Zeitschrift: Swiss express : the Swiss Railways Society journal

Herausgeber: Swiss Railways Society

Band: 3 (1991-1993)

Heft: 12

Artikel: The Simplon Tunnel. Part 2, The second bore

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DOI: https://doi.org/10.5169/seals-855266

The Second Bore.

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Traffic through the tunnel quickly built up and, within a short time, reached the capacity of the line. In the middle of the tunnel, a crossing station was established, staffed by two men, but it was realised that the only solution would be to open out the auxiliary tunnel to full dimensions.

While the first tunnel was being built, the principal railways of Switzerland had been nationalised, the Jura - Simplon being absorbed on 1st May 1903. Thus, the government inherited, not only the line and tunnel, but all the plant and material associated with it. The nation had become the first party to the construction contract, and the State engineers recommended that the clauses in the contract relating to the construction of the second tunnel be invoked.

In the engineers' minds were the memories of the problems which had beset the construction of the first tunnel. Should a fault develop, releasing either water or the "moving rock", the tunnel would be seriously threatened, with a resultant loss from the suspension of traffic. The difficulty of maintenance in the single tunnel was another factor. With two tunnels, maintenance, repairs and overhaul could be carried out in one tunnel, while traffic continued to run in the other. The crossing station in the tunnel, at the international boundary, would enable trains to cross between the two tunnels, thus halving the length of the single line section.

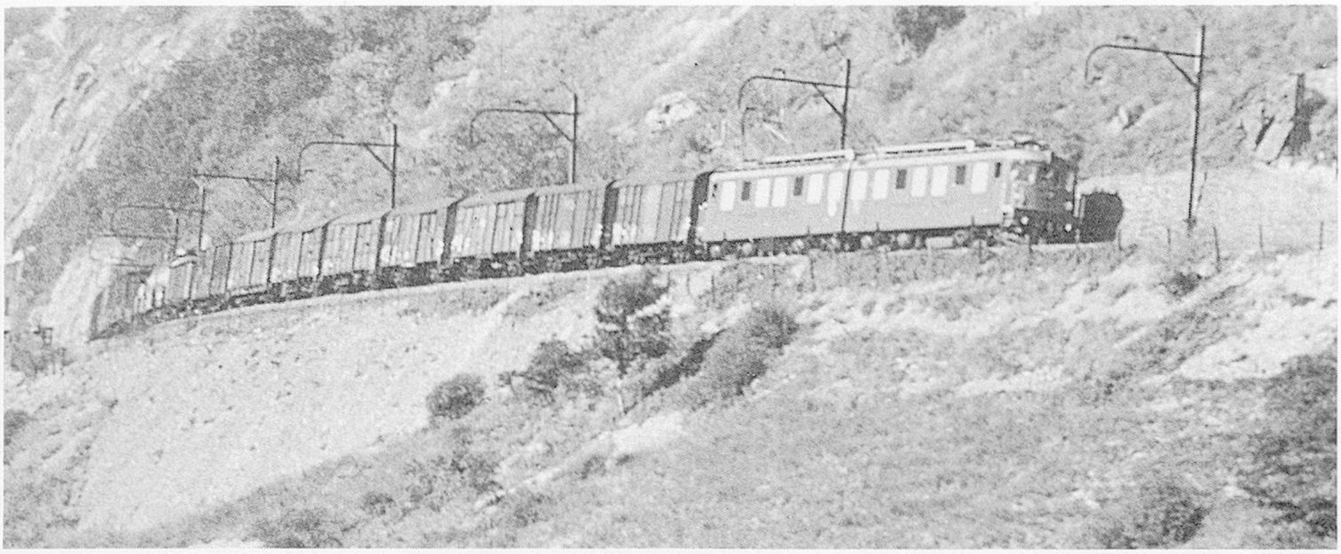
Not unreasonably, the contractors objected to building the second tunnel according to the original contract, which called for the cost to be £800,000. Their argument was that it was not equitable to ask them to carry out a contract in 1903 at a price settled in 1898, tha cost of labour and materials having risen in the intervening period. Lengthy discussions between the contractors and the Government ensued, with the final result that the Government backed down and the original agreement was abrogated.

Another eight years were to pass before work was started, and even then only at the insistence of the engineers, who insisted that postponement was leading to a dangerous situation. Tenders were called for, but there was no response, as a clause had been included calling for any damage to the first tunnel, as a result of work on the second tunnel, to be repaired at the contractors expense. Memories may be short, but they were not so short as to forget the problems which beset the original work, and it was realised that their reoccurence was highly probable.

Although one contractor, perhaps more courageous, speculative or foolhardy than his contemporaries, offered to undertake the work for £1 million, the Administrative Council refused to accept it. The only alternative was to construct the tunnel as a State enterprise with direct labour. This, then, was the means finally adopted, with F.Rothpletz as chief engineer. Once again, work started first at the Swiss end, on 12th December 1912, the Italian end being slightly delayed by the final resolution of political and other details.

The equipment stored after completion of the first tunnel in anticipation of the very situation now arising, was found to be antiquated, inefficient and uneconomical. Tunnel building had undergone tremendous advances in the intervening period. The hydraulic rotary drill had been ousted by the compressed air percussion drill, whilst locomotives and wagons for the works trains had improved considerably. Almost all the construction equipment had to be modernised to meet contemporary practice.

One of the first practical problems to be solved, one which had not arisen during the original undertaking, was the disposal, at the Swiss end, of the spoil from the second tunnel. This would see the light of day on the south side of the first tunnel mouth, whereas the dumping ground was on the north side of the main line. The prospect of an endless stream of



Freights in 1967 were mostly composed of short-wheelbase wagons, as is this example behind a BLS Ae8/8, a short distance from Brig

narrow gauge trains crossing the busy international route could not be tolerated and it was not possible to take the narrow gauge tracks either above or below the main line to reach the Brig yards.

The solution was ingenious; several narrow gauge sidings were laid on the south side of the main line, paralleled by several standard gauge sidings. This yard was spanned by an electric travelling crane. Standard gauge trains brought construction materials to the yard; the narrow gauge trains brought spoil. The wagons of the latter were fitted with detachable bodies which the crane lifted across into a standard gauge wagon. The crane then lifted from a standard gauge wagon a narrow gauge wagon body loaded with construction materials and transferred it onto a narrow gauge wagon. This must have been one of the earliest, if not the first, application of what has become known as "swap-bodies".

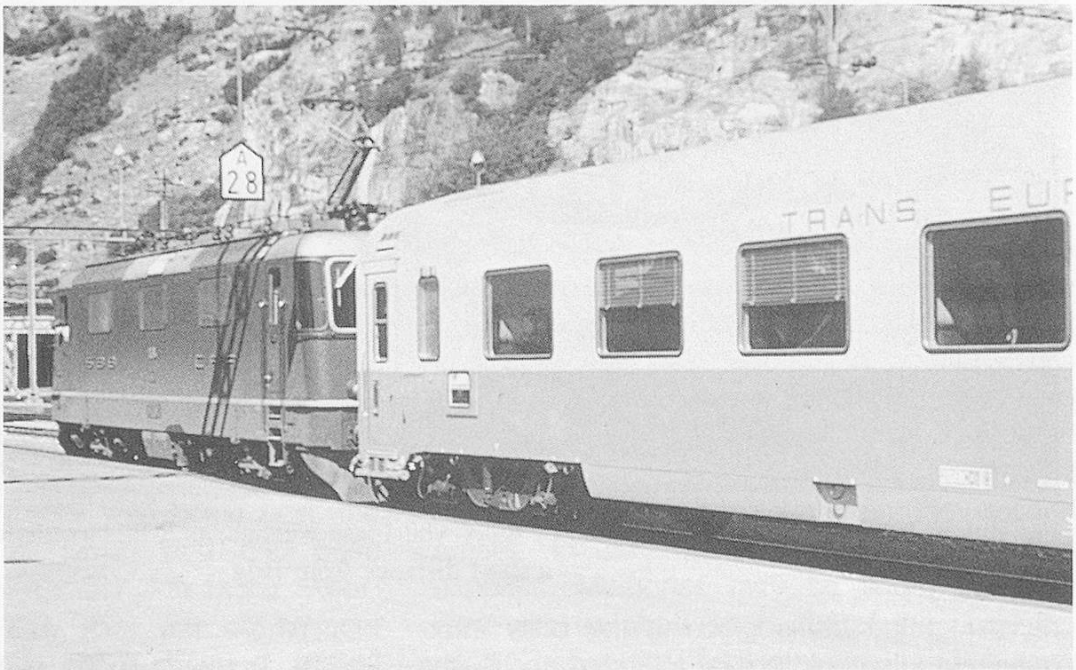
The method of opening out the auxiliary tunnel to full dimensions depended on the nature of the rock. Where it was dense and safe, the unlined gallery was roughly timbered with a post on either side supporting a heavy cross-piece, converting the roof into the floor of an upper heading. A hole was driven upwards to the height of the final tunnel, from where the rock was removed sideways and downwards, widening the arch on either side, until the tunnel reached its full dimensions. The shoring was then removed, leaving the tunnel ready for lining.

Where the rock was rotten, friable and badly fissured, more elaborate staging was used. The danger was that rock movement might be transmitted through to the first tunnel, damaging its masonary lining. In such conditions, the practice was to advance only a metre or so at a time, lining the bore as quickly as possible.

On the Italian side, the "moving rock" was again encountered, some 3 Km from the tunnel entrance. In a stretch of 55 metres, pressures were experienced which exceeded anything recorded during the boring of the first tunnel. Without any warning, needles of gneiss irrupted into the tunnel, from both the roof and sides. Each irruption set up tremors which deformed and cracked the lining of the first tunnel.

To overcome the rock pressures, a massive rectangular steel chamber was built, in which work could continue in greater safety. Once the section had been passed and the tunnel lined, this chamber was dismantled. It had held, but had been distorted to an incredible degree by the forces to which it had been subjected.

Continuously, while the second tunnel was being driven, the first tunnel was kept under surveillance for signs of deformation or weakening of the lining. Serious damage was, indeed, detected, and work was stopped in the second tunnel. With the distinct possibility of a cave-in threatening the first tunnel, a steel structure, resembling a series of huge horseshoes and connected with steel sheet, was constructed on a rail wagon. This was run into the tunnel to the affected section, where the structure was set on foundations at each side of the tunnel. Concrete was driven into the gap between the steel and the damaged tunnel lining to form a steel and concrete "bandage".



During the '70s, the TEE *Lemano* was formed of Italian stock, shown here about to leave Brig for Genève behind the ubiquitious SBB Re4/4^{II}.

To speed up handling of the narrow gauge trains at the working face, an electric travelling crane was installed that spanned both narrow gauge tracks in the fully excavated bore. It was able to transpose arriving wagons of construction materials with wagons of spoil waiting to be removed by lifting wagons over each other.

The tunnels are lined with masonry throughout. Where the rock is sound, this lining is light, but in less solid areas it is up to 1.2 metres thick. Artificial stone was used extensively in the second tunnel, preferred because of its more uniform finish. However, natural stone, with its greater strength, lines the area subject to the high rock pressures. Subterranean springs were sealed with asphalt before the lining was set in position and the spaces between the lining and the rock filled under pressure with cement.

The First World War brought disruption to work on the tunnel. Swiss workers engaged in the work who were eligible for military service were called up to counter the threat of invasion. More serious was the Italian entry into the war on the Allied side. The Italian workers answered the call to arms almost to a man, depleting manpower until work ground virtually to a standstill.

In March 1918, the northern bore reached the mid-mountain crossing station, but there had to stop until the end of the war released Italian workers to complete the southern end, still about 2 Km short of the meeting point. When work did resume, in 1919, construction and labour costs ranged from 200 to 250% above those prevailing at the commencement of work in 1912.

Damage to the first tunnel, on the Italian side, was severe enough to close it once the second tunnel was available for use, to enable renovation to take place. During this period, the crossing station in the heart of the mountain was the busiest spot between Domodossola and Brig.

The initial tunnelling of the Simplon is accepted as a monument to the technical prowess of the Swiss and Italian nations, but it is debatable whether it was not excelled by the construction of the second tunnel. To the engineers, the strain of the later undertaking was the greater, as the slightest miscalculation or moment of carelessness might have caused the collapse of the first tunnel. This strain was not relieved until 4th December 1921, when the final keystone was placed in the arch of the second tunnel. The official opening followed in 1922.

To be continued