

## 4.2 EPOXY INJECTION

The Injection of polymer under pressure will ensure that the sealant penetrates to the full depth of the crack. The technique in general consists of drilling hole at close intervals along the length of cracks and injecting the epoxy under pressure in each hole in turn until it starts to flow out of the next one. The hole in use is then sealed off and injection is started at the next hole and so on until full length of the crack has been treated. Before injecting the sealant, it is necessary to seal the crack at surface between the holes with rapid curing resin.

For repairs of cracks in massive structures, a series of holes (Usually 20mm in dia and 20mm deep spaced at 150 to 300mm interval) intercepting the crack at a number of location are drilled. Epoxy injection can be used to bond the cracks as narrow as 0.05mm. It has been successfully used in the repair of cracks in buildings, bridges, dams and other similar structures. However, unless the cause of cracking is removed, cracks will probably recur possibly somewhere else in the structure. Moreover, in general this technique is not very effective if the cracks are actively leaking and cannot be dried out.

Epoxy injection is a highly specialized job requiring a high degree of skill for satisfactory execution. The general steps involved are as follows.

i. **Preparation of the surface:** The contaminated cracks are cleaned by removing all oil, grease, dirt and fine particles of concrete which prevent the epoxy penetration and bonding. The contaminants should preferably be removed by flushing the surface with water or a solvent. The solvent is then blown out using compressed air, or by air drying.

The surface cracks should be sealed to keep the epoxy from leaking out before it has cured or gelled. A surface can be sealed by brushing an epoxy along the surface of cracks and allowing it to harden. If extremely high injection pressures are needed, the crack should be routed to a depth of about 12mm and width of about 20mm in V-shape, filled with an epoxy, and stuck off flush with the surface.

ii. **Installation of entry ports:** The entry port or nipple is an opening to allow the

injection of adhesive directly into the crack without leaking. The spacing of injection ports depends upon a number of factors such as depth of crack, width of crack and its variation with depth, viscosity of epoxy, injection pressure etc. and choice must be based on experience. In case of V-grooving of the cracks, a hole of 20mm dia and 12 to 25mm below the apex of V-grooved section, is drilled into the crack. A tire-chute is bonded with an epoxy adhesive in the hole. In case the cracks are not V-grooved, the entry port is provided by bonding a fitting, having a hat-like cross-section with an opening at the top for adhesive to enter, flush with the concrete face over the crack.

### iii. **Mixing of epoxy:**

The mixing can be done either by batch or continuous methods. In batch mixing, the adhesive components are premixed in specified proportions with a mechanical stirrer, in amounts that can be used prior to the commencement of curing of the material. With the curing of material, pressure injection becomes more and more difficult. In the continuous mixing system, the two liquid adhesive components pass through metering and driving pumps prior to passing through an automatic mixing head. The continuous mixing system allows the use of fast-setting adhesives that have short working life.

### iv. **Injection of epoxy:**

In its simplest form, the injection equipment consists of a small reservoir or funnel attached to a length of flexible tubing, so as to provide a gravity head. For small quantities of repair material small hand-held guns are usually the most economical. They can maintain a steady pressure which reduces chances of damage to the surface seal. For big jobs power-driven pumps are often used for injection. The pressure used for injection must be carefully selected, as the use of excessive pressure can propagate the existing cracks, causing additional damage. The injection pressures are governed by the width and depth of cracks and the viscosity of resin and seldom exceed 0.10Mpa. It is preferable to inject fine cracks under low pressure in order to allow the material to be drawn into the concrete by capillary action and it is a common practice to increase the

injection pressure during the course of work to overcome the increase in resistance against flow as crack is filled with material. For relatively wide cracks gravity head of few hundred millimeters may be enough.

**v. Removal of surface seal:**

After the injected epoxy has occurred; the surface seal may be removed by grinding or other means as appropriate. Fittings and holes at the entry ports should be painted with an epoxy patching compound.

