

Restoration systems

Injection systems to restore the watertightness and structural integrity



Restoration systems Drytech Restoration Systems, employing injection techniques, are used to waterproof structures against leakage and protect structural reinforcement. The repairs are carried out from within the building: therefore no excavation or demolition work is necessary.

Emergency work Work is both possible and effective even in the presence of water under pressure, meaning that even emergency situations can be resolved.

Immediate control All the renovation techniques enable the work to be checked immediately to ensure its effectiveness.

Applications Drytech Renovation Systems are used to resolve a complete range of problems: from small domestic leakage to cracks in dykes.

1. Concrete waterproofing injections.

Waterproofing using injection techniques for: cracks, cold and working joints, even subject to water under pressure, diaphragm walls, tunnels, dykes, purification plants, hydroelectric power stations, car parks, etc.

2. Curtain grouting waterproofing injections.

Waterproofing of stone or brick walls in contact with the ground using the curtain grouting technique.

3. Structural reinforcement injections.

Structural reinforcement and waterproofing of walls made of stone, solid bricks or reinforced concrete.

4. Injections protecting against capillary action.

Creation of a chemical barrier protecting walls in stone or solid bricks from capillary action.

Drytech Drytech has specialised in waterproofing since 1963.

Strengthened by this experience, Drytech undertakes worldwide research for the most advanced waterproofing systems, improving and applying them and thus consolidating its role as a specialist committed to helping businesses and private individuals.

Acrylic resins

Compatible with the environment and all waterproofing membranes. They can also be used to restore drinking water tanks. They are classed as domestic waste for disposal purposes. Excellent for the development of a long term watertight seal in structures and surrounding ground.

High chemical resistance: ideal for waterproofing purification plants and collection tanks for aggressive water.

Excellent resistance to fire: they are not combustible and do not develop noxious gases when exposed to fire for long periods of time.

Polyurethane resins

Suitable for waterproofing and improving the ground condition as well as for injection into brick or stone structures.

Large cavities and significant water inflows can be stemmed with polyurethane within just a few minutes as a provisional measure.

Epoxy resins, mortars and micro-cement for injection

Used to fill and structurally reinforce cracks and voids in walls and load-bearing structures, generally where structures are dry during injection.

Silicate based resins and cement emulsions

Stone or brick walls are waterproofed creating a chemical barrier to protect them from capillary action.

Injection with acrylic resins

Pressure waterproofing.

At the time of injection the resin has the same viscosity as water, thereby saturating the cracks, joints, cavities, gravel pockets and concrete voids.

The resin forms a flexible gel within a few minutes. The resin expands in the presence of water, sealing the crack by pressure.

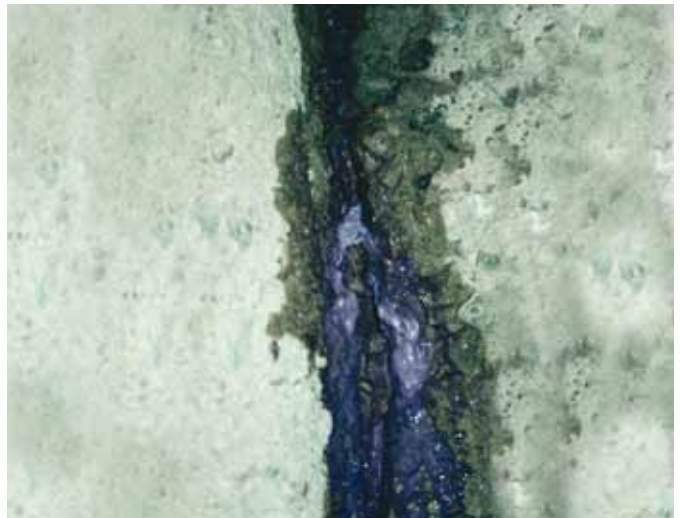
It returns to its original volume in the absence of water.

This reactive and reversible swelling effect remains constant over time and enables the resin to adapt to any movement in the crack, meaning that the effectiveness of the waterproofing remains unaltered.

The crack does not need to be prepared.

The effectiveness of the waterproofing, which acts under pressure, does not depend on the condition of the wall where the crack is located or the presence of oil or carbonates. This means that no cleaning is required leading to a saving in time and money.

* **Laboratory test:** 100 transitions, equal to 20 years of working life.
References: the first applications date back to the early 1960's and the resin injected at the time is still an effective waterproofing agent.



Use with water under pressure

The resin is perfectly effective even in the presence of water. The injection pump can produce a very high pressure level - a few hundred bar - countering any water pressure present.

This means that the Drytech System can also be used to restore active or inactive dykes. In the photographs: work carried out on weirs on the Rhine.

Immediate control

Work carried out from inside the construction - without demolition or excavation - combined with the quick action of the resin, means that the effectiveness of the restoration can be verified immediately.



Injection with acrylic resins

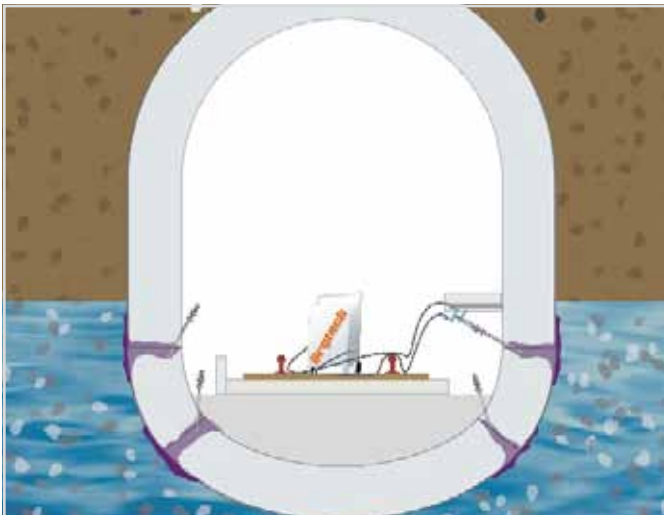
Metropolitana Milanese, Milan

The Drytech System has been used to restore two sections of the underground railway in Milan. The rise in the water table - which started in the 1980's due to a reduction in water consumption caused by the closure of many factories - reached the tunnels in some areas of the city, causing heavy infiltrations through the joint between the concrete bed and the inverted arch, forming veritable waterways beside the tracks.

Using injections of acrylic resin, Drytech sealed both the concrete bed/inverted arch joint, and the vertical joints between the elements of the arch itself using acrylic resin injection techniques.

The work was carried out during the night when the metro service was closed. There was no effect on the daytime train service as no demolition work was necessary.

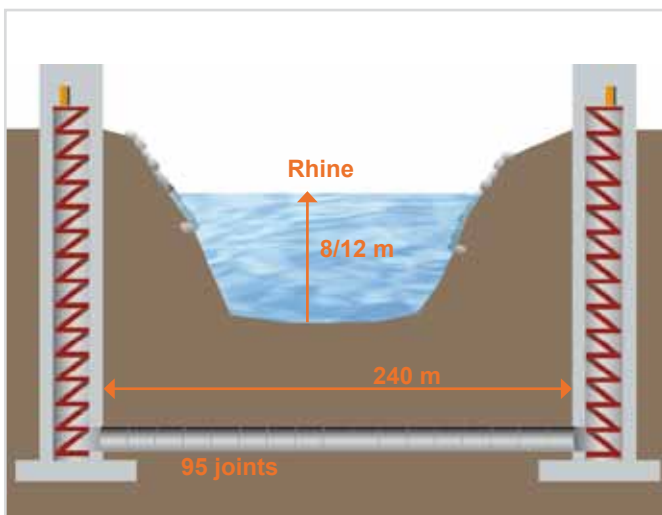
In the photographs below: the water level covers the track sleepers. The same section perfectly dry after the restoration work.



Utility tunnel under the Rhine St Johan, Basel

The utility tunnel running beneath the River Rhine at a depth up to 27 metres was repaired using Drytech acrylic injections over the entire length. The original tunnel was constructed using pipe jacking methods 3.50 m in diameter in 1974 and had suffered significant damage over time. A total of 2000 meters of joints were restored to the original watertight conditions.

Together with the addition of a new system of district heating ducts to transport thermal power - produced by the incinerators - the state holding company ordered the complete restoration of the tunnel.



Injection with acrylic resins

UBS in Basel

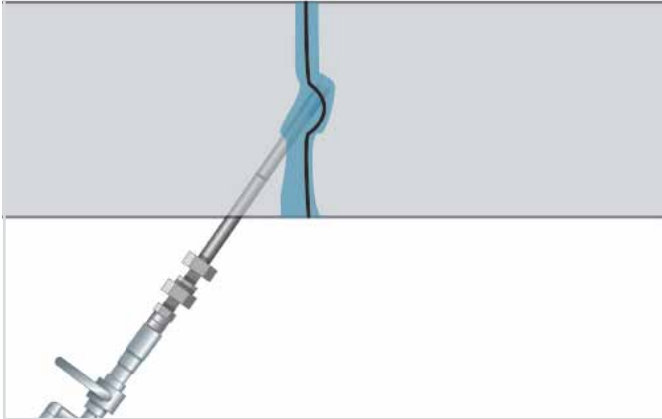
During the winter the cracks in the underground air duct were subject to considerable thermal movement causing heavy infiltrations of water.

A special elastic acrylic resin formulation was developed for this job capable of expanding by more than 50% of its volume.

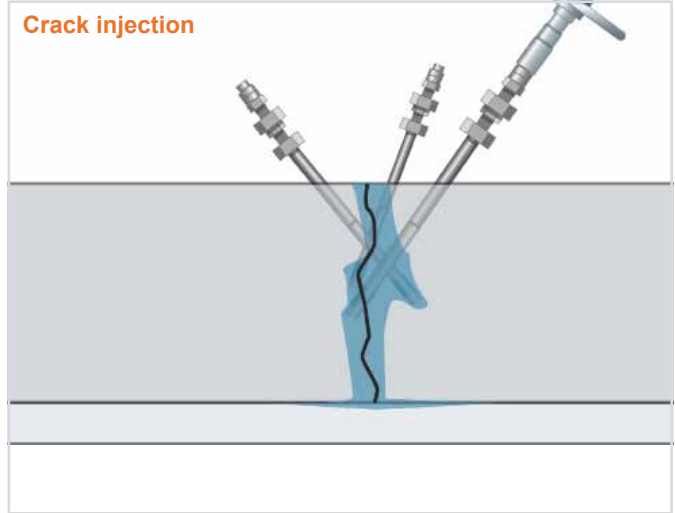
Expansion and reversibility, the main properties of the acrylic resin used, guarantee the perfect tight seal of the air duct, even in the event that the cracks are subjected to considerable movement during the winter.



Diaphragm wall joint injection



Crack injection



Injection of working joints

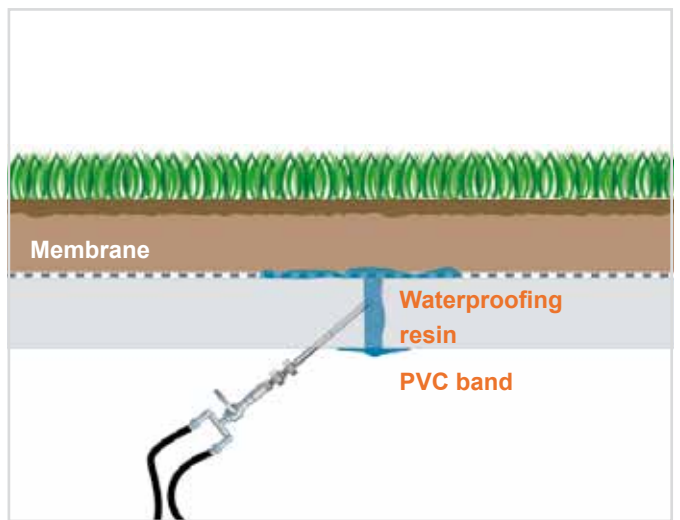
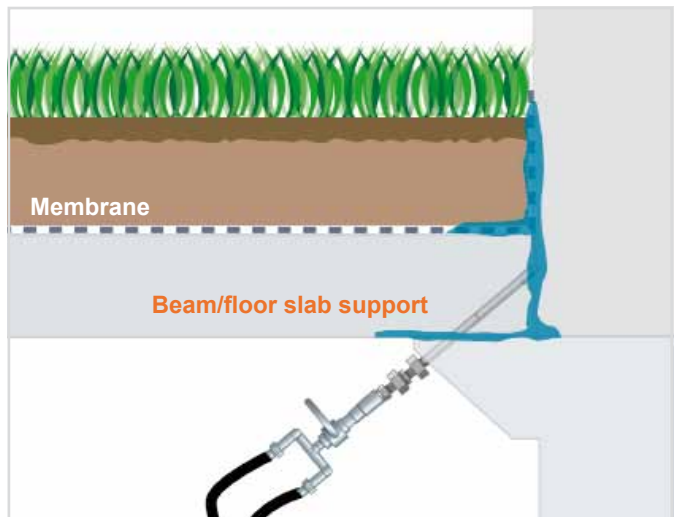
Underground car park, Basel

Restoration of the floor slab movement joint and floor slab beam supporting the joint in an underground car park.

The injection technique was used against water leakage caused by wear and tear of the floor slab connection joint and floor slab working joint membranes.

The work was carried out from within the building: therefore no excavation or demolition work was involved with no effect on normal use of the car park.

The acrylic resin injections, combined with the application of a PVC holding tape guarantee a tight seal even for movement joints.



Injection in concrete bed joint

Waterproofing of a cellar below the water table.

Heavy rains created an underground water course and a consequent 1 m high pool of water around the building in Lugano.

The subsequent infiltrations caused flooding in the second level below ground which reached a height of 50 cm.

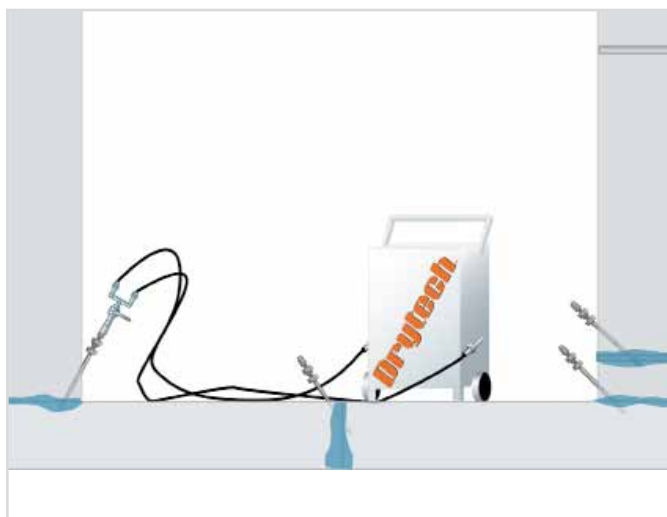
Defects such as joints, cracks, gravel pockets and holes in the formwork spacers were waterproofed from within using injection techniques, guaranteeing the perfect water tightness of the cellars.

In the photographs: Drytech technicians prepare the battery of injectors along a crack in the concrete bed joint.

The resin injected saturates the crack.

A technician sucks up the water expelled by the pressure of the resin.

The resin is blue to distinguish it from the water. The pigment is reactive and the resin becomes completely colourless after a few minutes.



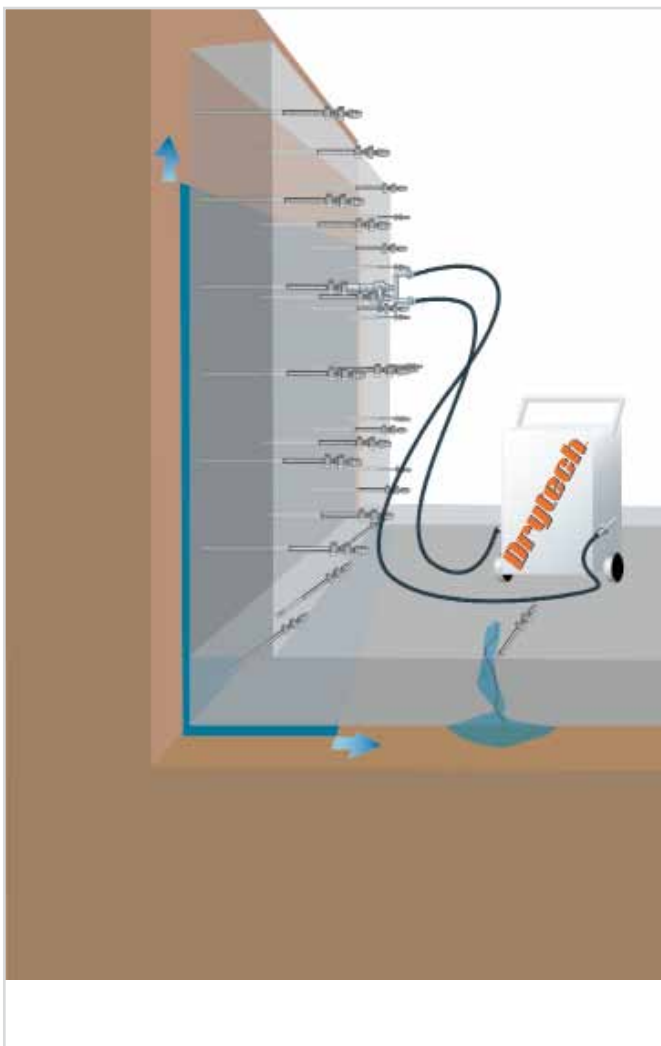
Curtain grouting technique

Curtain grouting techniques are used particularly for porous or permeable structural elements creating a grout curtain of resin between the wall and the diaphragm wall or between the wall and the ground below.

The grout curtain technique complies with the WTA 4-6-98 recommendation.

Waterproofing injections of acrylic resin on the back of Predal* walls between the Predal itself and the diaphragm wall.

**Predal trademark - prefabricated wall*



Waterproofing and reinforcement

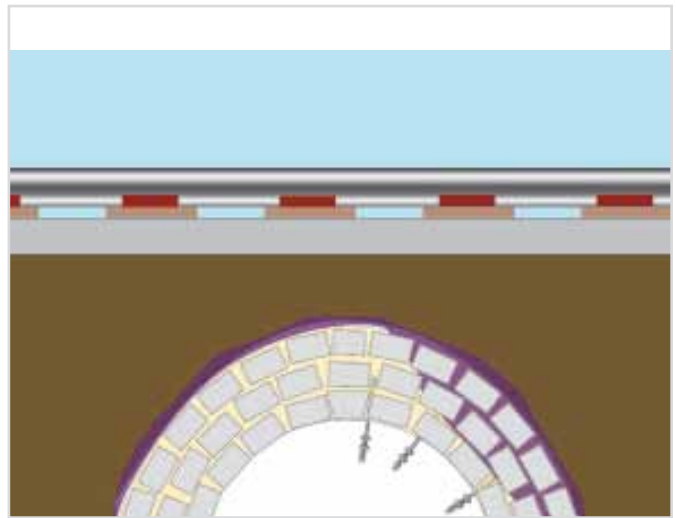
These techniques are applied above all when large quantities of material need to be injected. For example when the ground or the area to be filled assume the load-bearing function.

- weak and instable ground (e.g. sand, sand mixed with gravel).
- concrete beds without sufficient load capacity (e.g. limited dead load/insufficient reinforcement).
- walls, for example in concrete or other materials, that do not support punctual loads (in this case the possibility to carry out injections of curtain grouting must also be checked).

Injections in a railway underpass made of natural stone and solid bricks. Waterproofing and stabilisation of the simple structure subjected to serious damage caused by frost.

The acrylic resins used in low-pressure injection techniques have proved to be particularly suitable for saturating the considerable voids in the structure.

Carried out from within the vault, the work did not require excavation of the rail bed above, thereby avoiding interruptions in the circulation of trains. Night shift working was also not necessary.



Waterproofing injections and structural reinforcement

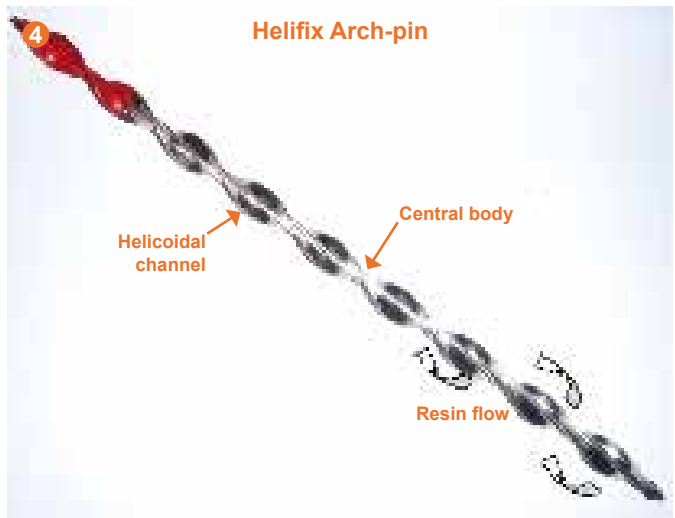
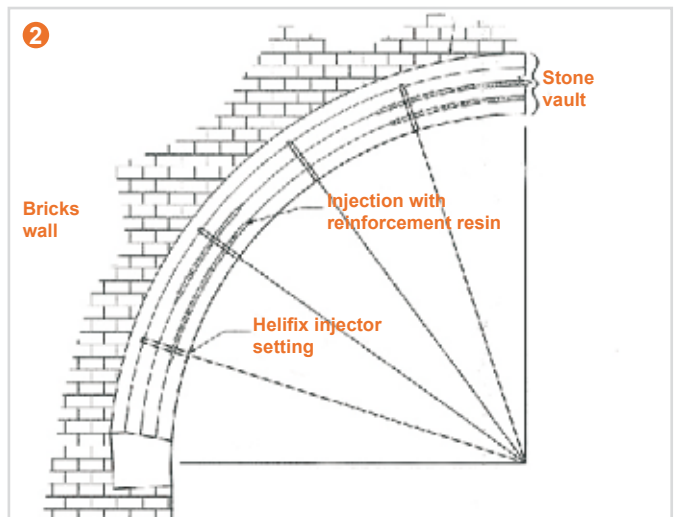
The Helifix injection technique is used to waterproof and structurally repair a brick arch in a single operation. The photographs show the restoration of a brick vault.

The technique developed by TAM uses elliptical injectors that become an integral part of the vault. The rings of bricks are crossed by the Helifix Injectors, uniting them and making the structure coherent.

These injectors are also ideal for the structural restoration of cracks.

The structure is waterproofed through resin injections introduced under pressure through the elliptical channels of the same Helifix Injectors.

The resin fills the voids created over time in the mortar between the bricks and, once set, makes the vault impermeable and at the same time considerably reinforces the structure.



- 1 Waterproofing and structural restoration of the Fenton Manor Tunnel, London.
- 2 Outline of work: the three brick rings in the vault are crossed by the Helifix Arch-Pin injectors, which consolidate the structure by uniting the rings.
- 3 Technical staff at work.
- 4 The Helifix Arch-Pin injector: the helicoidal channels used for resin injection are highlighted.
- 5 Technical staff prepare the hole for insertion of the helicoidal injector.
- 6 Injector insertion.
- 7 Low-pressure injection.
- 8 Waterproofed and reinforced vault.

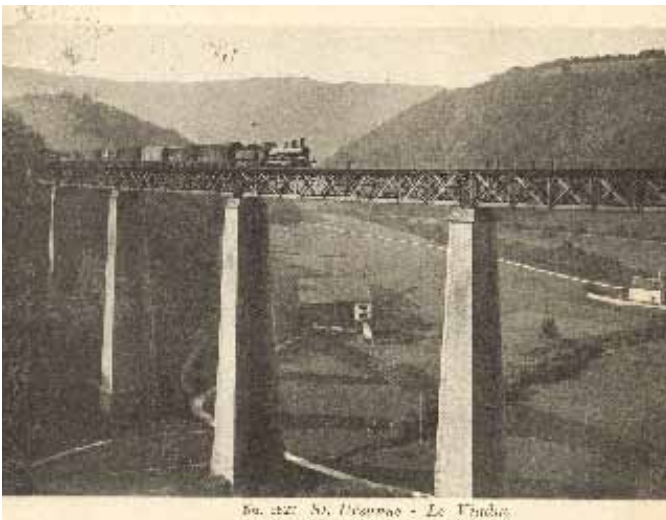


Structural reinforcement

Viaduct of St. Ursanne

Built in 1875-76, it became a historic monument in 1900. The viaduct of St. Ursanne was fully restored between 2000 and 2002.

The original railway viaduct has been replaced with large prefabricated elements, whilst the high stone vaults have been reinforced with injections of cement mortar and micro-cement. The work lasted 8 months overall.



Repair of structural cracks and reinforcement

Repair of structural cracks

Restoration of structural cracks in the floor slab and pillars of a motorway bridge.

The technique of injections of epoxy resin and micro-cement is used above all for structural reinforcement.

Thanks to the restoration of the membranes above, the cracks are dry.

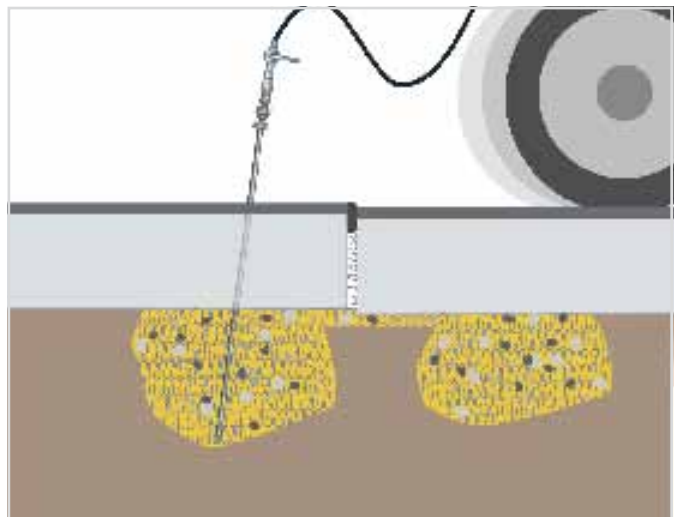
After cleaning the cracks, they are injected with epoxy resin guaranteeing the adhesion and gluing of the same.

The force of traction of the epoxy resin is 5-6 times greater than the break-out force of the concrete.

Reinforcement of the roadbed

The absence of a tight seal of joints in reinforced concrete roads and the washing away by rain cause subsidence and cracks in roadways.

Injection techniques can be used to reinforce the ground and the area supporting the concrete road beds, or to locally fill the void created between the concrete road bed and the ground.



Restoration of walls with capillary humidity

Bottmingen Castle and moat (Basel)

In 1986 Drytech replaced the waterproof gunite of the submerged part of Bottmingen Castle.

To prevent the capillary rise of water, injections of cement mixed with silicates were carried out before applying the macro-porous gunite.

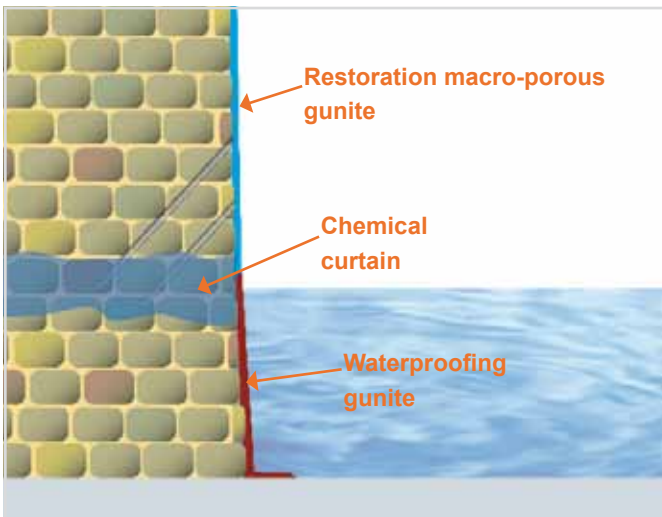


2006

1986

Below the outline of the work, a photograph of the condition of the submerged construction in 1986, before restoration and waterproofing.

In the photographs: removal of the old plaster and, below, application of the waterproof gunite for the part submerged in water.



1986



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