

A “REINJECTABLE” WATERSTOP SYSTEM FOR WATERTIGHT JOINTS

WATERTIGHT CONCRETE JOINTS

Concrete is one of the most widely used materials in the building and construction industry representing an annual market in the United States alone of \$223 billion dollars. It is also the chosen building material for the lining of tunnels where each section (wall or slab) is poured separately (insitu). Concrete has proven to be durable, structurally sound, and able to be formed in many various shapes and sizes, either precast or poured in place.

One inherent characteristic of most concrete structures is that they are poured or fitted in stages, thus causing a seam or joint to be produced at the point where the various concrete sections are joined or come together.

The introduction of joints creates openings, which must usually be sealed in order to prevent the passage of water, gases, liquids or other unwanted substances from entering into the concrete structure.

In order to prevent leaking and ensure a watertight joint a sealant or waterstop must be applied or installed in the joint section prior to completing the second concrete placement.

In recent years, it has become increasingly recognized that there is more to providing an effective seal at a joint than merely filling the "as constructed" gap with an impervious material.

The functioning of a joint sealant depends as much on the movement to be accommodated to the type and shape of the joints to the physical properties of the sealant to be utilized.

Joint design, which broadly covers the interrelationship of these factors, should be an important consideration in the design of most concrete structures.

TYPES OF JOINTS AND THEIR FUNCTION

CONTRACTION (CONTROL JOINTS)

These joints are purposely made planes of weakness designed to regulate cracking that might otherwise occur due to unavoidable, often unpredictable, contraction of structural units. They are appropriate only where the net result of the contraction and any subsequent expansion during service is such that the units abutting are always shorter than at the time the concrete was placed. They are frequently used to divide large, relatively thin, structural units, for example; pavements, floors, canals, tunnel linings, retaining walls and other smaller panels.

Contraction joints in structures are often called "Control Joints" because they are intended to control crack location. Contraction joints may form a complete break, dividing the original concrete unit into two or more units.

EXPANSION JOINTS

Expansion joints are designed to prevent the crushing and distortion (including displacement, buckling and warping) of the abutting concrete structural units that might otherwise occur due to the transmission of compressive forces that may occur as a result of expansion, applied loads or differential movements arising from the configuration of the structure or its settlement. Expansion joints are made by providing a space for the full cross section between abutting structural units when the concrete is placed through the use of filler strips of the required thickness or leaving a gap when precast units are positioned.

CONSTRUCTION JOINTS

Construction joints are made at the surface, created before and after interruptions in the placements of concrete or through the positioning of precast units. Locations are usually predetermined by agreement between the Architect, Engineer and the Contractor, so as to limit the work to be done at one time to a convenient size.

Construction joints may run horizontally or vertically depending on the placing sequence prescribed by the design of the structure.

JOINT DESIGN FOR WATERSTOPS

In water-retaining and water-excluding structures, it is normal practice to provide waterstops in all the aforementioned joints. Waterstops can be manufactured from different materials, i.e., flexible PVC, natural rubber, copper, and other metals. By far the most widely used material is flexible PVC.

FUNCTIONS OF WATERSTOPS:

Waterstops incorporated in movement joints must perform the following functions:

- Stop water migrating through the joint
- Withstand hydrostatic pressure
- Resist movements without failure
- Allow for expansion and contraction movement
- Transverse shear movement
- Longitudinal shear movement (rare)

Normally, the width of the waterstop should not be in excess of the thickness of the concrete member to avoid severe weakening of the concrete cross section and excessive waterstop cost.

The use of waterstops and their "functionality" varies with the type of structure being considered. In structures such as, dams, canals, reservoirs, water purification systems, wastewater treatment plants, and tunnels, watertight joints are an absolute requirement. To minimize the danger of leaks, waterstops are embedded in the concrete at the site of planned joints, cutting across the opening of the joint so that water will not be able to travel beyond that point. Yet waterstops have problems of their own. For example, the waterstop may be knocked out of alignment or buckle under the load when concrete is poured around it, so that it never forms an effective barrier, or the newly-poured concrete may not settle and consolidate properly, creating air voids around the waterstop through which water can seep. Therefore, with tunnel construction on the rise in the U.S. the demand for a product that will ensure watertight joints is a major necessity.

A new technology that will provide a viable alternative to waterstops is the injectable hose or grout tube. This unique waterstop system has been used with great success in central Europe, the Far East, Asia, and most recently in the United States. Originally used in the building and construction industry, the reinjectable waterstop system hose has also found great success with an application in the tunneling and underground construction industries where sealing against water ingress is, if anything, even more important.

The injectable hose/tubes are much simpler and cheaper than conventional waterstop installation and the reinjectable waterstop hose/tube can offer the owner a reliable vehicle for 100% sealing between walls and slabs and between different concrete pours in tunnels.

The reinjectable waterstop grout/tube hose is designed to replace conventional PVC, rubber, and metal waterstops in joints, between walls and slabs, and between different concrete pours in tunnels. The installation of this injection hose prevents the migration of water through the joint by using a combination of state-of-the-art grout/tube technology and acrylate-ester waterstop technology.

In theory, when PVC, rubber, or metal waterstops are placed in a concrete joint they act as a barrier to prevent water movement across the joint. In reality, due to placement difficulties and poorly consolidated concrete in the waterstop area, they are seldom installed properly and all too often, fail to perform as designed. These waterstop failures usually will not occur until after the concrete has had time to shrink and has gone through a few thermal expansion and contraction cycles. Unfortunately for the Owner and Engineer, when the failures begin to manifest, the contract warranty period has ended and now they must consider expensive repairs and/or maintenance to fix the leaks.

Up until only a few years ago, design engineers did not have many waterstop alternatives to choose from. With the introduction of hydrophilic gaskets and grout-tube waterstops, engineers can now effectively address leakage concerns during design.

There are several injectable waterstop tubes currently available in the United States. The most common one being composed of a reinforced spiral of steel wire; this prevents collapse of the tube when the concrete is poured. The spiral is covered with a woven fabric membrane, which filters the current particles during the pour and allows easy passage of the injection resin through the tube. The outer synthetic membrane protects the inner woven membrane. This type of grout tube offers a one-time injection process.

There is only one re-injectable waterstop hose currently available, which consists of a specially designed, yellow flexible PVC grout-tube coupled with a state-of-the-art acrylate-ester based chemical grout resin. The hose has a thick-walled, PVC construction, which is capable of withstanding the external pressures created by the overlying concrete. Small diameter openings are located along four grooves around the perimeter of the hose. In each of the four grooves are compressible neoprene strips, which are held in the four grooves by an open-webbed, nylon mesh. These neoprene strips cover the openings so that no concrete can enter the hose during the concrete placement operations. The hose is placed in the center of the concrete slab or wall joint (between the first and second concrete placements) and anchored down with plastic clips. After the second concrete placement has been poured and has had sufficient time to set, the specified injection material is pumped through the hose. Under internal fluid pressure created by the pump, the neoprene strips compress against the overlying concrete and allow the injection grout to flow out of the perpendicular openings and into the concrete joint. These same neoprene strips prevent cement slurry from entering into and clogging the hose when concrete is placed on top of it during the pour. The staggered pattern of the perpendicular openings assures uniform discharge of the grout material into the joint.

The manufacturer of the reinjectable waterstop hose further improved the system by developing a low viscosity (20-40 cps) injection resin to be used in conjunction with the hose, so that if future injections were required the hose would be a viable vehicle for access into the joint area.

Due to its low viscosity, the hydrophilic injection resin is able to flow into the void spaces within the joint as well as any honeycomb areas or shrinkage cracks that intersect the joint. The chemistry of the injection resin allows for a cure time of 45 minutes to an hour. During that time the grout will not chemically react with water, thus allowing for the joint to be completely sealed with the resin and the hose to be flushed out and left clean for future use. Once the injection resin has cured it will form an impermeable barrier within the joint.

The hydrophilic swelling characteristics of the first injection resin produced by the manufacturer was based on a vinyl-ester composition which was tested satisfactorily at a sealing capacity of 7 bar (99.63 psi) head of pressure at the University of Dortmund in Germany in 1990. The technology of hydrophilic sealing resins was further improved upon by the manufacturer to the present time, which incorporates the group of acrylate-ester resins and gels belonging chemically to the family of hydrogels. The grout is composed of water-soluble acrylic-ester monomers, which do not contain solvents. They can be cleaned easily using water. This acrylate-ester injection resin cures to a flexible, solid synthetic material, which can resist even permanent water pressure. The cured resin is stable towards acids, concrete, alkaline solutions, and fuels and will not attack steel, PVC, bitumen or other commonly used joint sealant material.

REINJECTABLE GROUT/TUBES

AND HYDROPHILIC WATERSTOP SYSTEMS

Inherent to the success of creating a permanent seal with the reinjectable waterstop hose, is the selection of a sealing material that will not deteriorate over time. Although polyurethanes, ultrafine cements, and epoxies may also be injected into the hose the

water-soluble, acrylate-ester based grout is recommended. Unlike polyurethane or epoxy, the acrylate-ester resin does not deteriorate from repeated wet/dry cycling inside the joint. The molecular structure of the material allows it to be water-soluble in its uncured state, thereby creating a time period for the material to flow without a reaction to the surrounding moisture. This reaction is different to polyurethanes in that there is no chemical reaction, foam layers, or transportation of water in the sense of a "wicking" effect. The swelling process is, like the solution of common salt in water, a purely physical process and is, therefore, ageless and reversible.

However, a physical characteristic that is shared between polyurethanes and acrylate-ester grout is the elasticity of the grout material. This elasticity coupled with the swelling and re-swelling characteristics make it the ideal choice for sealing joints that are subject to repeated expansions and contraction's as the joint opens and closes. Additionally, the chemical resistivity of the acrylate-ester grout makes it additionally advantageous for use in contaminated groundwater situations. The chemical resistance of this material was further tested and documented at the Laboratory for Macromolecular Chemistry and Plastics Technology by Prof-Dr. Thomas Mang, Chemical Engineer Aachen Technical College, Aachen, Germany on May 18, 1993.

The degree of swelling, possible discoloring, consistency and amount of dissolution of the inject material was noted and recorded on a certificate of chemical stability signed by Dr. Mang and is available for reference and publication through the manufacturer.

INJECTABLE VS. REINJECTABLE WATERSTOP HOSES

The main advantage in using the reinjectable waterstop hose as opposed to the injectable grout tube is the ability to re-inject more than one 'time. Thermal stresses in the concrete, differential settlement, equipment vibrations, earthquakes, etc. can all cause excessive movement in the structure, possibly causing new leaks to develop in the joint area. The ability to reinject the hose is dependent on using a special formulated water-soluble acrylate-ester grout, or a micro-fine cement for the initial injection. The use of a water-soluble grout or micro-fine cement injection material allows the hose to be flushed clean with water before the grout and/or cement has time to cure or harden.

The evacuation process of the reinjectable hose requires the use of a small vacuum pump or diaphragm pump, which is attached to either of the colored vent, ends; with the remaining vent end placed in a bucket of clean water. Once the pump is hooked up a reverse pressure is applied which pulls the neoprene strips in, closing over the one-way valves and allowing whatever residue of grout material that is remaining inside the hose to be flushed out without depleting the grout material that was injected earlier. The previously injected grout material remains in place and begins to cure and/or harden to form an impermeable barrier, which completely seals the joint area.

With the injection hose cleared of grout material, it can be accessed and reinjected at any time in the future to reestablish a watertight seal. While polyurethanes and epoxies may be injected through the hose, the fact that they are water-reactive and not water-soluble, prevents their removal from the hose, thereby making it a one-time injection.

INSTALLATION OF THE RE INJECTABLE WATERSTOP HOSE

The procedure for laying out the reinjectable waterstop hose is quite simple. Once the base concrete or invert in a tunnel is set, the hose is laid and fixed with simple plastic clips spaced about 15-25 cm (6-10") apart in what will become the joint with the next pour. The vent ends are left exposed or encased in a junction box for access at a later date. Once both blocks of concrete are set and cured, often three to six months are allowed for the latter. The hose can be injected with either a synthetic resin or microcement grout utilizing the smaller diameter hose or regular Portland cement can be injected through the larger diameter hose.

The reinjectable waterstop hose is to be installed in maximum lengths of 40'ft (12m). Any length less should be used as field conditions require. For normal wall thickness of 8-16", the injection hose should be installed in the center of the wall. In thick walls, the installation of two hoses is possible. The same dimensions also apply to seal off foundation slabs with vertical joints.

The hose is clamped into position with specially designed plastic anchor clips spaced approximately 6-10" (15-25cm) apart. It is essential that there is direct contact between the injection hose and the concrete. This will prevent floating of the hose in freshly poured concrete and will enable the injection material to reach the concrete joint and not the sound concrete of the wall.

After the second placement of concrete has been made, only the different colored vent ends are visible (either housed in a plastic junction box or sticking out of the concrete near the joint or hose termination area). The vent end lengths can be adjusted and field cut and measured as predetermined by the engineer to fit the desired application and constructability at the site and to aid in achieving an easier access area for the contractor during the injection process.

OTHER USES FOR THE REINJECTABLE WATERSTOP HOSE SYSTEM:

1. In Conjunction with Expansion Joint Waterstops The injection hose is fastened to the edge of a centerbulb-type expansion joint waterstop to be embedded into the concrete. The hose may be injected to seal voids caused by insufficient consolidation of concrete in the vicinity of the expansion joint.
2. In Underpinning Operations The larger injection hose when fastened to the underside of the structure being supported provides an efficient and cost effective vessel for pumping grout into the void between the underpinning and the structure below. The larger hose 15/16"-24mm with an internal diameter hole of 3/8"-10 mm is designed to handle Portland cement and large quantities of other fine cements, which may be used in this application.
3. In Top-Down Construction As with underpinning operations, either the smaller ' hose 3/4"-19mm or the larger hose described above may be fastened to the underside of the upper structure prior to completing the concrete placement below. This allows not only for structural grouting between the two surfaces, but also provides the means of sealing the same joint against water penetration. Simply flush the hose clean after the cementitious grouting operation and re-use it by re-injecting the joint sealant grouting material into the same hose. Vacuum and flush out the

hose again and it remains in place for any subsequent use or maintenance purposes.

4. In Slurry Diaphragm Wall Construction The reinjectable waterstop hose can be securely positioned in the joints between slurry diaphragm wall panels, providing the means for a scheduled injection of a hydrophilic sealant and/or cement grout. The manufacturer will supply the engineering for correct positioning and installation methods to suit any bulk-head configuration.

The injection hose can be conventionally installed at the juncture between the diaphragm wall and the slab-on-grade which can provide a positive seal in a location where no other waterstop system can be as effective.

INJECTION PROCEDURES FOR THE REINJECTABLE HOSE

Injection starts at one end of the 'hose and follows these steps: Remove the closure plugs from both the injection end and the opposite vent end. Connect an injection fitting into the chosen injection vent end (either the green or clear hose) and securely tighten. Hook up the injection pump nozzle to the injection fitting and begin pumping. Initial injection pressure should be between 75-150 psi (5-10 bar). Continue pumping until the entire joint is sealed and the injection material is visibly flowing out of the opposite vent end.

From the moment that the material flows out of the opposite vent end, stop pumping and cap off the vent end. Resume pumping by gradually increasing the pressure until the pressure gauge reaches approx. 500-600 psi (35-40 bar) maximum. Maintain this pressure for approximately 3-5 minutes up to 600 psi (40 bar). To seal the joint, apply moderate pressure for a long injection time, rather than exerting a high pressure for a short injection time. This is essential to allow the injection material to thoroughly penetrate the joint. Once the maximum pressure (600 psi - 40 bar) is held for approximately 5 minutes, reinject the specified injection material into the hose from the opposite vent end within the gel time of the injection material. This allows for an even pressure distribution of material over the entire length of the joint.

Disconnect the injection pump from the injection fittings and connect a vacuum pump to either PVC vent end. Place the opposite vent end into a bucket filled with water. During the vacuum process the acrylate-ester resin or cement grout will be flushed from the injection hose, the valves will be closed by the neoprene strips and the hose will be directly flushed clean with water. Because the acrylate-ester resin is not water-reactive in its uncured state, the material will not set up inside the hose. This material along with cement grout allows the hose to be cleaned and re-used any time in the future. Water reactive polyurethanes or epoxy resins will set up inside the hose thus allowing for only a one-time injection process.

When the water flow is clear on the vacuum side, disconnect the water supply (take the vent end out of the water bucket). Disconnect the vacuum pump and close the injection end and remaining vent end with the closure plugs. This vacuum and flushing procedure allows for the reinjection of the hose at any time in the future, if required.

LABORATORY TESTING OF INJECTION FUNCTIONS AND SEALING

Expert testing of the reinjectable waterstop hose was commissioned in March of 1990 at the University of Dortmund Fachbereich Bauwesen by Prof.Dr.-Ing J.Neisecke and published in *Expert Opinion G 10/90* dated October 26, 1990. Those taking part in the experiments agreed that the function principle and waterproofing action of the reinjectable waterstop hose system should be judged by means of test specimens and laboratory testing, which should be done under conditions as near to real life as possible.

Altogether 6 test specimens of high density concrete B35, normal Portland cement PZ 35 F, water-cement ratio=0.5 were prepared in the measurements of 200cm x 50cm x 20cm. These specimens each consisted of a 10cm thick bottom slab, on top of which another 10cm thick top slab was poured. In order to create a construction joint between the top and bottom slab.

A hydrophobic sealing medium was added to the lower concrete. The lower concrete was thoroughly watered prior to placing the upper concrete to achieve a distortion of the bond. To prevent a rise or shearing off of the upper concrete from the bottom slab during a later injection, caused by pressure built up in the construction joint, a lateral tie reinforcement was built in between the bottom and top slab. Additionally, two honeycombs were created at a time by making up gravel of 2/8 mm grain. One of the honeycombs contained the injection hose, while the other was placed 5-8 cm away from the hose.

The specimens were injected with a polyurethane injection resin, the hydrophilic resin (a vinylester composition) supplied by the manufacturer, and an ultra fine cement.

The original vinylester injection resin developed by the manufacturer for the reinjectable waterstop hose was a combination of a vinylester component and an activating agent - this composition has since been approved upon. The acrylate-ester resin has been extensively tested in laboratories and on the jobsite since 1993 and is the recommended material for optimum injection results.

The test specimens were injected with the previously listed grout materials and the hose was cleaned out following the injection of the ultra fine cement and vinylester swelling material. Both slabs containing the injection of cement and swelling resin were re-injected and the hose flushed clean following the second injection.

Water pressure checking for compactness was completed by means of the injection hose. For optical assessment of the injection results all test specimens were cut by diamond wheel so that the construction joints as well as all honeycombs and bending cracks could be assessed and photographed and documented.

Supplementary examinations on water impermeability were conducted on the cut out specimens containing the swelling vinylester injection resin. These specimens did not allow water to pass through during water loading according to DIN-1048 (German Testing Standard) in steps of 1 bar (14.22 psi), 3 bar (42.67 psi), and 7 bar (99.56 psi).

Conclusion and recommendation of the expert based on the examinations and laboratory test specimens lead to the following results:

The used injection technique made it possible to inject the injection materials - polyurethane resin, vinylester inject resin, Duroseal R-581) and cement Z 1 through the reinjectable waterstop hose into the construction joints in an order of magnitude \geq 0.1mm width.

It was possible to fill larger honeycombs through such kind of construction joints - both 5-8 cm from the injection hose and the also the honeycombs created over the hose. The injection grout was able to penetrate into cracks areas, which intersect the hose.

The cleaning of the injection hose by vacuum - emptying and water rinsing was successful following the injection of the cement and vinylester resin. Thereby proving that a reinjection becomes possible any time and as often as one likes.

By reinjecting with pressures of up to 50 bar (711.14 psi), areas which before were not injected, - (even small pores and structural imperfections in areas close to the hose) - could be filled and the hose once again vacuumed clean and left open for future use.

Naturally, one cannot overlook the fact that the conclusions that were reached were as a result of only 2m long and 20 cm high laboratory test specimens. However, if one takes into account that the examination was first of all intended to assess the functional principles and the sealing action of the reinjectable waterstop hose, then the conclusions are highly convincing.

In addition, in June of 1990, during his assessment of the waterstop system, Dr. Neiske was able to see for himself, the simple and safe placement and installation of the reinjectable waterstop hoses as well as the injection operations performed under actual site conditions on a large-scale project located in Düsseldorf, Germany.

HISTORICAL REFERENCE

The first installation of the reinjectable waterstop hose and injection of hydrophilic swelling resin on a tunnel was completed in 1988 on the Oslo Tunnel in Norway. According to the Contractor, 25,000 m (82,000'ft) of reinjectable hose was installed and successfully injected with 35,000 tons of vinylester injection resin. The hose was vacuumed clean and the joints continue to remain watertight. This was the first project where the hydrophilic injection resin technology was utilized in large quantities against constant hydrostatic pressure.

According to the manufacturer, as of August 8, 1996, 2' 600' 000 meters (8,500,000 ft.) of reinjectable waterstop hose has been installed in 16 countries worldwide.

U.S. TUNNEL - CASE HISTORY

In Dallas, Texas where S.A. Healy Company is completing the construction of "DART" (Dallas Area Rapid Transit System), passengers will be able to travel to the city center from the Loop 12 by-pass. One of the lines, lot NC, passes through a tunnel. The NC lot is the sole DART section with underground stops and lines: the running tunnels - two tunnel tubes each 5.029m long and 6.553mm in diameter are located - in City Place

Station with two 134m long platform tunnels and - in the Knox Hendersen Street Station with two approx. 146 m long platform tunnels and ventilation tunnels. This project consists of over 5,000 m long running tunnels and is expected to be partially operational the end of 1996.

In November of 1995, serious water leaks began in the City Place Station area. The leaks occurred at the interface of the cut and cover section and the mined section on one of the escalator inclines. The Contractor suspected that there was a failure in the membrane liner. The worst leaking area also coincided with a construction joint providing a path for the water to enter the structure. Two liners along with waterstops were required in all joints for exterior walls, roofs, and inverts.

A jobsite visit was scheduled to review the situation and discuss the repair options with the Owner, Engineers, Contractor, Membrane Supplier and Waterproofing Consultants. Upon review of the plans and following a physical jobsite inspection, a repair specification was submitted to the Owner, Engineer, and Contractor for approval. During the jobsite meeting, it was agreed that the S.W. Entrance area of City Place Station would be repaired by means of grout injection through the placement of metal packers drilled and placed at 45° degree angles, intersecting the leaking joints.

It was also agreed that the Contractor could install a reinjectable waterstop hose on the identical designed construction joint at the S.E. Entrance (currently under construction) in order to avoid the same type of costly repairs in the event of subsequent leakage.

In March of 1996, 500 linear feet of leaking joints and/or cracks were sealed with three separate leak repair materials; a non-foaming polyurethane based resin to stop fast-flow water leaks, an acrylate-ester gel and resin were also utilized on the weeping areas and damp cracks with little or no flow.

The reinjectable waterstop hose system was installed by S.A. Healy during the summer of 1996 on the 150'ft. S.E. Entrance construction joint and was injected with the acrylate-ester swelling resin the beginning of October, 1996. The area took 45 gallons of injection resin, which is 11 times the normal amount utilized for new-to-new construction joints, thus indicating evidence of large voids within the joint area. The hose was vacuumed out and left clean for future use. Subsequent leaking areas of the tunnel were also injected with the same swelling acrylate-ester. The Contractor is satisfied with the results.

The general rule for consumption of injection material through the injection hose for new to new concrete construction is: 1 gallon per 40'ft of hose, or 1 liter per meter. This estimate remains true only if the concrete work is of the highest quality and workmanship.

The repairs that are made following failed water barrier performance are extremely costly and are generally not accounted for in the original cost estimate to the Owner. Disputes over warranty periods for watertightness are also a problem, sometimes resulting in the need for arbitration.

The use of a reinjectable waterstop system for joints becomes more cost effective and viable as Engineers and Owners are able to review performance specifications and subsequent repair costs on the recently completed tunnel projects in the United States.

Aside from the repair and maintenance costs, the need to preserve the structural integrity of the concrete is very important. This requires that less intrusive leak repair activities be considered in the future. Drilling and placement of packers into newly constructed concrete to stop leaks by means of grout injection is very expensive and if done improperly can cause further damage to the structure.

One way to help eliminate these extra costs and repair concerns is to install a reinjectable waterstop hose -grout tube during the initial construction phase. Thereby assuring a cost-effective and non-intrusion way of accessing the joint areas at any time in the future if necessary.

The cost to repairs leaks after construction have proven in some cases to be more than 3 times the amount to install, inject, and vacuum out the injection hose.

ADVANTAGES OF THE REINJECTABLE WATERSTOP HOSE SYSTEM

- The reinjectable hose provides substantial reduction in construction costs and schedules for labor intensive waterstop installations.
- The reinjectable hose can provide a means to leak
- test the joint by injecting normal water through the hose. Water tightness of the concrete can be determined and joints requiring additional sealing can be completed during construction.
- The reinjectable waterstop hose eliminates the ' problems associated with poorly vibrated concrete and leakage in cold joint areas.
- The reinjectable waterstop hose provides the Owner with a "WORRY-FREE" MAINTENANCE SYSTEM" for the lifetime of the structure.
- The reinjectable hose provides a reliable performance guarantee for expansion joints - where movement of the joint historically causes leakage.
- The reinjectable hose can be used in the future to repair leaks emanating from the joint areas due to settlement or seismic movement.



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