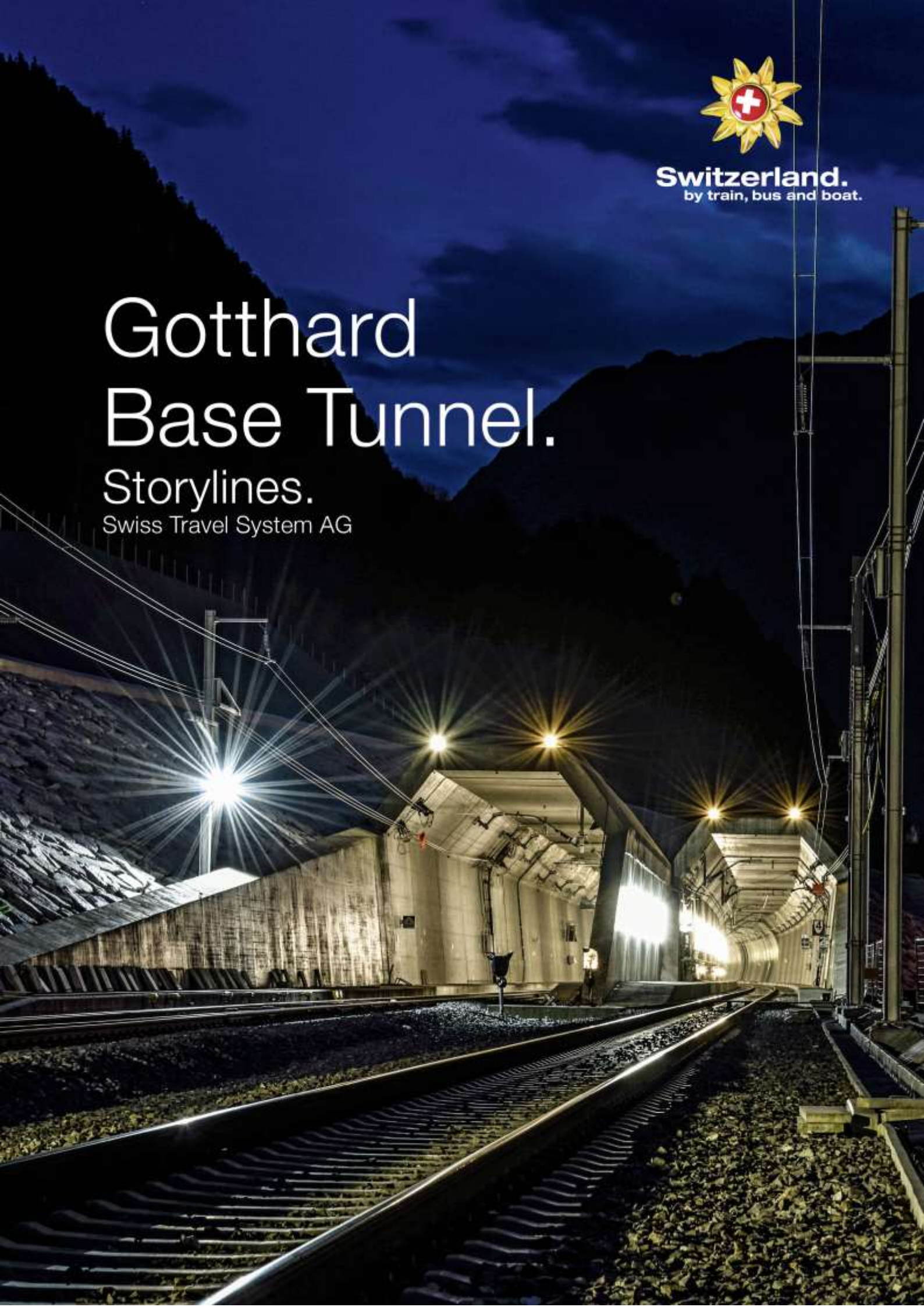

Gotthard Base Tunnel.

Storylines.

Swiss Travel System AG

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Swiss Travel System AG
Limmatstrasse 23
Postfach 1975
CH-8021 Zürich
media@swisstravelsystem.com
SwissTravelSystem.com/gotthard

Coverpage:

A spectacular journey through the Swiss Alps – in the world's longest train tunnel

It has taken 17 years to build this structural masterpiece that smashes all records: the new Gotthard Base Tunnel through the Swiss Alps is the longest train tunnel in the world and an example of Swiss precision, innovation and reliability. The 57 kilometre tunnel runs through the mountain at a depth of up to 2,300 metres. In just 20 minutes, it links Erstfeld, north of the Alps, with the southern portal in Bodio. The reduced travel time brings the surrounding towns, regions and neighbouring countries a step closer. In addition, the Ceneri Base Tunnel in the Ticino, scheduled for completion in 2020, will create a flat route through the Alps. The route will reduce the journey time between the economic centres of Zurich and Milan to under three hours and will affect national and international traffic, and in particular European corridor traffic. Switzerland will thus write another significant chapter in the Gotthard route's long history: from the pack-mule route over the Gotthard in the 13th century to the Gotthard stagecoach and finally the Gotthard railway, which ushered in a new era of travel on the north-south axis. Europe's new north-south transport hub is also leading the way from an ecological standpoint: as part of the New Railway Link through the Alps (NRLA), it aims to shift transalpine heavy freight traffic from road to rail. But the ground-breaking new route does not mean an end to the old – the historic mountain routes over and through the Gotthard will remain in operation. From the end of 2016, travellers and rail enthusiasts will be able to choose between the pioneering work of the 19th century or that of the 21st century to travel through the mythical mountain massif. A Gotthard round trip will thus link the high-tech flat route with classic Alpine train travel, connecting the past with the future.

History I:

The Gotthard Route – world-class historical heritage

No other traffic route in the world has shaped a country to the extent with which the Gotthard route has shaped Switzerland, says historian Kilian T. Elsasser. The expert on the history of transport is dedicated to the preservation of the Gotthard region's historical heritage.

Kilian T. Elsasser knows the historical transformation of the Gotthard transport landscape like the back of his hand. The historian and head of the museum consultancy Museumsfabrik (Museum Factory) emphasises that Switzerland's very existence is inseparably linked with the Gotthard Massif. The opening of the continuous pack mule trail in the 13th century transformed the pass crossing of regional significance into the political and economic backbone of the cantons bordering on Lake Lucerne.

The opening of the railway line in the 19th century established the Gotthard as the most important north-south link through the Alps and Switzerland as a neutral transit country in Europe. For a long time, the Gotthard Railway was one of Switzerland's largest tourist attractions. Every third international visitor came specifically to see and experience the marvel of engineering that was the Gotthard Railway and the majestic Alpine landscape – the "cradle of Switzerland", as evocatively described by the Nobel Literature Prize laureate Carl Spitteler in his 1897 travel guide «Der Gotthard» ("The Gotthard"). "The Gotthard line was so profitable that it subsidised the Swiss Federal Railways until the motorway opened in 1980," Elsasser explains. "Besides the numerous technical world records and density of archaeological transport stratification, the Gotthard's political impact makes it a unique pass crossing. There is no comparable transport landscape in the world which has shaped a country in the same way."

Elsasser stresses the immense historical relevance of the Gotthard transit routes for Switzerland. He is committed to preserving the old Gotthard route beyond the commissioning of the Gotthard Base Tunnel and is an advocate for its inclusion as a UNESCO World Heritage Site.

Kilian T. Elsasser studied Public History in Boston, USA. He was curator of rail transport at the Swiss Museum of Transport in Lucerne for 13 years and launched the Museumsfabrik museum consultancy in 2004. An author and editor of a number of publications on Swiss transport history, Elsasser published the book «Der direkte Weg in den Süden: Die Geschichte der Gotthardbahn» ("The direct route to the South: the history of the Gotthard Railway") and «Wanderweg Gottardo: Zu Fuss entlang der Gotthardbahn» ("The Gotthard trail: walking along the Gotthard Railway") in 2007. «Die drei Weltrekorde am Gotthard» ("The three world records on the Gotthard"), co-authored with Alexander Grass, and the village tour of Göschenen «Quatro, tre, due, uno – whaaam!» will be published in May 2016.

Museumsfabrik: Based in Lucerne, the Museumsfabrik (Museum Factory) provides comprehensive consultancy services to museums, designs and holds own exhibitions and educational programmes and manages the BLS Foundation. The Museumsfabrik also researches and writes about the history of the railway and transit routes on the Gotthard – from the early pack mule trail to the modern motorway. The company covers a broad range of projects from scientific publications and documentaries to popularly written articles.

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History II:

The Gotthard – at the cutting edge of history

The history of the traffic routes crossing over and through the Gotthard Massif is inextricably linked with Switzerland's history and legends. The literary scientist Boris Previsic has examined both in depth.

The Gotthard Massif is charged with national symbolism like almost no other landscape in Switzerland. It not only links the country's disparate geographical and climatic regions but also the four distinct languages and cultures.

The construction of the first continuous pack mule trail in the 13th century brought the Gotthard Pass Europe-wide significance as a central trade and traffic route across the Alps. And it was no coincidence that the founding cantons of the Swiss Confederation forged their first alliances with one another during the same period. Or so the official national historical narrative goes until the 1980s. The opening of the Gotthard train tunnel in 1882 – the world's longest tunnel at the time – thrust the Gotthard as a rail link through the Alps into the international spotlight. In the course of a Europe-wide trend towards national unity and its relating symbolism, Switzerland was defining its origins largely in line with Schiller's *Tell.* In the same vein, August 1st was declared Swiss National Day in 1891.

Switzerland is once again about to open a tunnel through the Gotthard. It is once again the longest train tunnel in the world and once again, Switzerland's connecting role at the heart of Europe is being highlighted – more than reason enough to take stock and look forward. Prof Dr Boris Previsic organized a lecture series about the Gotthard in autumn 2015 at the University of Lucerne – the city where the 1871-founded Gotthard Railway Company was based. Previsic the literary scientist has examined in detail the writings surrounding the Gotthard and illustrates in a fascinating manner how the Gotthard region has forged Swiss national identity and history while at the same time demonstrating an enormous degree of internationality: merchants and pilgrims, migrant workers and writers from all over the globe were and still are lured by the transit route on the Gotthard. For centuries, this much-travelled massif reaching up to the roof of Europe has been at one with itself at the cutting edge of history.

Boris Previsic has held a SNF professorship for literary and cultural studies at the University of Lucerne since 2015. The literary scientist and trained concert flautist supports art projects from Eastern Europe to the Alps. Besides his lecture series «Gotthardfantasien» ("Gotthard Fantasies") at the University of Lucerne, Previsic has also edited the same-named volume on the Gotthard, which will be brought out in June 2016 by the Swiss publisher HIER UND JETZT to commemorate the official inaugural opening of the Gotthard Base Tunnel.

Gotthard Railway Company: The Gotthardbahn-Gesellschaft (GB) was founded in Lucerne in 1871 with the purpose of building and operating the Gotthard Railway. The new company was presided over by the Swiss politician, business leader and railway entrepreneur Alfred Escher.

Existing Gotthard Train Tunnel: Opened in 1882, 15 kilometres long and at the time the world's longest railway tunnel. The tunnel was largely excavated by Italian workers from the Piedmont and Lombardy regions under precarious conditions, and two very young neighbouring countries of Switzerland – Italy and the German Reich – carried the main financial burden.

Copyright Alp Transit Gotthard AG, Breakthrough Faido 2006

History III:

From crossing the Gotthard in 20 hours to speeding through in 20 minutes

Crossing the Gotthard along the old pass road evokes the past. The journey back through the longest train tunnel in the world allows a glimpse into the future. In its entirety, this round trip through space and time transforms the historic quantum leap on the Gotthard into a remarkable experience.

The opening of the Gotthard Base Tunnel marks the latest milestone in the traffic route's eventful history. Since the 13th century, the Gotthard route has established itself step by step as a key north-south transit link through the Alps. A trip over the Gotthard Pass in the traces of bygone travellers throws the difference between then and now into sharp relief. The northward-bound journey back through the Gotthard Massif – a 20-minute train ride through the longest railway tunnel in the world – is in contrast a journey back to the future. Twenty hours seem like a reasonable time for a journey over this legendary mountain and through its fascinating and archaic landscape. But for the pack mule trains of the Middle Ages, the trail represented the most gruelling of challenges. Later on, the stagecoach ride along winding mountain roads was regarded as a trial to be endured by the merchants, scientists, ambassadors and world travellers undertaking the journey. Today this time-honoured, horse-drawn mode of travel is once again plying the pass road between Airolo and Andermatt, offering an entertaining experience that is both sustainable and unique. Entertaining experiences can also be had with Andermatt local Bänz Simmen, who conducts guided tours of his village and snowshoe treks through the surrounding countryside. The outgoing and urbane Simmen is an absolute authority on the region and its history and eschews worn clichés in favour of the facts. He remarks that then and now, the opening of the pack mule trail and the modern flat rail link have one thing in common: "Change accompanying the opening of new transport routes has always aroused fears in Andermatt. Ultimately however, it has always yielded opportunities," he says. Bänz Simmen sees the pending change as an opportunity to focus on a return to nature.

Despite spending several years in Zurich and travelling extensively abroad, Bänz Simmen has always been drawn back to his native village of Andermatt. In the 1980s, he was the founder of Switzerland's first snowboarding association. Today Simmen not only runs snowshoe treks and guided village tours – his small internet café is a popular meeting place for guests of all ages. He also lent a hand at the Gotthard Base Tunnel construction sites at Sedrun, Faido and Amsteg. A trained laboratory technician, Simmen has a special interest in minerals and is also keen on the GPS treasure hunt geocaching. www.kiosk61.ch

Travel times through the ages: The journey along the medieval pack mule trail from Basel in the north of Switzerland to the southern border at Chiasso took 6 days. The opening of the transit route for wheeled traffic in the 16th century reduced the journey time to 3.5 days. In 1882, the opening of the Gotthard railway line slashed the travel time between north and south to 10.5 hours, thus significantly increasing the route's importance. 134 years on, Switzerland is once again opening the longest train tunnel in the world. It will cut the journey between Basel and Chiasso to 4 hours.

Gotthard Stagecoach: The Gotthard Stagecoach started operating on the pass route in 1842. A nostalgic trip from Andermatt to Airolo in a replica of the original Gotthard stagecoach can still be enjoyed today. http://www.gotthardpost.ch/index.php/de/reise

Copyright: Andermatt Tourismus, Devil's' bridge

History fact sheet (1/2): History of the Gotthard transit route: 1200 – 2016

Pre-12th century: The Gotthard Pass was well known during the Roman era; however, the Schöllenen Gorge made it extremely difficult to cross.

From 1220: Construction of the 60-metre long wood Twärrren Bridge, running the length of the Schöllenen Gorge. Construction of a wooden bridge over the Reuss, which, according to legend, was built by the Devil and thus became known as the Devil's Bridge.

1595: Construction of a stone bridge over Schöllenen Gorge, the second Devil's Bridge.

16th century: Construction of the *Strada Urana* across the Piottino Gorge at Faido, a gorge as forbidding as the Schöllenen.

1708: Opening of the 65-metre long Urnerloch, the first road tunnel in the Alps, to replace the Twärrren Bridge, which had been washed away in 1707.

1831: Opening of a new road, more than five metres wide and suitable for vehicles. Renovation of the bridge over the Schöllenen Gorge.

1825: The first railway in England inspires a vision of a railway line running from northern to southern Europe.

1871: Foundation of the Gotthard Railway Company under the chairmanship of Alfred Escher.

1872: Construction of the Gotthard tunnel begins. The project is led by Louis Favre and at its peak employs as many as 5,000 workers.

1882: Three-day opening of the 15 km train tunnel, at that time the longest in the world, with special trains running between Lucerne and Milan.

1947: Vision of a two-deck, combined road and rail base tunnel through the Gotthard from engineer and traffic planner Carl Eduard Gruner.

1960s/70s: Evaluation of various options for a base tunnel.

1963: Swiss parliament decides to build a road tunnel through the Gotthard.

1974: Decision made to build a dual-track base rail tunnel, but due to an economic recession and political disagreement the project is put on ice.

1980: Opening of the world's longest road tunnel through the Gotthard.

1991: Parliament votes to construct two base tunnels at the Gotthard and Lötschberg.

1992: Clear support for the NRLA project (New Railway Link through the Alps) in a referendum, with almost 64% in favour.

1993: First exploratory drilling in the Gotthard from Faido into the Piora Basin.

1994: Public approval for the Alpine initiative to protect the Alps, which aims to limit road freight traffic.

1998: Adoption of the FinöV proposal, which confirms, inter alia, public approval for the financing and construction of the NRLA project.

1999: Start of drilling and blasting work by AlpTransit Gotthard AG.

15 October 2010: First breakthrough in one of the tunnel bores and start of installation of the railway infrastructure on the north side of the Alps.

11 December 2016: Start of operations on the 57 km rail tunnel, the longest in the world.

History fact sheet (2/2) Significance of the Gotthard railway for Switzerland

The first bridge over the Schöllenen Gorge on the Gotthard transit axis in 1220 at a height of 2,106 metres allowed the pass to be crossed for the first time. For central Switzerland, the pass was significant both politically and economically. The construction in 1595 of the stone bridge further eased passage over the Schöllenen Gorge. By 1830, the Brenner Pass, at an elevation of 1,370 metres, had 20 times more traffic than the Gotthard. But the limited appeal of the Gotthard transit route barely affected the Confederation: the route compelled the authorities along the way to collaborate, while the modest transit operations drew little attention from the major powers.

In 1825, the inauguration of the world's first railway line in England prompted speculation about a rail link between northern and southern Europe. Experts in Alpine road construction had long viewed the Gotthard terrain as impassable, although strategically it was the ideal link between north and south. In 1863, after lengthy disputes about the route, the Gotthard Railway Company was established in Lucerne, and the involvement of Alfred Escher, an influential politician and businessman from Zurich, marked a turning point.

The Gotthard Treaty of 1869 defined the route of the Gotthard rail line and shortly after the Gotthard Railway Company was incorporated, with Escher as its chairman. The route between German-speaking Switzerland and Ticino also coincided with the political interests of the German Reich and Italy and was therefore co-financed by the three parties. Under the direction of Louis Favre, work on the Gotthard tunnel began as early as 1872. As many as 5,000 workers, most from Italy, worked at the northern and southern portals. The conditions were extremely tough; at least 199 workers lost their lives and Louis Favre himself died in the tunnel in 1879.

The first breakthrough occurred in 1880, with a lateral deviation of just 33 cm and a deviation in height of 5 cm. Just two years later, on 1 June 1882, the first scheduled trains ran the length of the Gotthard route between Lucerne and Chiasso. The *Augsburger Allgemeine* commented: "The dividing wall that separated the nations has come down... the countries have moved closer to one another." The connection through neutral Switzerland bound the country to the European community while strengthening its neutrality.

The opening of the Gotthard tunnel thus not only marked inauguration of the world's longest railway tunnel, but also a feat of engineering on a global scale. The Gotthard railway was hugely popular for many years until the First World War. Numerous tourists came to Switzerland to see the Gotthard railway; further south became their target destination only later.

The Gotthard railway also helped the mythical Gotthard region to take on a new dimension. People reflected on Switzerland's history and revived the legends of William Tell and the Devil's Bridge. After the line was built, Switzerland no longer considered itself an Alpine country, but increasingly perceived itself in political and historical literature as a Gotthard state.

Today, the Gotthard is an example of a genuine interaction between natural and cultural landscapes. From north to south, the Gotthard transport landscape reflects a cluster of transport systems that for the most part have remained unchanged. Bridges, tunnels, routes, roads, railway buildings, hotels, residential houses and fortifications from across the centuries enrich the landscape.

The opening of the Gotthard Base Tunnel at the end of 2016 will add a new element to the transport landscape, once again drawing the regions and neighbouring countries closer to each other.

Source: Alp Transit: Eine Utopie wird Realität (Bundesamt für Verkehr)
Verkehrslandschaft Gotthard (Kilian T. Elsasser)

Construction I:

Girl power in the tunnel

Gender stereotypes are outdated in the 21st century. But how about in the world of tunnel construction? James Brown's famous lyric "It's A Man's Man's Man's World" still largely applies to hard graft underground. Take a closer look however, and you will discover that the female element plays an important role in the Gotthard Base Tunnel.

Blasting, heat, force, rock – tunnel building is work for tough guys. This notwithstanding, the main muscle power for the construction of the Gotthard Base Tunnel was provided by Sissi, Heidi, Gabi I and Gabi II – the four tunnel boring machines, or TBMs, supplied by the German company Herrenknecht. More information about the inner workings and attributes of these gigantic, 450-metre-long gripper-type TBM powerhouses is available from the manufacturer in Schwanau.

As the co-author of the final construction report, civil engineer Christine Ebenhög brings genuine girl power to the construction of the Gotthard Base Tunnel. She has accompanied the work over many years and has an almost unparalleled knowledge of the ins and outs of this giant tube system, a network of 152 kilometres of tunnels, shafts and passages penetrating the mountain. Her husband is currently working on another breakthrough in the Swiss Alps – the Albula Tunnel II between Preda and Bergün in canton Graubünden. As one of just a few women in a man's world, Christine Ebenhög brings light to the world of tunnelling not only with her professional expertise but also a human touch.

The female element is keeping the Gotthard Base Tunnel in good working order after commissioning too – Trudi, Clara and Marie-Therese are the names of the three impressive turbines at the power plant in Amsteg. Together, they supply up to 120 megawatts of electricity to the Gotthard Base Tunnel, thus making a substantial contribution to freight and passenger transport through the Alps.

Herrenknecht is the world market leader in mechanised tunnelling technology. Active around the globe, this international group is headquartered in Schwanau in Baden-Württemberg, Germany.

Civil engineer Christine Ebenhög comes from Germany. Today, the mother of four lives with her family in Personico at the south portal of the Gotthard Base Tunnel.

The Amsteg hydroelectric power plant is located in the municipality of Silenen in canton Uri. In view of the increased demand on energy for the Gotthard Base Tunnel, the old power station dating from 1922 was replaced in the 1990s by a new plant built into a rock cavern.

Gotthard Base Tunnel: 57 kilometres long (east tube: 57,091 metres; west tube: 56,978 metres). The longest train tunnel in the world runs through the mountain at a depth of up to 2300 metres below ground. After 17 years of construction, this masterpiece of railway engineering will officially enter into service at the end of 2016. www.swisstravelsystem.com/gotthard

Albula Tunnel II: The Albula Tunnel lies on the Chur – Thusis – St. Moritz line and has been part of the UNESCO World Heritage Site "Rhaetian Railway in the Albula/Bernina Landscapes" since 2008. Construction on the existing, 5.8-kilometre-long Albula Tunnel was completed in 1903. The tunnel is located at around 1800 metres above sea level and is the highest-altitude main line Alpine tunnel. A new tunnel is currently being built. Running parallel to the existing structure, it is expected to enter into operation in 2022.

Swiss tunnel network: Switzerland's public transport network is 27,385 kilometres long, of which the railway network comprises 5232 km (as of 2012). Switzerland is a railway country – not only do the Swiss travel an average distance of 1751 km by train annually, they are also known as keen tunnel and bridge builders: Switzerland's railway network includes 310 tunnels and 6088 bridges. www.swisstravelsystem.com/en/media-texts/facts-figures-on-public-transport-in-switzerland.html

Copyright Alp Transit Gotthard AG, Sedrun eastern tunnel

Construction II:

The Gotthard rocks have their own tales to tell

For the new 57 kilometre Gotthard Base Tunnel through the Swiss Alps, miners have had to bore through no fewer than 13 layers of deep-lying rock – definitely a man's job. But civil engineer Christine Ebenhög also knows her way around when it comes to rock strata. For the past 11 years she too has been working on the world's longest train tunnel. And she understands the tales that the tunnel rocks have to tell.

Christine Ebenhög is passionate about her profession. So much so that she and her family left their Hamburg home in northern Germany to move some 1000 kilometres to Ticino in Italian-speaking southern Switzerland. The parents of four children have both been working on the 57-kilometre tunnel, which enters into operation at the end of 2016 as the longest train tunnel in the world. As assistant to the head construction manager, she is well acquainted with the tunnel and can relate to the story which each stone tells. From hard granite to crumbly dolomites, the geological layers change from gleaming anthracite to white and matt. It's as if one is walking through different rooms, each with its own special character. Each type and every metre of rock represented a new and different challenge for the tunnel miners. Christine Ebenhög is one of very few women who have ventured into the depths of the tunnel. Underground work is hard, the conditions are tough – and superstition has it that women in tunnels bring bad luck. But Christine's experiences on this project have proved positive; she and the few other women have been welcomed by the international team and treated with the respect and courtesy they deserve. So much so that all the 176 cross-passages as well as both single-track tunnel tubes have even been dedicated to a "patroness" among the women's workforce. And to Christine fell the honour of pressing a red button to blast one of the cross-passages and to carry a celebratory party cake into the tunnel. For all workers on the Gotthard Base Tunnel over the past 17 years the unifying element has been the completion to pioneering perfection of the longest train tunnel in the world. Different teams from various constellations of countries have concentrated all their commitment to this goal. All the tunnel walls are now concrete-lined, mainly from the excavated rock. The various geological layers are no longer visible and one can only hazard a guess at what lies behind these massive walls. But what is certain – soon the first scheduled trains will be speeding their way through the gigantic Gotthard massif.

Christine Ebenhög of Germany's Lombardi Group has been working at the southern portal of the Gotthard Base Tunnel for the past 11 years. The mother of four has been responsible for compiling and coordinating contracts, protocols and reports, and knows this ambitious pioneering project in detail. She cooperated on the almost 300-page final report.

Lombardi is one of the engineering companies which has been working on the Gotthard Base Tunnel. AlpTransit Gotthard Ltd. is the constructor of the Gotthard axis of the New Rail Link through the Alps. Specialist consulting engineers have been responsible for the planning and on-site construction management.

Cross-passages: The Gotthard Base Tunnel consists of two 57-kilometre single-track tubes, which are inter-connected by 176 cross-passages – one every 325 metres. They serve as technical rooms for the rail engineering technology and, in the event of an emergency, as escape ways from one tunnel tube to the other

Copyright AlpTransit Gotthard Ltd, North Portal Erstfeld Gotthard Base Tunnel

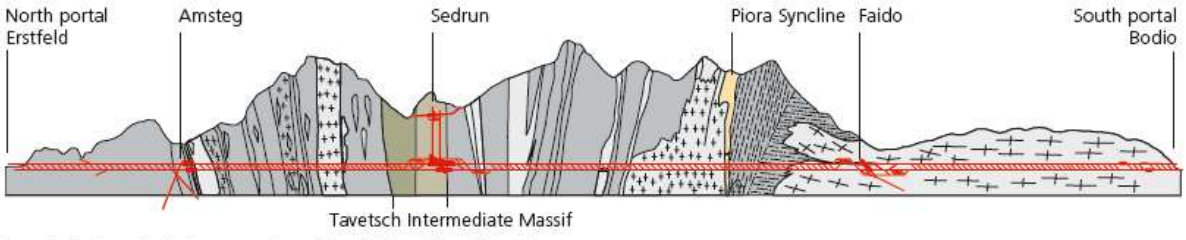
Geology fact sheet

The Gotthard Massif is part of the Swiss Alps and the source of four major alpine rivers: the Rhine, Reuss, Rhone and Ticino, which flow in all four directions. The formation of the Alps began through the continental drift and collision of the African and Eurasian tectonic plates. The geological formation of the Alps was a multistage process that progressed from tectonic plate shifts to sedimentation to sustained elevations and formations.

The exact geological conditions inside a mountain range are difficult to predict. Tunnelling comprises the latest exploration techniques and test bores supported by forecasts from experienced geologists in order to keep risks to a minimum. The 57 km Gotthard Base Tunnel traverses three main mountain ranges (the Aare Massif, Gotthard Massif and Pennine gneiss zone) and two intermediate areas with diverse rock strata, ranging from hard granite to partly crushed sediment. The two intermediate areas constituted a major challenge. Geologists suspected a 'floating rock mass' in the Piora Basin, a water-saturated, sugar-like dolomite that is under high pressure with risk of leakage. However, preliminary boreholes showed dry conditions at tunnel level. As a result, the miners encountered no problems when boring through the Piora Basin in autumn 2008. The Tavetsch intermediate massif was the second critical formation. Geologists expected to find rock layers created through strong pressure in this area, which led to plans for an additional intermediate heading. People, materials and machines were able to reach the tunnel construction site and the multifunction station in the mountain via a 1 km horizontal access tunnel and two 800 metre shafts. Blasting work was carried out at the bottom of the shaft in both tunnel bores at the north and south ends. As the high mountain overlay and strong pressure threatened to deform the tunnel bores, a special reinforcement structure was necessary. The engineers developed a novel, innovative concept with flexible steel arches that pushed together under pressure of the rock and thus prevented deformation of the finished structure.

To speed up the excavation work, further intermediate headings were planned from Amsteg and Faido. Overall, the Gotthard Base Tunnel was excavated from five construction sites simultaneously.

Excavation work on the longest tunnel in the world was completed in March 2011. The tunnel's interior construction was completed in September 2012, and the rail infrastructure was installed by the end of September 2015. Test operations have been running from October 2015 and will continue to the end of May 2016. The Gotthard Base Tunnel will open officially on 1 June 2016, with commercial operations expected to begin on 11 December 2016.



Longitudinal geological cross section of the Gotthard Base Tunnel

Source: AlpTransit Gotthard: new transport routes through the heart of Switzerland

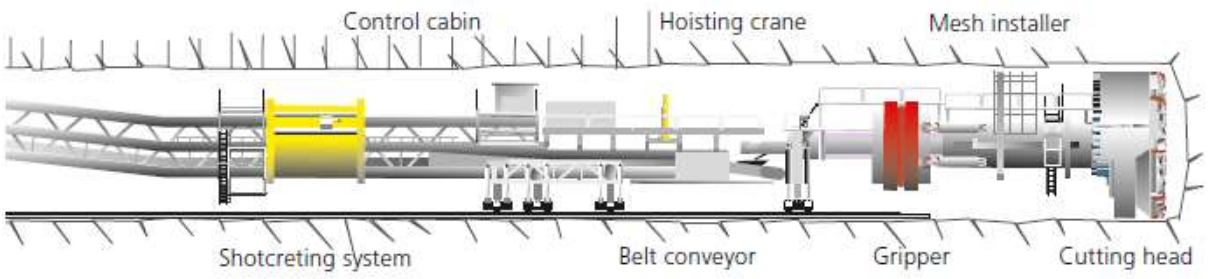
Engineering fact sheet

The new high-speed link through the Alps calls for a high degree of precision in the construction. Reliable and highly accurate surveying techniques enable the route to be defined down to the millimetre.

Tunnel surveying: To survey the tunnel, satellite measurement technology was used across the entire project area to create a network of fixed points. Due to the huge dimensions of the long, underground tunnels, organisation of the tunnel survey constituted a major logistical challenge. The final breakthrough of the Gotthard Base Tunnel took place on 15 October 2010, approximately 30 km from the south portal and 27 km from the north portal. The breakthrough was extremely accurate with a horizontal deviation of just 8 cm and a vertical deviation of 1 cm, making it one of the most precise breakthroughs in the history of tunnel construction.

Excavation methods: Four tunnel boring machines excavated almost 75% of the Gotthard Basel Tunnel, with blasting used for the remaining 25%. The choice of tunnelling method depended not only on the expected rock conditions, but also on development opportunities, environmental conditions and economic realities. The length of the route and the planned overall construction period also played a role.

Tunnel boring machine: A tunnel boring machine with a drilling head diameter of up to 9.5 m and driving equipment is approximately 450 m in length. A single tunnel boring machine costs about CHF 30 million. These machines are particularly suitable for longer routes, as the procurement and provision of installation takes longer than for conventional tunnelling with drilling, blasting and clearing.



Tunnel boring machine (TBM) drive

Interior construction: After excavating the rock, the tunnel bore was reinforced to prevent rock falls and protect workers. Reinforcing elements of varying degrees of strength were used depending on the geological conditions. Anchors, shotcrete and steel arches can be combined modularly. This is followed by application of a sealing foil, which protects the tunnel bores from water ingress. For the Gotthard Base Tunnel, appropriate systems were developed to meet the specific requirements and conditions. The interior lining of the tunnel, which serves as the supporting structure, must last for 100 years without significant maintenance work. Therefore, the high quality and service life of the construction materials were of paramount importance.

Shell work equipment: Mechanical and electromechanical equipment was installed in the Base Tunnel before installation of the rail infrastructure. Two examples: An operational ventilation system ensures an optimum working environment for maintenance work, and supplies fresh air and smoke extraction in the event of fire. A drainage system takes mountain water and contaminated water caused by accidents out of the tunnel through separate pipes.

Source and more information available at: https://www.alptransit.ch/de/medien/publikationen/

Sustainability I:

The Gotthard Base Tunnel – a gigantic environmental project

The Swiss population is calling for the environmental protection of the Alps; Europe is calling for an efficient transport link through the Alps. The Gotthard Base Tunnel provides a sustainable solution. And with a key focus on environmentally friendly construction on this 152 kilometre-long tunnel network, Mother Nature is a major beneficiary.

By adopting the Alpine Initiative proposal in 1994, the Swiss electorate took a stand against the swelling tide of traffic on the country's transit routes. In the search for a solution, the federal government drew up the New Railway Link through the Alps (NRLA), a project aimed at moving heavy goods traffic from road to rail. The Gotthard Base Tunnel is the centrepiece of the puzzle. And Switzerland is preaching by example – the longest train tunnel in the world is one of the largest environmental protection projects ever to be undertaken in Europe.

The construction company was tasked with completing the work in an as environmentally compatible manner as possible. The man responsible for this is Alex Regli, head of Environment and Planning at Alp Transit Gotthard Ltd. He speaks with enthusiasm about the numerous measures implemented to benefit people, flora and fauna, water and air quality. And it fills him with particular satisfaction that in some places, an improvement on the original state could be achieved – for instance at the north portal, where a stream has been rerouted and re-naturalised, or in the area of the southern access, where a chestnut forest has been strengthened. Newly erected dry stone walls offer reptiles and other small animals a new habitat. This enabled the compensation for the inevitable environmental impact of building a tunnel. The re-naturalisation processes are already well advanced. At the north and south portals, it is difficult to detect the traces of almost two decades of drilling, blasting and concreting.

Alex Regli has been involved in the construction of the flat rail link through the Alps since 1992, at the time as an engineer at Swiss Federal Railways. Since 1999, he has been working for Alp Transit Gotthard Ltd., the company in charge of building the Gotthard Base Tunnel, where he heads the Environment and Planning department.

Environmental measures: Streams were rerouted and temporary storage sites for excavated rock irrigated in order to protect the population and environment from dust. Purposely planted bitter vetch and other natural protection systems provided small reptiles and other animals with a transitional habitat. Springs, groundwater, surface water, wastewater and air were constantly monitored and sludge carefully disposed of. Environmental construction specialists supported the site managers throughout all stages of construction.

Environmental organizations: Alp Transit Gotthard Ltd. involved environmental organizations in the project from the onset. The construction company and a representative of the association of environmental organizations have been in regular dialogue throughout. This dialogue is ongoing.

Copyright Alp Transit Gotthard AG, Gotthard Base Tunnel aerial picture North

Sustainability II:

Gotthard rock for bathing belles

The rock lay deep inside the mountain for millions of years. Today, it serves as a place where sun-worshippers go to relax. Both bathers and the flora and fauna in Sedrun and on Lake Uri are benefitting from the material excavated from the Gotthard Base Tunnel. Take a look at two flagship projects combining leisure and sustainability.

Some of the around 28 million tonnes of rock excavated from the Gotthard Base Tunnel is now benefiting the flora and fauna on Lake Uri, where it has been used to regenerate the delta of the River Reuss on the southern shore. The result is an ecologically valuable shallow water zone with several islets – a newly created Eldorado for bathers and relaxation seekers.

The Neptune nature reserve islets and Lorelei bathing islands form a barrier protecting the shoreline of Lake Uri from the waves – which can be particularly strong in high föhn winds. Some 200 plant and 70 bird species have settled into the embanked areas and the adjacent nature reserves where Mother Nature is enjoying a new place in the sun. Today, bathers bask on the Lorelei islands, on the very rock that lay deep inside the Gotthard Massif for millions of years. “It’s like the Caribbean!” was the enthusiastic press reaction at the inauguration of the bathing islands. The project was realised at no additional cost and is a prime example of the kind of sustainable commitment that benefits the environment, economy and society in equal measure.

Sedrun in canton Graubünden is the recipient of a new swimming lake – Lag Claus Surrein – courtesy of the construction of the Gotthard Base Tunnel. The construction site at Sedrun yielded greater quantities of spoil than anticipated. On the initiative of the local municipality, this was used to create an artificial lake. An idyllic natural paradise set against a backdrop of the surrounding mountains now attracts bathers and sun-seekers to relax and linger. In summer the waters are pleasantly warm, making the lake an asset to the region that delights locals and visitors of all ages.

The Kommission für das Reussdelta (Reuss Delta Commission) is committed to the protection and promotion of the Reuss Delta. Its members assist the government of canton Uri in an advisory capacity and keep the population informed on the project. http://www.reussdelta.ch/Kommission.41.0.html

Disentis Sedrun Tourism is responsible for promoting Lag Claus Surrein and has all the latest information on this nature-oriented lake project.

Copyright Alp Transit Gotthard AG, Sedrun Lac Claus Surrein

Sustainability fact sheet

Reasons for construction of the Gotthard Base Tunnel: The Gotthard Base Tunnel is the centrepiece of the AlpTransit project (also known as the New Rail Link through the Alps, or NRLA) approved by the Swiss electorate in 1992. The purpose of the NRLA is to improve the public transport network and to shift transalpine freight traffic from road to rail. The low-level link through the Alps enhances the attractiveness of transalpine freight traffic and transport capacity. It will also have a significant impact on passenger transport, as it brings time savings and supports the broader objectives of Swiss transport policy.

Shift of freight traffic from road to rail: The majority of freight traffic through the Swiss Alps is transported by rail. With a rail share of 63.4% (according to a 2012 report), Switzerland is by some distance ahead of any other country; just under 60% passes through the Gotthard. The flat, low-level route through the tunnel will be beneficial to freight traffic in a number of ways. It allows the transit of longer, heavier trains with fewer locomotives and shorter travel time. It also increases transport capacity, with up to 260 freight trains scheduled to pass through the Gotthard Base Tunnel every day. The historic Gotthard railway line, by contrast, permits a maximum of only 180.

A trend analysis published by the Federal Office of Transport also outlines the potential impact of the new rail link on the region and estimates that the commissioning of the Gotthard Base Tunnel and Ceneri Base Tunnel will dramatically reduce noise pollution in this area and have a positive effect on airborne pollutant levels in the Gotthard region. Source: http://www.bav.admin.ch/aktuell/00479/index.html?lang=de&msg-id=58902

Environmental measures during construction: The low-level Gotthard rail link will help to protect the ecosystem of the Alps. The construction process itself was designed to be as environmentally friendly as possible. Extensive measures were implemented during the planning phase and the construction of the tunnel in particular in order to minimise the impact on people, animals, the air and water.

- Air pollution was kept low by transporting materials primarily via conveyor belts, rail and ship.
- Residents were protected from dust and noise by temporary topsoil embankments and noise barriers, and restricted operating hours on the construction sites. To prevent the release of dust into the air, non-asphalted construction areas were irrigated and streets and vehicles were cleaned on a regular basis.
- Mountain and tunnel water was processed and cooled according to statutory provisions before being reintroduced into rivers. Streams affected by the construction of the tunnel and access routes were diverted and partially upgraded beyond the existing perimeter (e.g. Walenbrunnen stream, Erstfeld/Schattdorf).
- As construction work also affects the habitats of flora and fauna, compensatory measures were implemented. Cleared trees were replaced with habitat, streams rehabilitated and riverbank areas renaturalised. Temporary use areas were restored to their original condition.
- More than 90% of excavated material was recycled to produce concrete mixes for the tunnel lining, as landfill for a shallow water zone in the Uri lake basin (nature reserve and swimming area), to create a lake in Sedrun and to backfill material extraction areas below Faido and in Buzza di Biasca.

Cooperation with environmental authorities and organisations: Alp Transit Gotthard AG remained in constant dialogue with environmental authorities and Swiss environmental organisations throughout the construction process. The fact that the various environmental associations were represented by a single point of contact enabled joint solutions to be found. All companies on the construction sites were supervised by environmental construction officials in order to ensure that measures were carried out in an environmentally sound way.

Source: Alp Transit Gotthard AG, https://www.alptransit.ch/de/shop/publikationen/

Personal Encounters I:

Where train drivers' dreams come true

Record-breaking depth, length and speed – the sheer scale of the Gotthard Base Tunnel is fascinating. Nonetheless, the mountain line with its viaducts, loop tunnels, galleries and breathtaking vistas remains a firm favourite with railway enthusiasts and photographers. Train driver Markus Leutwyler has been capturing the Gotthard on camera since he was a child. He presents the charms of a route that has exercised a lifelong hold over his imagination.

Train drivers jokingly refer to it as the "Holy Mountain". Not because the Gotthard sits – steeped in legend – at the heart of Switzerland, but because not every train driver has the privilege of manning the controls here. Previously, this route was the preserve of the longest-serving engine drivers, and they had to take a special exam to be fit for the Gotthard. Braking techniques need to be mastered on a stretch that overcomes more than 600 metres in altitude – especially when driving heavy freight trains. Although train driver Markus Leutwyler is not one of the select few who get to travel the Gotthard in the driver's seat, he knows the route inside out. Since he was a small boy, he has had a passion for filming and photographing the trains as they weave their way along the mountainside. The topography of the Gotthard stretched the 19th century railway pioneers to their very limits. Bridges, galleries, loop tunnels and of course the tunnel through the massif – Markus Leutwyler is irresistibly drawn to these feats of railway engineering. The line nestles perfectly into the landscape in an almost playful manner: seen from above, the Gotthard trains perform an enchanting spectacle; running this way and that, switching direction and vanishing into tunnels only to re-emerge in the most unexpected of places. It is no surprise then that this route is a popular template for many model railways. Equally fascinating as the technical aspects on the journey linking north and south of the Alps is the changing appearance of the vegetation and places along the route. On the northern ramp of the Gotthard, the River Reuss has eroded incredibly deep into the valley. On the southern ramp, viaducts span the valley floor at dizzying heights. It is this intriguing interplay of contrasts that makes the Gotthard so appealing and unique.

Markus Leutwyler discovered a love of photography and filmmaking as a child. He launched and has been running his own company for 20 years. It was his passion for railways and a fascination with the interplay between nature and technology that prompted him to become a train driver.

Markus Leutwyler's highlights along the Gotthard route:

- the Chästelenbach Bridge on the northern ramp of the Gotthard
- the world-famous loop tunnels circling the church at Wassen
- the Gotthard Tunnel, running beneath gigantic masses of rock
- the Biaschina on the southern ramp with its railway lines and road viaducts at different levels

What will change when the Gotthard Base Tunnel enters into service? "The Gotthard Base Tunnel is a pragmatic solution made possible by technological progress," says Markus Leutwyler. "I will miss the variety of trains currently operating on the mountain route. Today you can still see different types of freight trains, bank engines, passenger compositions and foreign trains. In future, most of them will disappear into the Gotthard Base Tunnel as they travel between north and south."

Copyright Alp Transit Gotthard AG, first test drive Gotthard Base Tunnel

Personal Encounters II:

“All change” in Wassen

Since the Gotthard Railway started operating, traffic between the north and south of the Alps has revolved around Wassen. The opening of the new Gotthard Base Tunnel will bring more tranquil times to the village famed for its double railway line loop. The locals are far from fazed by the coming change.

The route followed by the Gotthard Railway has elevated the church at Wassen to national landmark status. This is where the train travels a double loop, thus passing the church three times to the delight of generations of Swiss children on their first school trip to canton Ticino. The village of Wassen (population 450) is well known far beyond the country’s borders. Countless railway enthusiasts, photographers and tourists are attracted by this spectacle, particularly when vintage train compositions are operating. For Wassen native Markus Gamma Kalbermatten, this transit traffic is simply a part of daily life. It has been a long time since freight and express trains stopped at Wassen station, and soon they will be vanishing completely into the depths of the mountain. Today he can still see trains circling the village from his living room window. But what do the thoughts of traffic-encircled Wassen’s residents revolve around in these eventful times? In his more than 80 years, Markus Gamma Kalbermatten has witnessed many comings and goings in the traffic landscape. He has also been documenting the developments and traffic-related innovations photographically for many years. The pending commissioning of the Gotthard Base Tunnel doesn’t worry him. It isn’t a big issue in the village either, he says. He doesn’t think that the flat rail link through the Alps will have a major impact on Wassen, except that it will become a little quieter in the village. Going by recent investments in the transport infrastructure, he is confident that the Gotthard mountain route will remain operational. There isn’t the slightest hint of excitement in the village on the Gotthard’s northern ramp. For Wassen and its famous baroque church, life after the opening of the Gotthard Base Tunnel will carry on as normal.

Markus Gamma Kalbermatten was born in Wassen. He trained as a mechanical engineer in Baden. After some years in Zurich, he returned to Wassen, where he worked at the local hydroelectric power station until retirement. In his leisure time, he photographs the area and observes the changes in and around the village.

Wassen: The small village was already known as a 13th century stage stop on the pack mule trail over the Gotthard Pass. In the 17th century, Wassen was a customs post where canton Uri levied duties for traded goods. Pretty stone and timber houses and a magnificent village fountain evoke a bygone era. Italian surnames among the residents bear witness to the fact that many miners from Italy who came to build the existing Gotthard Train Tunnel in the 19th century settled in the area.

Wassen Church: The Catholic church at the centre of the valley atop the village hill dates from 1734. Its fame comes from the spiral train tunnels on the Gotthard railway line which reveal views of the church from three perspectives.

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Basic Media Information

Even more spectacular through the Swiss Alps – along the world's longest and deepest train tunnel

The Gotthard Base Tunnel opens at the end of 2016

When it comes to train travel, Switzerland can claim more than its fair share of pioneering achievements through the ages. Now the country has achieved another spectacular success, not only for Switzerland but also for Europe and the wider world – completion of the longest and deepest rail tunnel on the planet. Under construction for 17 years, the Gotthard Base Tunnel extends for 57 kilometres at a maximum depth inside the mountain of 2300 metres. This technical masterpiece links the Swiss cantons of Zurich (bordering Germany) and Ticino (bordering Italy). Trains will be able to speed through the tunnel in only 20 minutes at up to maximum 250 kilometres per hour, cutting travel time not only within Switzerland but also between northern and southern Europe.

Train travel on the Gotthard route is nothing new. The original line – still in operation today and popular for its panoramic views – dates back to 1882, when rail travel was still in its relative infancy and Switzerland was experiencing the advent of tourism. That route climbs from an altitude of 470 to 1100 metres, across no fewer than 205 bridges and through a special system of tunnels as it masters the Gotthard massif. An eternal attraction for countless tourists is the beautiful Baroque church of Wassen in the narrow Uri Valley, which can be seen spectacularly from different angles as the train travels between tight loop tunnels.

Construction of the century

It was hailed as a historic decision when, in 1992, the Swiss people voted in a national referendum to back ambitious government plans and financing for a new Alpine transit route. Focal point was to be the country's "construction of the century", the Gotthard Base Tunnel through the Swiss Alps, with its 2600 workforce from more than ten nations. In December 2016 – nearly a quarter of a century later – the first regular trains will be speeding through the mighty Alpine massif. Until then exhaustive security and technical tests are being carried out to ensure the smooth, safe operation of regular rail services. Festive inauguration of the Gotthard Base Tunnel will take place at a special ceremony in June 2016. The new rail route will link German and Italian-language Switzerland (Erstfeld in Canton Uri with Bodio in Canton Ticino), also cutting considerably travel time between Germany and Italy in both directions. Faster train travel means that international visitors to Switzerland will be able to spend more time at their chosen destination, be it on business or for leisure.

Tradition teams up with high-tech

Completion of the new state-of-the-art Gotthard Base Tunnel will not mean the end of the historic mountain route. On the contrary – it will retain the unique Alpine appeal of its many scenic splendours. Travellers will be able to choose for either the futuristic and faster flat-rail route or the legendary and more leisurely line (which still permits passengers to stop off when and where they please along the way). Even better – passengers will now be able combine the

best of both, and discover for themselves why travel by public transport in Switzerland enjoys such international acclaim. By taking a Gotthard round-trip they will be able to experience tradition teaming up with high-tech. And 140 years of history and heritage coming face to face with the future.

Further information: **SwissTravelSystem.com/gotthard**

Swiss Travel System tickets are obtainable worldwide. For an overview of international points-of-sale, see **SwissTravelSystem.com/wheretobuy**. For further information, media texts and photo material, consult our Media Corner – **SwissTravelSystem.com/media**