The Simplon Tunnel. Part 2, The second bore

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John Jesson

460.024 in '*Zugkraft Aargau*' livery, departs Brig for Genève, pushing its train. *Photos:* John Jesson

After the opening in 1906, traffic through the tunnel quickly built up and within a short time reached the capacity of the single line. In the middle of the tunnel, a crossing station had been established, staffed by two men, but it was realised that the only solution would be to open out the auxiliary tunnel to full dimensions.

Prior to this, during the construction period of the first tunnel the principal railways of Switzerland had been nationalised, with the Jura - Simplon being absorbed on 1st May 1903 into the SBB/CFF. Thus, the government inherited, not only the line and a partially constructed tunnel, but also all the plant and material associated with it. The nation had become the first party to the construction contract, and almost immediately 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 problems besetting 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 of concern. With two tunnels, maintenance, repairs and overhaul could be carried out in one tunnel, while traffic continued to run in the other. Having 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. However 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 1897, the 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 in 1904 the Government backed down and the original agreement was abrogated.

Another eight years were to pass before work was started on a second tunnel, 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 that beset the original work, and it was realised that their reoccurrence was highly probable. Although one contractor, perhaps more courageous, speculative or foolhardy than his contemporaries, offered to undertake the work for £1m, 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 Herr F. Rothpletz as chief engineer. Once again work started, first at the Swiss end on 12th December 1912, with the start at the Italian end being slightly delayed by the final resolution of political and other details. Unsurprisingly the equipment stored after completion of the first tunnel in anticipation of a quick start on a second bore, 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 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 in a yard on the south side of the main line, paralleled by several standard gauge sidings all being spanned by an electric travelling crane. Standard gauge

trains brought in construction materials to the yard; the narrow gauge trains brought in spoil from the tunnel works. The narrow gauge wagons were fitted with detachable bodies that the crane lifted across into a standard gauge wagon. The crane then lifted from other standard gauge wagons a narrow gauge wagon body loaded with construction materials and transferred it onto an empty narrow gauge wagon. This must have been one of the earliest, if not the first, application of what have become known as "swap-bodies".

The method of opening out the auxiliary tunnel to full dimensions depended on the nature of the rock. Where this was dense and safe, the unlined gallery was equipped with roughly timbered posts on either side supporting a roof of heavy crosspieces. This roof then became the floor of an upper heading. From this 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 masonry 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 at some 3 Km from the tunnel entrance. In a stretch of 55m 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, these deforming and cracking 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 problem section had been completed, 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.

While the second tunnel was being driven, the first tunnel was kept under continuous 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". 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 were lined with masonry throughout. Where the rock was sound, this lining is light, but in less solid areas it is up to 1.2m 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 2km 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.

*This is the second of three articles by John Jesson that first appeared in **Swiss Express** over 20 years ago. With many new members having joined the SRS since then we have decided to re-run them.*

From directly over the tunnel mouths, looking down on the car shuttle entering the original bore.

The successor to the Class 470 units is the Class 610, one of which is departing Brig for Genève.