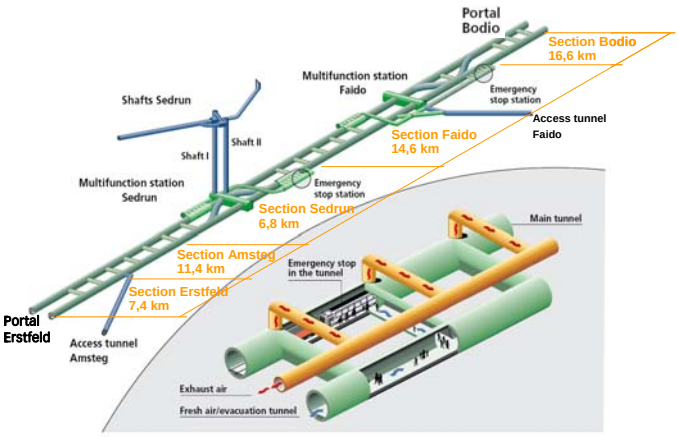
World Record in Tunnelling in the Swiss Alps

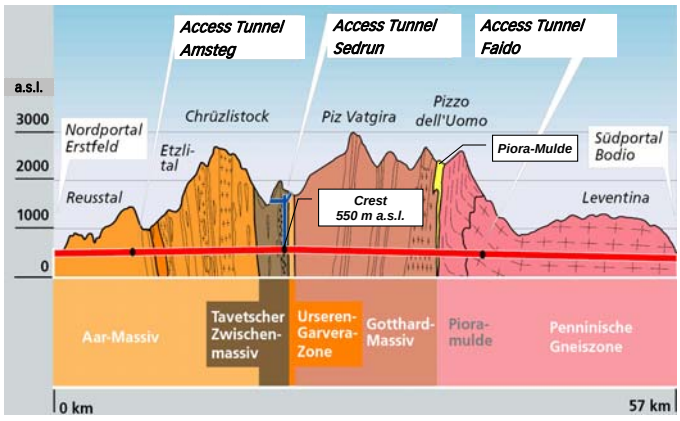
By Kurt Eichenberger

On 15th October 2010, after more then 10 years of construction works, the first final breakthrough in the eastern tube of the 57 km long Gotthard Base Tunnel became true. Together with the 15.4 km long Ceneri Base Tunnel, which is also under construction, they form the lowest-lying of all existing and planned alpine crossings. With an execution period of nearly 20 years (2000-2019) and estimated final costs of CHF 12.2 Billion, the two tunnels represent also the largest environmental project of this century. Nationale Suisse as one of two lead insurers of the construction site policy for both tunnels is proud to be part of this monumental and historic project.

The Swiss people have clearly decided in favour of protecting the alpine environment to transfer the freight traffic from the roads to the railways and at the same time to integrate Switzerland into the European high-speed railway network.
These goals will be achieved with the construction of a continuous flat rail link through the central Alps massif at Gotthard and Ceneri, enabling freight trains with up to 4,000 tonnes of load-hauling capacity to travel through Switzerland and passenger trains with top speeds of 250 km/h to travel through the tunnels.
Two separate tubes are planned, each 9.4 metres in diameter and 57 km in length. They are located around 40 metres apart and connected with cross cuts at 300 metre intervals. In total, 153 km of adits, shafts and main tunnel sections will be built. To reduce the construction time, two access tunnels, one in Amsteg and one in Faido as well as a vertical shaft in Sedrun - later an other one was added - were built, in order to increase the number of working fronts. Tunnelling works was then carried out from these three sites and both portals in Erstfeld and Bodio.
Multi-functional stations are found at the Sedrun and Faido sites. They contain tunnel change points, technical rooms for electro-technical equipment for railway operation and emergency stopping points. The latter serve as exits for train passengers in emergency situations



Source ATG: Scheme of the Gotthard Base Tunnel

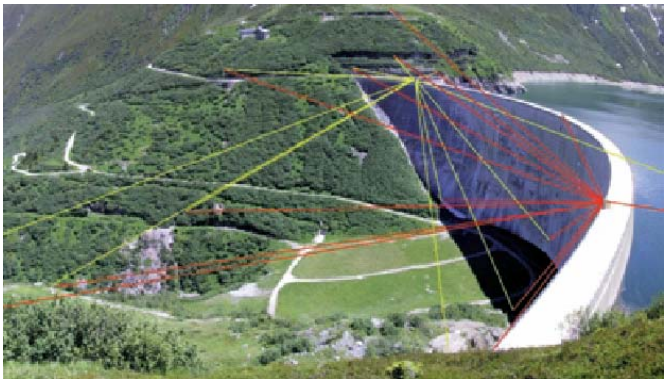


Source ATG: The geological longitudinal section of the Gotthard Base Tunnel

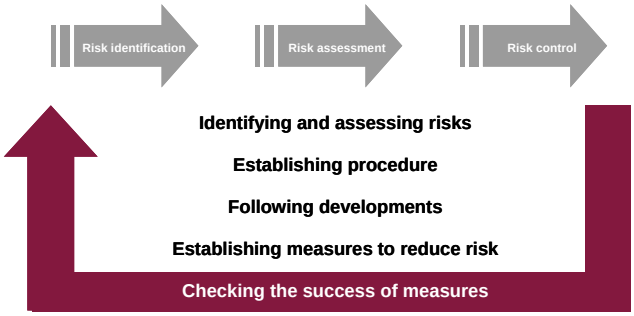
85% of the Gotthard Base Tunnel goes through stone that tunnel builders consider favourable. The tunnel mainly goes through crystalline stone interspersed with a few narrow sediment zones. Around 80-90 fault zones are anticipated with regard to the construction of the base tunnel. To minimize risks during tunnel construction, comprehensive tests have been carried out since 1989.
Sedrun is the most spectacular of the 5 sub-sections. Owing to its complex geology, it had to be cut through using explosive techniques. Daily progress here can range from a few centimetres to several metres. All other sections were cut through using tunnel boring machines.
There is significant covering-over at the Gotthard massif where over 2300 m of rock mass are pressing down on the tunnel tubes. Rock temperatures of up to 50°C are anticipated. They are reduced to a maximum of 28°C for the workers.
The so-called Piora-Mulde consisting of sedimentary deposits is found to the south of the Gotthard massif. The initial assessment of this almost brought the project to a halt. As a result of intensive tectonic movement during the orogeny, this sediment between the Gotthard massif and the Penninischen Gneiszone was sandwiched together and has a saccaroidal formation. However this zone was successfully driven into without any problems as the geological pre-assessments predicted.

With tunnel building, subsidence on the surface level must be taken into account owing to possible water removal. There are three water dams within the vicinity of the Gotthard Base Tunnel. To ensure early recognition of the impact of the construction of the Gotthard Base Tunnel on the surface level, and to ensure

the appropriate measures are taken in good time, the principle and policyholder, AlpTransit Gotthard AG, a 100% subsidiary of the Swiss Federal Railways (SBB) together with the Federal Office for Water and Geology, has been carrying out investigations since 1992. The latest in the range of precautionary measures are automatic surface area measurements for dams. This monitoring system is a world first and a genuine innovation in measurement technology. The system provides automatic all-year-around monitoring of a valley cross-section at each dam. In the areas that need to be monitored, there is snowfall of up to 3 metres and they are inaccessible for 5 months of the year. Some must endure avalanches.



Source ATG: Automatically calculated angles and distances at the water dams

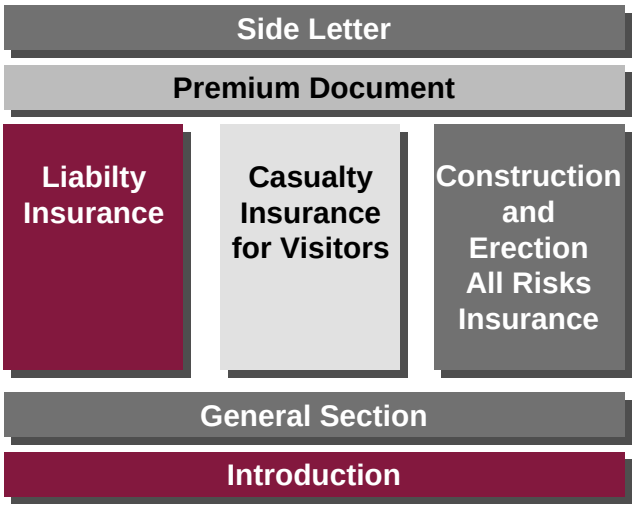


Source Nationale Suisse: Risk Management

Risk engineers from the lead insurers conduct regular site surveys, attending the construction site in the average twelve times a year. During these surveys they observe the individual construction sites with respect to potential perils affecting the system, i.e. the tunnel construction, and risks inherent in the system. Standardised reports are compiled following these site surveys.
The policyholder's highly professional project management has so far resulted in an acceptable level of claims compensation and has, in the event of a claim, always led to solutions drawing consensus.

As one can imagine, the specifications of standard project insurance policies were well exceeded in terms of the determination of the scope of cover, personnel and organizational resources and capacity in the event of a claim and damage prevention. The structure of it in its final version is shown here. The contract was drafted as a single document i.e. there is no general terms and conditions of insurance attached to the policy. It consists of three main parts:

- Principal and contractor liability insurance
- Casualty insurance for visitors and
- Construction and erection insurance.



Source Nationale Suisse: Set-up of the construction site policy

These sections were supplemented by the

- Introduction, where the definitions applicable to the contract are set out;
- The general section, which sets out provisions that are of importance to all lines of insurance that make up the contract;
- The premium document, which is self-explanatory;
- The Side Letter describing in closer detail the meaning of individual provisions that are difficult to understand using examples in order to set out the contractual objectives.

With regard to liability insurance, the policy provides insurance for the legal liability of the insured persons. The principal essentially has cover from ground up. The companies, which are divided into two groups, i.e. smaller companies such as engineering studios and planners and large construction companies or consortia that are responsible for an entire section, worth several hundred million francs, must have basic cover of differing amounts. If the basic policy expires in the course of an insurance year, the construction site policy applies and provides insurance protection in the form of DIC/DIL.
The vast CAR/EAR cover has been based on Swiss terms and conditions. Vital equipment or equipment highly exposed to damage, such as self-propelled or floating equipment, cranes, motor vehicles, aircraft and vessels and adits and tunnel construction machinery are exempt from the construction site policy. For a project with a duration that lasts almost half a working life, the question of the recognized rules of technology is closely associated with. These may change. The set-up of the insurance contract must therefor provide space to handle new findings and model considerations not only but especially in case of an accident. This again requires an appropriately farsighted concept of the insurance contract.
For more information regarding the project and or its cover please revert to the author.