

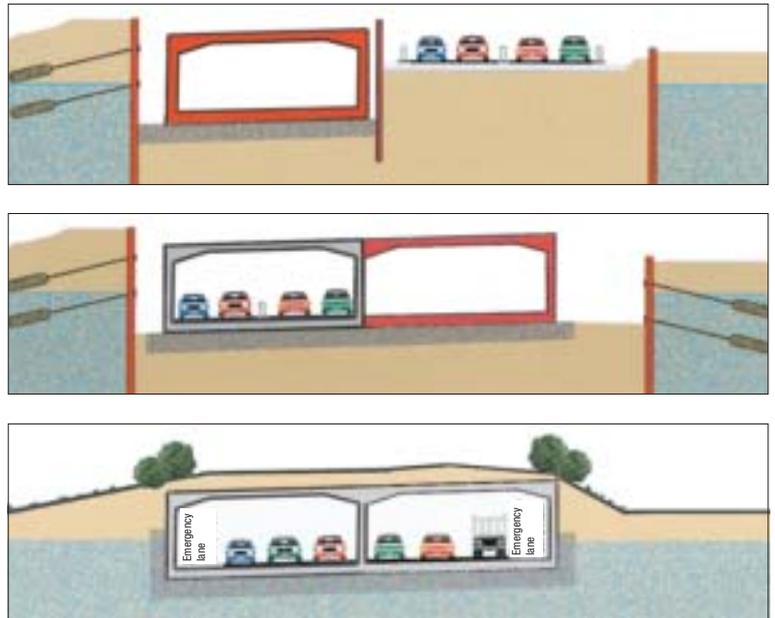
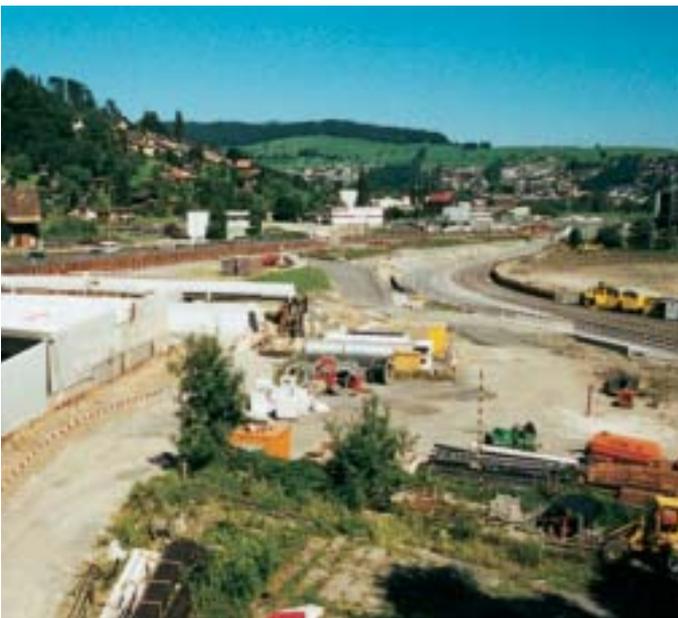
# NORTH-WEST PASSAGE

**Three working phases, distributed over two-year cycles: this is the structure of the projects that have characterized the accomplishment of a tunnel of 960 metres, with relative intersections and interchanges, at the border between Italy and Switzerland. A work that has required the use of considerable quantities of concrete and, as a consequence, of quality admixtures.**

The expansion of the motorway infrastructures closely concerns many European countries, including Switzerland that boasts of the high quality of its motorway network. One of the principal arteries that passes through it is the motorway A2 Lucerna - Chiasso: this, through the tunnel and the rotary of the San Gottardo, connects Lombardy to Lucerna, continuing then towards the heart of Europe. In this section, the works for the construction of the Schlund tunnel have been particularly interesting. Commissioned by the Cantonal Department of the Public Works of Lucerna, it is in reinforced concrete with a total expansion of 960 metres and is realized under the natural level of the ground. The tunnel provides for two carriageways, composed of three lanes for each direction with each lane being from 3.5 to 3.75 metres wide. In the design prerequisites it was desired that the tunnel be constructed completely under the level of the countryside plane with a reduced vertical cross-section and a limited visibility of the covering. The particularly soft soil conditioned the design; thus a box-shaped cross-section with a flat covering was chosen. The works for the construction of the rooms

and of the carriageways, assigned to the firm RGE A2 TWS (with the construction supervision of the Community of the Engineers of Schlund), were divided into three primary phases, distributed over two-year cycles: phase 1 that provided for the construction of the east passage was completed from 1998 to 2000; phase 2, regarding the realization of the west passage, began in 2000 and finished in 2002; phase 3, instead, started after the others, concerned the realization of the three-lane carriageways, plus the emergency lanes. The expansion works have also entailed the creation of an interchange with roundabout intersection: the structure of the Lucerna-Horw junction included a bridge that acts as a support for a roundabout intersection, equipped with seven access ramps. The construction of the interchange was assigned to the firms Arge Wakter-Porr AG and CST Luzern AG. The bridge that supports the road system of the junction has very deep foundations and an elevation above the countryside plane that ranges from two to six metres: the access ramps, in prestressed reinforced concrete, connect directly to the bridge without joints.

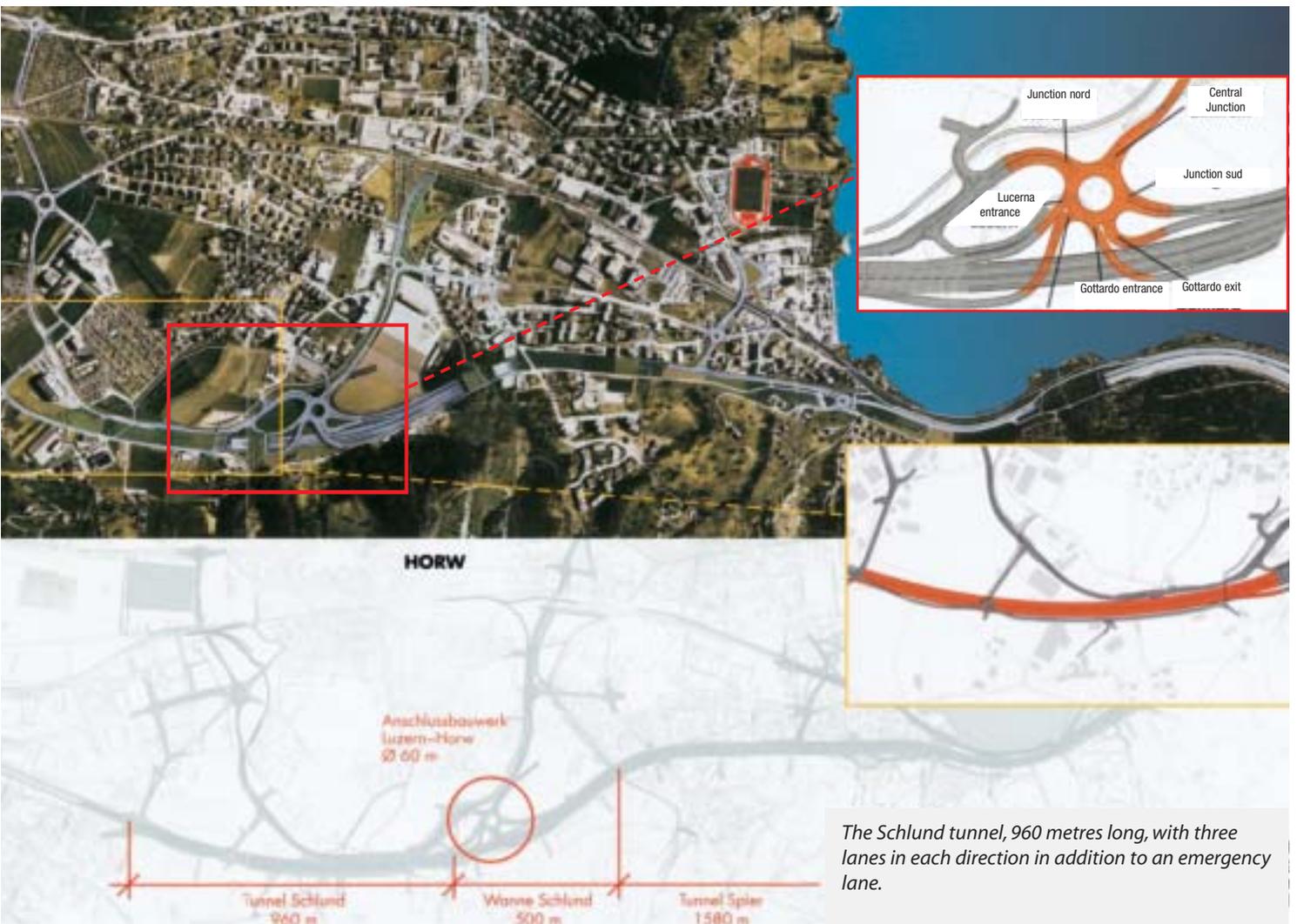




### Concrete: the protagonist

In the realization of works in reinforced concrete of these dimensions the true protagonist is the concrete. There have been, in fact, considerable quantities used both for the tunnel (approximately 80 thousand cubic metres placed on-site), as well as for the bridge of the roundabout intersection (10 thousand cubic metres). In these cases the importance of the “durability” of the work is clear, with “durability” understood as the retention of the structural integrity and of the

quality of the performances over time. In order to realize a functional and resistant structure it is of fundamental importance to use durable concrete, manufactured by the producer on the basis of the requirements of the norms. It is also necessary to render the quality of the mix as independent as possible of the conditions existing in the construction site, the quality of



*The Schlund tunnel, 960 metres long, with three lanes in each direction in addition to an emergency lane.*



the labour and the available pouring and compaction systems. This is possible by using a mix that, once unloaded by the concrete truckmixer, is capable of compensating for possible deficiencies and errors caused during the pouring phase. An effective solution is the use of admixtures for concrete; in fact these influence the rheological properties in a different manner, on the basis of their nature: with the retardant admixtures longer setting times are obtained, and thus as a consequence there is a decrease in the limit of flowing and plastic viscosity; with the superplasticising admixtures the water/cement ratio is reduced by 30-35%, thus improving the waterproofness and the mechanical performances of the hardened concrete.

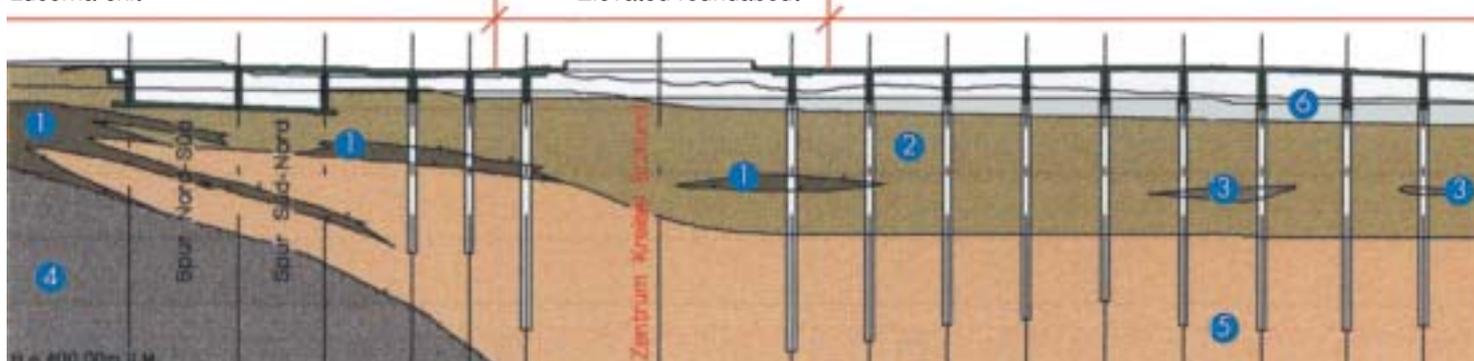
### The performances of the Mapei products

In the case of the Schlund tunnel and the roundabout, the Transportbeton AG of Lucerna supplied the concrete. The Swiss firm mixed the concrete with Mapei admixtures, thanks to

the numerous and important references and to the optimum results obtained worldwide. In the Helvetian construction site four products of the Admixtures line were chosen: MAPEFLUID N100\*, MAPEFLUID R104\*, MAPEPLAST PT1\* and MAPETARD\*. In fact, their characteristics make them suitable for the realization of infrastructures and civil engineering projects in general that have to deal with the aggression of the atmospheric agents and resist freeze-thaw cycles. MAPEFLUID N100\* is a superplasticising liquid for concrete. Particularly suitable for applications that require a moderate hydration speed of the cement at short curing ages, it is indicated for interventions such as that in question, where working with ready mix concrete to be pumped in successive phases. In addition to the superplasticising effect, MAPEFLUID N100\* guarantees a modest retardant action on the hydration of the cement. For this reason, the admixture is destined to the realization of reinforced concrete constructions exposed to aggressive agents, with unconventional compressive strength classes, and that require a reduction in the thermal gradients due to the hydration of the cement. MAPEFLUID R104\* is another retardant superplasticising admixture for concrete: like the previous admixture, it is a liquid product. Characterized by a low loss of workability, this product also presents various advantages: it increases the mechanical strength, reduces the water permeability, increases the workability, saves processing time and thus reduces

Ramp  
Lucerna exit

Elevated roundabout



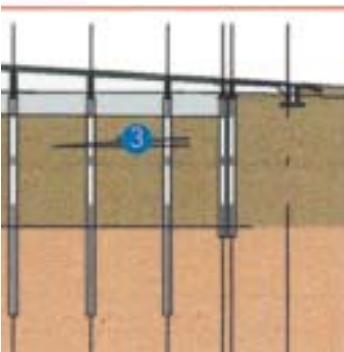


In the photos above:  
The Lucerna-Horw junction, composed of a roundabout intersection supported by a bridge and equipped with seven access ramps, during the construction (left) and when works were almost finished (above).

In the drawing:  
The section of the roundabout shows the geological structure of the ground on which the work was realized:

1. sedimentation of fluvial detritus
2. flooding sedimentation
3. peat moss
4. rock
5. older lake and delta sedimentation
6. artificial embankments.

Central Junction Ramp



costs. MAPEPLAST PT1\* is instead an air-entraining plasticiser: it is a surface-active admixture studied to incorporate microbubbles of air in mortars and concretes exposed to freeze-thaw cycles. As a consequence, it is particularly suitable for realizing constructions such as those in question and for civil engineering structures in general. MAPEPLAST PT1\*, in fact, is always used for the realization of structures that have to resist continuous thermal cycles; the production of concretes containing MAPEPLAST PT1\* is undoubtedly important also considering the recent European technical regulations (EN 206), that prescribe explicitly the englobing of a specific volume of air in the cementitious mixes destined for works exposed to the environmental classes with freezing.

MAPETARD\*, finally, is a plasticiser for concrete

\*The technical data sheets of the products cited in this article are available in the Mapei "Admixtures for concrete" binder. The relative technical data sheets are available on the "Mapei Global Infonet" CD and on the website [www.mapei.com](http://www.mapei.com).

**Mapecfluid N100:** superplasticiser for concrete with modest retardant effect.

**Mapecfluid R104:** superplasticising retardant for concrete.

**Mapecplast PT1:** air-entrainer for concretes and mortars.

**Mapetard:** retardant for concrete with plasticising effect.



with retardant effect: a liquid admixture, it gives a low loss of workability. With areas of application similar to those of the admixtures cited, MAPETARD\* is also recommended when there is required a greater workability of the mixture and a moderate hydration speed of the cement. In the Helvetian construction site, therefore, the use of Mapei products guaranteed an easy execution of the pours (thanks to a greater workability of the mixture) and an improvement of the mechanical performances of the hardened concrete mix.



## TECHNICAL DATA

**Schlund tunnel and roundabout intersection, A2**  
Lucerna-Chiasso Motorway (Switzerland)

**Project:** expansion works with the construction of a tunnel and a roundabout intersection in the 6 Kriens-Horw section

**Year of construction:** start of works 1998, end of works 2002

**Customer:** Cantonal Department of the Public Works of Lucerna

**Construction supervision:** Community of the Engineers of Schlund

**Construction company:**

- for the tunnel: RGE A2 TWS

- for the roundabout: Arge Wakter-Porr AG and CST Luzern AG, Lucerna

**Concrete supplier:** Transportbeton AG, Lucerna

**Mapei Materials:** MAPEFLUID N100, MAPEFLUID R104, MAPEPLAST PT1, MAPETARD

**Mapei Retailer:** MoBau Partner AG, Weinfelden

**Mapei coordinator:** Fredy Liniger