SINMAST INJECTION SYSTEMS
preserve and restore bridges with new methods and procedures.

The Italian Highway Department has achieved and set a precedent in rehabilitation of deteriorated and damaged prestress bridges with the use of Sinmast Injection Resins. The problem on older bridges was two-fold. (1) Shrinkage and settlement cracks developed over a period of years caused separation of the structure as a monolithic unit. These cracks allowed moisture and oxygen to flow easily into the structure causing deterioration of the concrete binder and creating corrosive actions on the reinforcement steel and cable systems. (2) The second problem resulted from two situations which occurred: (a) severe oxidation of the conduit and cables developed because of structural cracks which permitted moisture to enter, and (b) the cement grout used within the conduit which supposedly surrounded the steel prestress cables had either shrunk or was improperly installed. Subsequently, as a team effort, Sinmast counselled with the Italian Highway Departement on the abilities to develop specialized systems to solve these problems and to restore the bridges.

Sinmast Resin Injection System welds concrete and steel together to create a stronger than original design structure.

Since long time Sinmast has specialized in rehabilitation of cracked concrete structures. The bridges in discussion experienced typical fissure and crack damage common to bridges throughout the world.

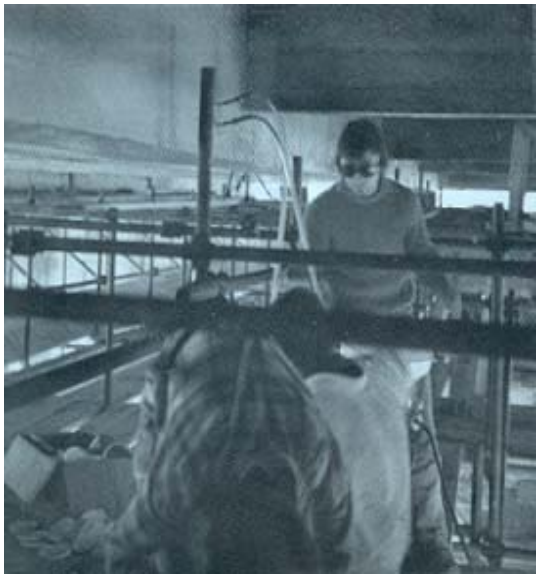
As a result of the damaged concrete, the soluble elements within the concrete binder were dissolving and washing away, leaving voids which collected moisture.
When freezing temperatures developed, the moisture would then crystallize and expand, causing further damage together with reinforcement steel separation from the concrete.

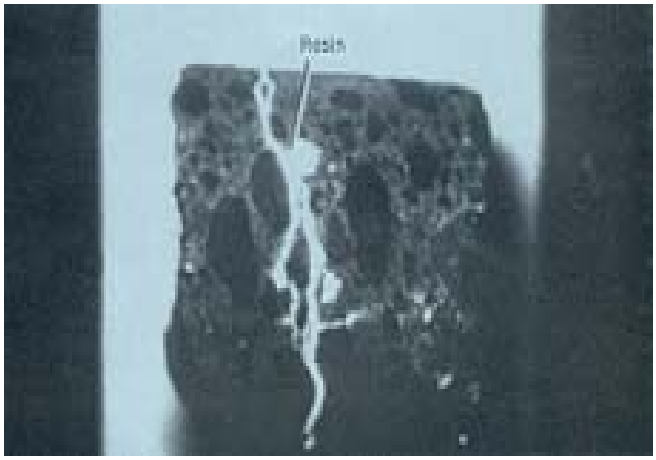
Only Sinmast Resin Systems were capable of working during severe winter conditions, permitting continuous year-round rehabilitation programs.

Photo, on left below, illustrates INJECTION C-1, epoxy injection resin being pumped into a fissures less than 1 mm in width.

Photo on right below, illustrates INJECTION C-1, epoxy injection resin filled all voids on this concrete core, thus adding to the compressive and tensile strengths of the concrete.

INJECTION 1 is a 100% solid, non-shrinking, modified epoxy resin. It maintains approximately 2-3 % elongation, thus being able to move with the normal expansion and contraction of the concrete. Once a void is filled with Injection 1 the welding of the concrete-to-concrete or concrete to steel is achieved and no further deterioration will occur.





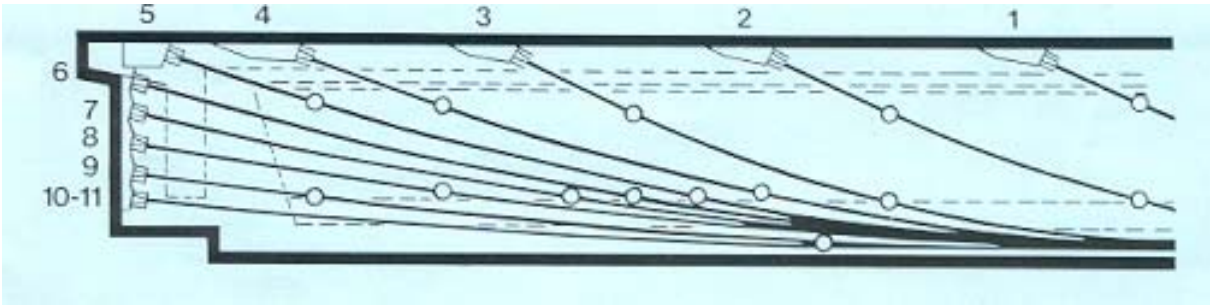
Sinmast Injection Resins save bridges from demolition.

Sinmast and Italian Highway Engineers combined experience to solve a universal problem of shrinking or misapplication of cement grouts in the cable system: cement grout, often does not travel completely through the cable system and or when it settles leaves voids which allows the oxidation process, thereby reducing the life span of the structure.

Sinmast has found damages and voids in many different types of grout systems including poor sealing of the cable tie-off areas. Therefore, Sinmast developed specialized products and systems to correct the varied situations.

The graph below illustrates part of a sectional span on a typical pre-stress cable system. The circle shows location of cable inspection and injection of INJECTION C-1. When a structure is held suspected of problems, it is extremely important to check each cable system approximately every 4 to 7 meters.
Photo below indicates the open cable system is seeping water. After exposing the cable system, air is blown through the conduit to determine where the voids and damaged conduit areas are located. Again experiences has shown many cables will conduct air all the way through. Opening of the cables also provides visual inspection of steel cables.

Injection of the concrete and cables may be coordinated and all completed at the same time using the proper injection resins for each job.



Final inspection of the bridge structure is now complete. To begin, Injection tees are carefully laid over the conduit and sealed with P.A.103 epoxy adhesive paste to prevent the Injection resin from seeping out from the cable system. Holes are tightly filled using a non-shrink, Mortar based on E/2 epoxy binder and quartz sand. When all tees are inserted and the holes filled, Injection can start: INJECTION C-1 is pumped into the cable system from the lowest elevated point. Until all water and air have been displaced from the conduits and pure resin pours out the highest exhaust vent. INJECTION C-1 has a long pot life allowing even

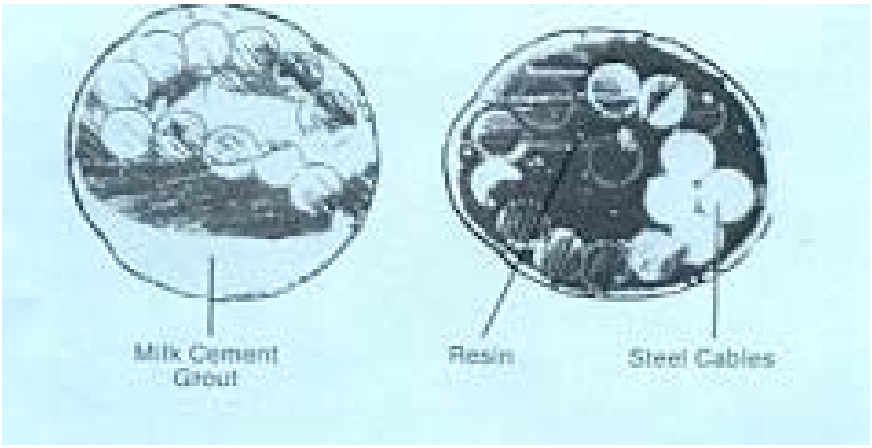
distribution of the resin through the cable system. Injection tees are then sealed and INJECTION C-1 resin is allowed to cure without regard to high humidity or low temperature, while all other work is completed and normal traffic resumed.

Cable is open to inspection and Sinmast tee is placed to inject resin.

Sinmast resin Injection in progress.

Sinmast Resins permit continuous bridge rehabilitation during winter months

The below photos illustrate actual cross-section of a cable system used to determine the effectiveness of INJECTION C-1 Resin. Other resin grout systems tested failed for various reasons. Primary failures resulted from: lack of filling entire cable system and upon release of tension, cable slippage developed. Sinmast was the only grouting system to successfully pass all tests. As a result of these bridge projects, Sinmast has now developed an exclusive grouting system for new prestressing projects.



SINIT, based on many years experience throughout the world, has studied and patented “a low pressure injection system” (patent N.932151).
The injected resin must to exert a certain pressure without exceeding 3 bars against the internal surfaces of the cracks, as a guarantee of a secure adhesion, especially in the presence of humidity. Extreme attention should be paid to the effect of high pressure: a pressure of one bar develops the equivalent thrust of ten tons per square meter.
Special tees are adhered onto the surface of the cracks using Epoxy Paste Adhesive (P.A.103 or P.A.103 S.G.). To avoid drilling the concrete as this obstructs injection voids.
These special tees of about 17 sq.m. of area, cover a wide section of the crack with consequent better distribution of the resin and considerable reduction of the time necessary for injection. They are installed every 30-60 cm while the entire crack is sealed with Epoxy Paste Adhesive in order to stop the resin from leaking with consequent loss of pressure.
Where cracks extend through the entire depth of member and are accessible from below, should be sealed with Epoxy Paste adhesive.
With an “injection pot” the resin is pumped at low pressure into a hose attached to injection tees.
The injection starts from the bottom of the crack proceeding from the lowest tee to the next higher up each time the succeeding tee shows evidence of the resin advancing. Be sure last tee filled is closed before proceeding to the next.
Repeat the process until the entire crack is filled.

After INJECTION Resin has cured and cracks are sealed, the Epoxy Paste Adhesive, used to adhere the injection tees, can be removed with hammer and chisel or with a cutting-off machine.