



NO-DIG SOLUTION FOR THE RELINING OF NON LINEAR VERTICAL PLUVIAL DRAINS

Operational Versatility of No-Dig IN.TEC systems in a description of a case history regarding the relining of pluvial drains with on line changes of diameters and with “T” and “Y” configurations.

The case

The company Grandi Stazioni SpA recently began a multi-year project that involves the renovation of the railway stations of the main cities in Italy.



Central railway station of Milan

The most complicated case has been the relining of the pluvial drains of the Central station of Milan, made of iron and cast iron, 22 meters long, some located inside cement slabs and some within the iron trestleworks supporting the cantilever roof.

The major operational difficulties were caused by the differences of the pipes linear developments (some of them with “T” and some with “Y” configuration), by the diameters changes (from 150 mm in the upper side till 250 mm in the lower side), and by the presence of multiple 90° bends.

The first problem to be solved by the company Grandi Stazioni SpA has been to find a repair system of the pluvial pipes which would represent a valid alternative to their replacement and would guarantee the safety of the travellers in transit under them. In fact their replacement would have caused big obstacles to the trains operations.

On top of that logistic problems, due to narrow spaces available within the working area, needed a very careful organization of the relining operations.



Pluvial drain with “Y” configuration

The solution

After various test demonstrations at the working site and a very careful examination of the references of the jobs with similar features already performed, Grandi Stazioni SpA has decided to choose the No-Dig relining system of IN•TEC Inside Technologies, developed since 1992 and applied with success in many countries within the renovation projects of old civil and industrial buildings.

In favour of this choice has played a fundamental role the fact that the production of the equipments, flexible liners, resins and the application know how were guaranteed by IN•TEC Inside Technologies known as being the developer and producer of the whole system.



Roof

The roof where the pluvials mouthpieces were located was 300 meters long. The access to it was possible only through a rung ladder with back protection and therefore not suitable for the handling of the equipment necessary to perform the relining. No electric power was available.

A scaffold has been installed and equipped with an electric winch which has lifted the equipments and consumables from the rails level to the roof. Furthermore an electric panel, suitable for feeding simultaneously various equipments, has been installed.

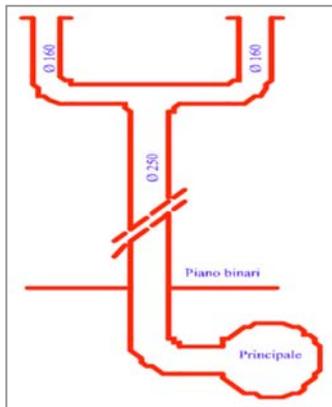
The scaffold assembly has been carried out at night in order to avoid to hinder the regular trains operations.

The handling of the equipments and consumables along the narrow spaces of the roof has been performed on iron gratings supported by two capsized iron “T” bars running along the walls of the roof vaults. It has been therefore necessary to use the two iron “T” bars as rails for a cart with wheels without tyres.

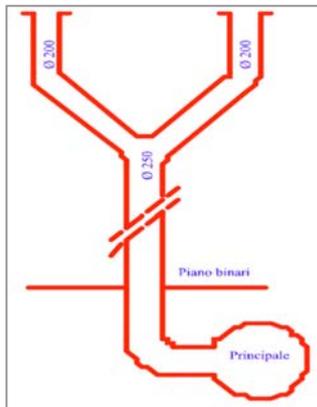
After all logistic problems have been solved, thanks to the technical support of Grandi Stazioni SpA, it has been possible to proceed to study the solutions for the relining of the pluvial pipes.

The videoinspections had shown three different types of pipes:

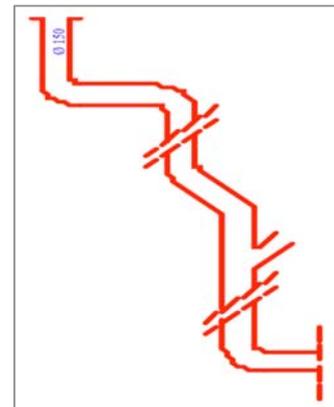
- **Pipes with “T” configuration:** with two cast iron branches (\varnothing 160mm) which, after a 1,4 meter vertical length and a 2,5 meters horizontal length were joining together into the main down pipe (diameter 250mm) at 90° . This down pipe was 11 meters long and reached the level just under the rails and, after a 90° bend, was ending into the drainage system located inside the embankment of the undergrounds of the Central Station
- **Pipes with “Y” configuration:** different from the above ones because the two upper cast iron branches in the past have been replaced with PVC pipes (\varnothing 200) which were joining the main down pipe at 45°
- **Pipes with linear configuration:** with 90° and 45° bends.



“T” configuration pluvial drain



“Y” configuration pluvial drain



Pluvial drain with multiple bends

The main difficulty has been to find a solution for the relining of the pipes with “T” and “Y” configurations because of online changes of diameters, due to past partial repairs, and because of their exit not at sight under the rails level.

IN.TEC technicians, basing themselves on the videoinspections pictures, have worked out a relining plan proper for each one of the above mentioned pipes configurations.

The production of the flexible liners with “T” and “Y” configuration and with online changes of diameters has been possible thanks to IN.TEC engineering and manufacture of specific production equipments.



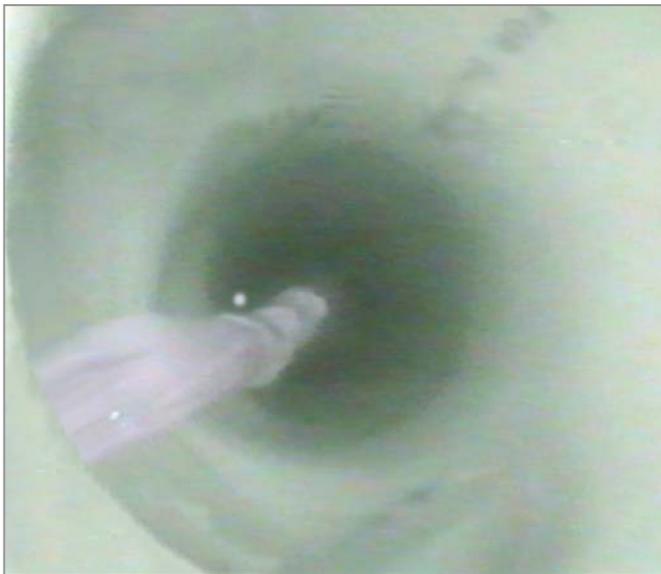
Flexible liner with “T” configuration

Then in IN.TEC laboratory has been developed and tested the most proper methodology for the impregnation of these special liners and their inversion into the pluvial pipes.

To this purpose a particular inversion procedure has been worked out to guarantee a perfect grip of the liner with the pipe at the joints level which was considered the most critical point.. The delicate phase of the inversion and positioning of the liners have been performed under the constant visual control of the camera placed on the other upper arm of the pluvial pipe.



Inversion on the central down pipe of the flexible liner with “T” configuration



Pulling out of the calibration cap after the relining with the “ Open End “ system

Finally due to the fact that these pluvial pipes did not have an inspection exit at sight the relining has been performed using the “Open End” system which consisted of the application at the end of the liner of a calibration cap which, after the curing of the resin, has been pulled out, so allowing the immediate functionality of the pluvial pipe.

Using this “Open End” system the pluvial pipes have been relined until under the rails level, so avoiding any masonry work.

Due to the above described engineering and application difficulties it has been possible to reline one pluvial pipe per day with a team of three technicians. In case of pipes with a linear configuration, even with bends, it is possible to perform a daily relining between two to five pipes, depending from the length and from the logistic difficulties.

During the last four years IN.TEC has relined 130 pluvial drains in the Central Railway Station of Milan and 37 pluvial drains in other Railway Stations of north Italy. The 2007 relining program will be concentrated on the pluvial drains of the main building of the Central railway Station of Milan.

By Edoardo Tisi
IN•TEC Inside Technologies S.r.l.
Via Torricelli, 10 - 20090 Segrate (MI)
Tel. 02 26951865 r.a
Fax 02 26921859
www.intec.biz info@intec.biz