



## Route des Nations, Geneva (CH)

# Sleeve pipe injection with hybrid-material and geotextile packers

<b>Client</b>	Republic and Canton Geneva
<b>Main Contractor</b>	Groupement Marti Nations
<b>Execution of works</b>	Renesco GmbH, Abt. Marti Geotechnik
<b>Construction period</b>	April 2020 – July 2020
<b>Construction period</b>	300,000.00 €

## Object description

The Route des Nations between Geneva Airport and the United Nation Organization district is excavated in loose ground. At a shallow depth the tunnel crosses a built-up urban area and faces quite challenging complex geological and hydrogeological conditions. Permeable gravel layers are separated by relatively dense strata. Therefore there are several water-bearing layers with different groundwater levels in the tunnel axis.

## Grouting works

Water ingress occurred during tunnel excavation. The high permeability in the soil layers in some areas made a pre-treatment necessary. The hybrid injection system developed by Renesco was used. Instead of a stabilizing mix, textile packers were used to seal the annular gap around the sleeve pipes. The injections had to be carried out with the greatest care and precision to avoid any negative impact on the surrounding buildings.

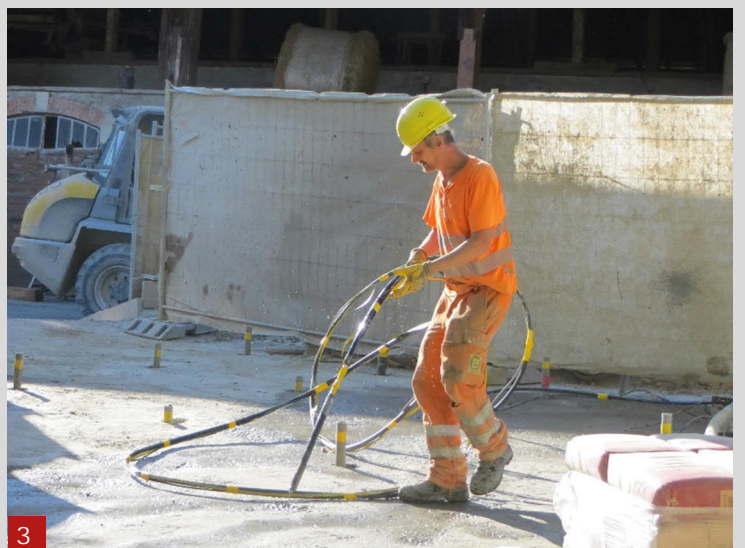
## Scope of work

Installation of sleeve pipes  
Cement CEM I 52,5 R: 85,000 Liter  
Polyurethane: 15,000 Liter

## Hybrid Injection

The newly developed hybrid-injection method sees the cement suspension mixed with polyurethane resin just before being injected into the borehole. As a rule, the proportion of polyurethane resin varies between 0% and 40%, and can be progressively increased or decreased during injection. The resin pump switches on and off automatically. This innovative injection control mechanism allows engineers to adjust the positive properties of cement and polyurethane resin to the exact hydrogeological conditions in the rock.

If an immediate increase in pressure is detected in a borehole when pure cement slurry is injected, no polyurethane resin is added as the cement slurry will be sufficient to seal the smaller fissures. However, if the injection agent drains out without an increase in pressure or if there is any leakage into the tunnel, polyurethane resin is added. The polyurethane-resin-cement slurry hybrid is then able to seal larger fissures with water ingress in the tunnel. Pure cement slurry subsequently penetrates the smaller fissures as part of the same process.



1. View onto the grouting field within built-up area
2. Textile packer before installation and after filling
3. Installation of packer