

## Gähler und Partner AG

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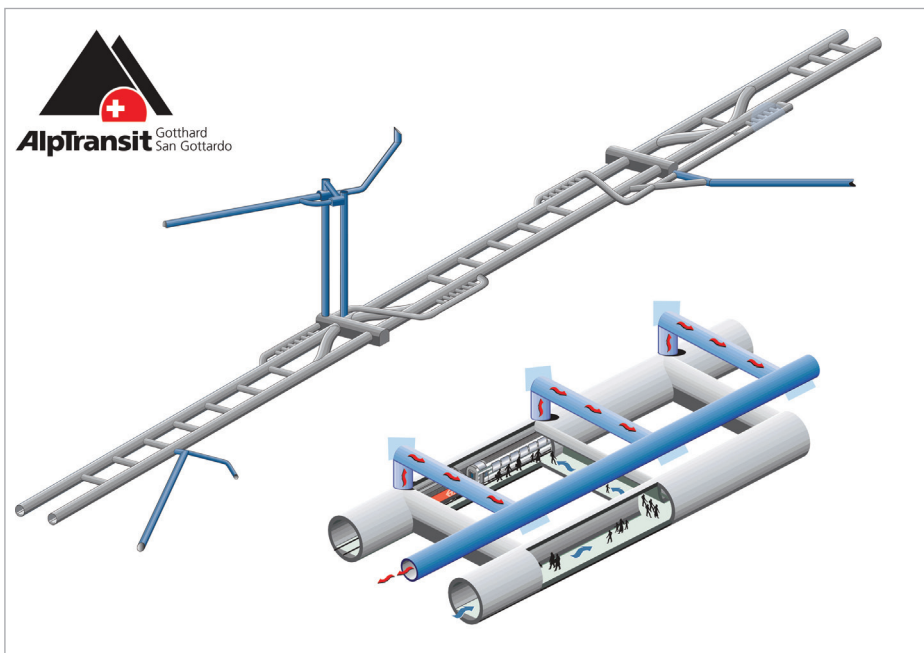
Gähler und Partner AG is a general planning consultancy, located in the canton Aargau (near Zurich). It operates in three disciplines: civil and geotechnical engineering, integrated building design and property development.

One area of expertise is large-scale infrastructure projects such as freeways, rail links and tunnels. The firm in present form was established in 1988 as a management buy-out, but its roots can be traced back until 1895.

Gähler und Partner employs 85 architects, structural and civil engineers, MEP engineers,

technicians, draftsmen, project managers and project developers.

Gähler and Partner specializes the intense collaboration of interdisciplinary generalists and specialists. This approach assures that complex structures and buildings can be designed, built and managed as efficiently as possible. In addition the collaboration guarantees integrated and sustainable design solutions.



Software: Allplan Engineering

## Gotthard Base Tunnel - The Alps, Switzerland

The Gotthard Base Tunnel is regarded as a pioneering achievement of the 21st century. After more than 20 years of construction, its 57 km route length will make it the longest railway tunnel in the world and the fastest way to cross the Alps on land. The aim of the project is to link Switzerland to the high-speed rail networks of the rest of Europe and to shift the growing flow of traffic from road to rail to the greatest extent possible. For passengers, the travel time between Zurich and Milan will be cut from more than 4 hours to less than 3 hours, while transport capacity for freight trains will increase from 1.700 t to more 4.000 t. With costs expected to reach 12 billion Swiss Francs (9 billion Euros) this is one of the greatest infrastructures projects.

### Organization and Geotechnical Challenges

To make this mighty project a reality within the shortest time possible, it was divided into five sections. From north to south, these are Erstfeld (7.4 km), Amsteg (11.4 km), Sedrun (8.8 km), Faido (14.6 km), and Bodio (16.6 km). The three middle sections will be tunneled via intermediate incisions. Up to 2.400 m of overlying rock resulted in geotechnical challenges, with extreme pressure in disturbance zones and temperatures of up to 50 °C. At some points the high pressure led to massive steel profiles being deformed within a matter of a few days, necessitating the need to re-profile and secure tunneling systems repeatedly.

### Engineering Consortium North

In 1994 the Gotthard Base Tunnel North engineering consortium, under the management of Gähler and Partner AG (associated partners: Gruner AG, Rothpletz Lienhard + Cie AG, CES Stalder + Wey AG), won the order for the design and the local construction management of the northern sections of the tunnel, Erstfeld and Amsteg. Within the engineering consortium, Gähler and Partner designed the two main tunnels at Erstfeld and Amsteg, as well as all the exterior projects at Amsteg. These included, among others, highway diversions and new link roads, installation areas, spaces for accommodation, cafeterias and offices, the adaptation and enlargement of the existing industrial railroad site station.

### Benefits of using CAD

Gähler and Partner use Allplan Engineering in all their civil and structural engineering projects, as well as for building design and building systems. The construction at Amsteg had originally been planned with another CAD system, with the switch to Allplan taking place towards the end of the construction work at Amsteg and the start of executional design at Erstfeld. The new software passed its christening with no difficulty at all. All the drawings from the first construction section were adopted without a hitch and could be integrated smoothly into the second section. Despite standardization, approximately 120 different block plans and more than 1.000 plans in total have been produced. This is a huge amount of data, but Allplan has dealt with it effortlessly.

To optimize the use of concrete and therefore the costs, the engineers have developed a system of size-adjustable formwork elements. A digital surface survey, which shows the precise location of the securing structure for the tunneling work, is read into Allplan and stored with the standard sections. Then, taking account the minimum component dimensions and the geometrical constraints, the ideal formwork configuration is worked out individually for each section of 10 m.

For standard situations, plan views, sections, and other details are created using the 2D mode in Allplan, while reinforcement is always designed in 3D mode. At complex points the engineers prefer to do a full 3D design and work with visualizations. This means that geometric tests can be carried out to determine whether there is sufficient space available, whether the vaulting thicknesses and clearance values are correct, and whether it is possible to run cable ducts in the desired locations. In particular with regard to cable ducts that change direction, design challenges are constantly arising. To make things more difficult, the maximum bending radii also need to be taken into account depending on the type of cable involved.

An example of a difficult location has been at Amsteg, where the access galleries and a cable duct for the rail power supply encounter the two tunnel tubes. The resulting spatial intersections between the different structures have been designed using a 3D model.

## Project information

Owner AlpTransit Gotthard AG  
 General Contractor AGN ARGE Gotthard-Basistunnel Nord  
 Engineering Office Gähler und Partner AG (Ingenieurgemeinschaft Gotthard-Basistunnel Nord)  
 Construction Period From April 1996 to December 2016  
 Location Erstfeld - Bodio, Switzerland



## Short project description

The "Gotthard Base Tunnel" is a railway tunnel beneath the Alps in Switzerland. With a route length of 57 kilometres, it is the world's longest tunnel. By 2016, after more than 20 years of construction, costs are expected to reach 12 billion Swiss Francs (9 billion Euro). It bypasses the old winding mountain route across the Saint-Gotthard Massif and establishes a direct route suitable for high speed and heavy freight trains. Together with other tunnels, it will become the fastest way to cross the Alps on land. High speed trains will be travelling at up to 250 km/h through the tunnel and cut the 4 h travel time from Zurich to Milan by an hour.

