

Tunnel Vision

Over three-quarters of Switzerland's Gotthard base tunnel has been excavated, and construction work is on schedule, as regional editor Anitra Green explains.

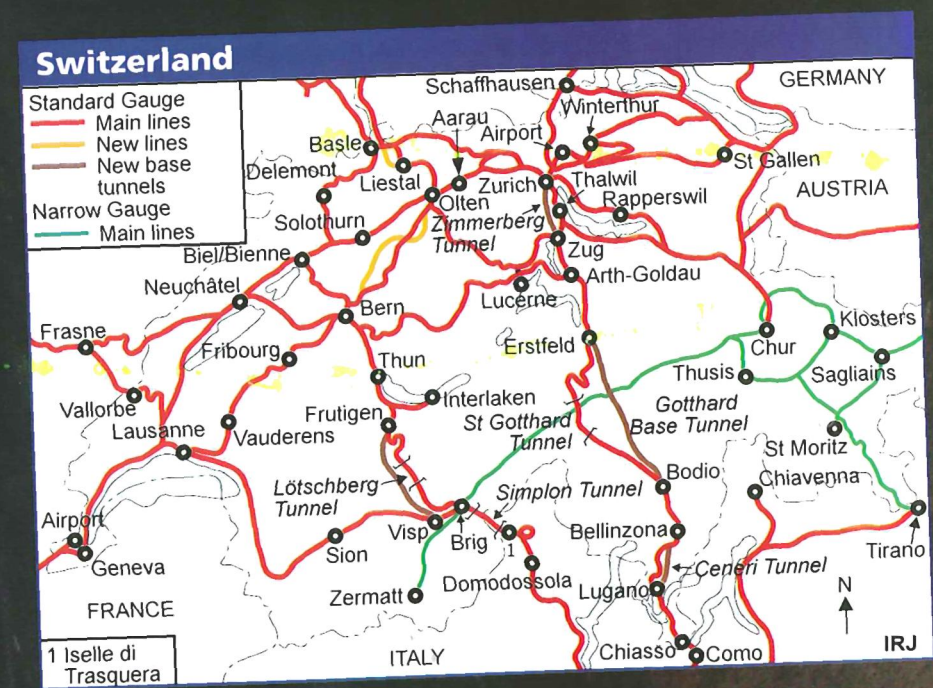
THE opening of the 57km Gotthard base tunnel is scheduled for the end of 2017, when it will become the longest in the world. Like the Lötschberg base tunnel completed last year, it will be equipped with the European Train Control System (ETCS), enabling up to 150 trains/day/direction to pass through it at speeds up to 250km/h. About one hour will be sliced off the Zürich - Milan passenger journey time which is currently 3h 33min.

According to Alptransit Gotthard, the company in charge of construction, work is on schedule: out of the total of 153.5km of tunnels and passages, 120.5km or 78.6% had been excavated by November 1.

Driving the twin tubes, 40m apart, is being carried out on several fronts, from the northern portal at Erstfeld, via Amsteg, Sedrun and Faido, to the southern portal at Bodio. At the core of the project are the multifunctional stations at Sedrun and Faido. Progress has been variable, and despite carefully-executed trial bores and exploratory drilling, the massifs still manage to produce some surprises.

Starting at the northernmost section, work on both tunnels southbound from Erstfeld to Amsteg is proceeding at an average of 14-18m a day with two tunnel-boring machines (TBM).

Tunnelling on the next section, between Amsteg and Sedrun, is complete, and concreting and installation of the pre-fabricated tunnel lining should be finished by the end of the year. A 1km section north of Sedrun proved to be one of the most difficult parts of the entire project, with severe tectonic pressures and the rock behaving more like loose material than solid rock. The problem was solved by pre-exploration with bore holes up to



100m long, a sophisticated system allowing for deformation of the rock, securing of the excavation with steel rings, radial stabilisation of the tunnel with steel anchors up 18m long, and sealing with shotcrete at each advance.

The third section, between Sedrun and Faido, is the longest. This part of the tunnel is being driven from both ends: southward from Sedrun, it is being driven by the traditional drill-and-blast method. This is mainly because of the geological conditions, which are not suitable for TBMs. Progress on the east tunnel in particular has been slowed by a difficult geological zone which has turned out to be about 100m longer than expected, and only about 1m a day can be cleared. The west tube, luckily, is apparently clear of this zone.

The northward section from Faido involved another of the major challenges in the tunnel project: the Piora syncline (a downward curving fold). A trial bore made in 1996 produced a mass of granular dolomite mixed with water, which is said to have nearly brought the entire project to a halt. Subsequent bores indicated that this doubtful stratum did not actually go down as far as the level of the tunnel, and the final bores in September revealed that the rock was hard and non-water bearing.

In fact the Piora syncline has been traversed without any notable problems, and the rock has remained stable. But to prevent the TBM getting stuck in this high-pressure zone, steel

rings were put in behind the drill head at intervals of about 1m, and the drill head itself was protected by applying a shotcrete seal to the cut surface. For additional protection, a shotcrete ring 30cm thick was constructed about 25m behind the drill head.

The main breakthrough between Sedrun and Faido is expected sometime in the first half of 2011, assuming everything continues to go according to plan. The northbound TBM on the eastern tube has about 9.4km to go. On the west tube, work is about 1600m behind, and the TBM is expected to reach the Piora section in the first quarter of next year. Finally, the tunnel between Faido and Bodio is finished, and the concrete inner lining of both tunnels on the southern part is complete.

The related project to build the 15.4km Ceneri base tunnel to the south is well on the way as well. By November 1, 98% of the 2.3km Sigrino adit (almost at the halfway mark) had been excavated, from where most of the tunnelling will be done, and preparation work had started at the northern and southern portals. Work on the main tunnel is scheduled to start at the end of 2009 or the beginning of 2010.

The final cost of the entire project, including the Ceneri tunnel, is estimated at SFr 11.9 billion (\$US 10.3 billion), of which the Gotthard tunnel will cost SFr 9.67 billion. Alptransit says every effort is being made to optimise costs, and it is optimistic that the current cost estimate will not be exceeded. **IRJ**