Screeding being done

4.0 Ponding Test

To ascertain the performance of the coating system, a 48-hour water ponding test was done before the application of protection screed on all roof terraces after curing of the final waterproofing layer. The proper inspection of the site was done to see any seepage and dampness after which de-watering of the tested area was done to assure client's satisfaction.

5.0 Conclusion

A five-year repair maintenance warranty was given to the client in case of any faults in product performance or application. An easy-to-understand point list of Do's and Don'ts was also provided to the client for better housekeeping of the roof terrace and to avoid any damages due to various unavoidable factors or usage of the terrace. It has been three years since application of the system, and the waterproofing system is working quite effectively.

Consultant: NNE Pharmaplan, New Delhi

Material supplier: Dr. Fixit, Pidilite Industries Ltd., Mumbai

Products used: Dr. Fixit Roofseal as coating along with Dr. Fixit Torchshield Primer