



Gold Buckle of the Steel Belt of Russia. To the 120th Anniversary of the Circum- Baikal Railway



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ABSTRACT

120 years ago, on June 22 (June 9 old style), 1901 the Committee on construction of the Trans-Siberian Railway approved final decision on the location of the route of Circum-Baikal Railway (CBR).

This railway is a monument to the heroic construction of the Trans-Siberian Railway. At the beginning of 20th century, the whole world followed its construction: someone with a shudder, someone with curiosity. The main goal was defined by the urgent need to connect the Central

part of Russia and the Far East. Hence, there was an insurmountable natural obstacle on the way: the largest lake in the world. Today the CBR is an architectural reserve, englobing a huge number of engineering structures. Many of them are still unique. Prospecting work on Lake Baikal lasted for 13 years. The lake is surrounded by mountains, 300 tributaries from different rivers flow into it. So laying a railway track was an extremely difficult task, Russian engineers have brilliantly coped with.

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In 1905, the construction of the Circum-Baikal Railway was completed. It was the third stage in the construction of the Trans-Siberian Railway that connected St. Petersburg and Vladivostok by rail. The Circum-Baikal Railway, 260 km long, ran from the port of Baikal (on the left bank of the Angara source) to Mysovaya Bay (the eastern coast of Baikal) (Pic. 1) [1]. But this event had been preceded by interesting and condensed history.

In 1881, when working out the project of the Great Siberian Road, two options for bypassing Lake Baikal were considered – northern and southern. The northern one was simpler. Expedition of O. P. Vyazemsky (1839–1910) (Pic. 2) (he conducted surveys of the Siberian and Trans-Baikal railways, subsequently supervised the construction of the Southern-Ussuriysk and Northern-Ussuriysk railways) established that the southern option, despite its complexity, is nevertheless preferable, since the area is better settled here. Therefore, they selected this option. The route passed along the rocky coast, skirting Baikal [2].

By 1899, the Central Siberian railway was brought to Lake Baikal (Pic. 3). Initially, it was planned to bypass it from the south along the so-called Circum-Baikal line, 232 versts long. In view of the high cost of this line, about 25 million rubles, and the difficulties of the forthcoming work with a tunnel of 3,5 versts in length, the Minister of Railways A. K. Krivoshein proposed a temporary solution to this problem. From Irkutsk, 80 versts of rail track are laid to the Listvennichnaya pier on the western shore of Lake Baikal (Pic. 4), and then there is a steamship service across the lake, which in this place is 35 to 40 versts wide [3].

For this purpose, the government purchased two icebreaker ferries in England, which were given the names «Baikal» (Pic. 5) and «Angara». Near the Baikal station (Listvennichnaya bay) and in the Mysovaya bay, wharves were built. For communication with the decks of ferries at the quays, two-span bridges with rolling tracks were built (Pic. 6) [4].

For transportation of light cargo and passengers, the Construction Department had its own flotilla, which consisted of the steamers «Second» and «Circum-Baikal», as well as three barges. This fleet was used to transport materials and workers along the route of the road under construction. The ferry service existed for almost 20 more years.



Pic. 1. Baikal station.



Pic. 2. O. P. Vyazemsky.

In the winter of 1903–1904 there were severe frosts, and the lake was covered with strong ice. Then from the Baikal station to the Tankhoi station, a 40-kilometer rail track was laid on the ice (Pic. 7) [5].

Preparatory work on the Circum-Baikal Railway, including deforestation (Pic. 8), construction of barracks for workers (Pic. 9) began in the summer of 1901, before the approval of the estimate and all technical documentation [6]. At the same time, a competition for the execution of tunnel works was announced in the press and about 50 applications were received from individuals and companies, including foreign ones. After the competitive selection, invitations were sent to only 28 participants [7].

The uniqueness of the route of the Circum-Baikal Railway was due to the absence of a coastal terrace near the western shore of Lake





Pic. 3. The starting point of the Circum-Baikal Railway.



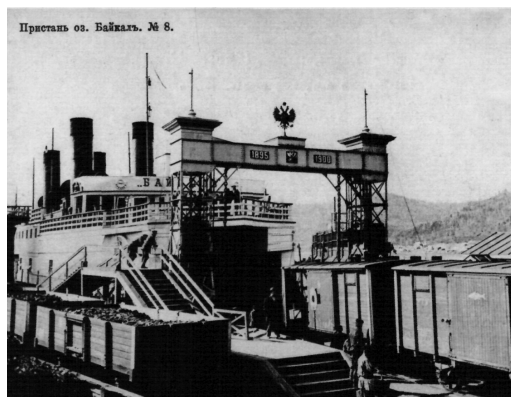
Pic. 7. Temporary railway laid on the ice of the lake Baikal.



Pic. 4. Listvennichnaya wharf.



Pic. 5. Icebreaker-ferry «Baikal» at the pier in Tankhoi.



Pic. 6. Icebreaker-ferry «Baikal» at the wharf.

Baikal. Therefore, as the head of construction of the western sixteen-kilometer section of CBR between the capes of Aslamov and Sharyzhgai, A. V. Liverovsky (1867–1951) (Pic. 10) (later the Minister of Railways of the Provisional Government, and then professor of Leningrad institute of railway engineers) said, «we have to lay track in steep rocky slopes, a shelf with upland slopes up to 60 m high (Pic. 11), then on retaining walls (Pic. 12) above the lake itself, in numerous tunnels (Pic. 13) cutting through granite capes protruding into the lake, then on stone arched viaducts over the falls (Pic. 14). In many places, it was necessary to protect the road bed from rock falls and individual falling stones by massive stone galleries (Pic. 15), as well as from the destructive effect of the Baikal waves with protective walls with stone prisms» [8].

The technologies existing at that time made it possible to tunnel at a speed of up to four meters per day, but due to the threat of constant avalanches, the tunnelling was carried out very slowly, no more than 96 cm per day.

The largest structure was a single-span bridge with a truss with an estimated span of 123 m across Berezovaya Bay with a depth of almost 27 m at 27 km from the Baikal station (Pic. 16). This superstructure was assembled on a scaffold in a recess, and then by longitudinal and transverse thrusting it was installed in the design position.

If on the entire Trans-Siberian Railway there were on average 0,89 artificial structures per 1 km of length, then on the Circum-Baikal Railway there were 2,23 artificial structures per 1 km. 12 tunnels and 4 protective galleries were built, 2,4 million cubic meters of rocky soil were

developed, 700 km of boreholes were drilled, and 2400 tons of explosives were consumed. For every 400 meters of the railway, there is at least one artificial structure built according to an individual project. Difficulties in organising construction were also aggravated by the lack of necessary building materials on site, except for stone. Even the sand had to be transported in summer on barges, and in winter on ice from Kultuk for 40 km. In total, about 16 million cubic meters of earthworks were carried out (Pic. 17). The highest embankment height was 13,4 m (78th km), the greatest excavation depth was 30,4 m (57th km). At the same time, in the western section, 62 % of earthworks were rock works, which were carried out only by the explosive method. Accordingly, during the construction of the railway, about 309 tons of dynamite and 2870 m of wick were consumed [4].

According to the approved technical conditions for construction of the Circum-Baikal Railway, the maximum slope of the longitudinal profile of the track was taken equal to 0,008. The smallest radius of curves was 150 sazhen (320 m). The roadbed was dumped under one track. The width of the main site of the roadbed was taken as 5,55 m, in rock cuttings as 5,32 m. At the approaches to the bridges for 10,7 m, the roadbed widened to 5,96 m. In the tunnels at a distance of 75 m, the excavations were developed for two tracks. The topside structure of the track (rails, turnouts, fasteners) was delivered by domestic factories without delay. The main and station tracks were made of rails weighing 32,2 kg/m (24 lb-ft). Rails weighing 30,2 kg/m were laid on additional crossings, which were already opened during the construction process [4].

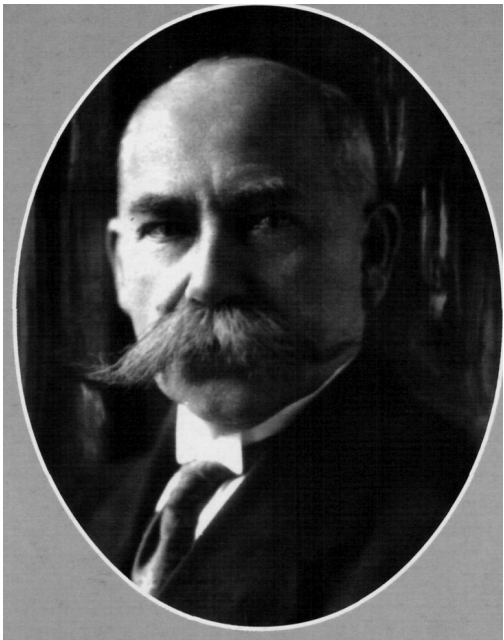
Temporary (working) train traffic was opened as the sections were ready: from Tankhoi station to Mysovaya station – in December 1902, from Tankhoi station to Slyudyanka station – in March 1904 and from Slyudyanka station to Baikal station – on September 12, 1904. The first train was accompanied by the Minister of Railways, knyaz M. I. Khilkov (Pic. 18). And two days later, it was allowed to open a temporary movement here of «...working trains and loaded cars with such a calculation and in such a size so as not to interfere with work on completion». Thus, from the start of work on the Baikal-Slyudyanka section in March 1902 to the opening of temporary train traffic on the



Pic. 8. Timber harvesting.

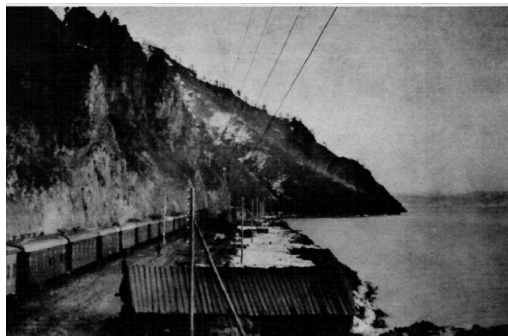


Pic. 9. Workforce settlement at Circum-Baikal Railway.

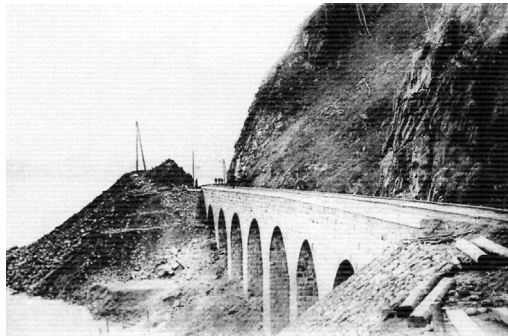


Pic. 10. A. V. Liverovsky.

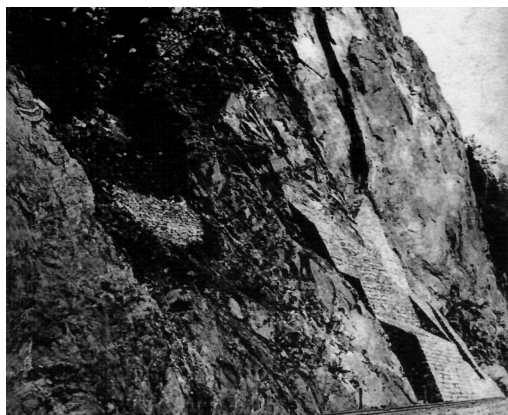




Pic. 11. The railway track along Baikal coast.



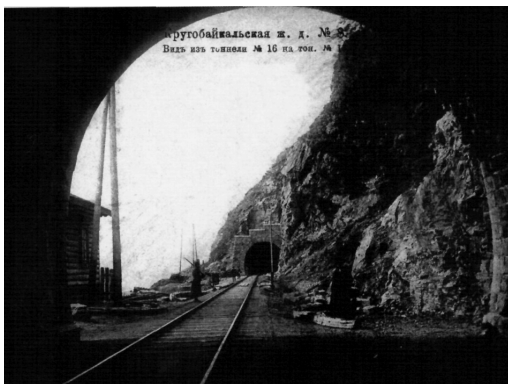
Pic. 14. Viaduct «Stubborn bay».



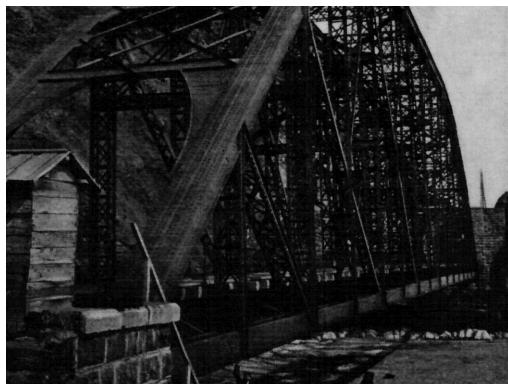
Pic. 12. View of the line of protection walls at the post No. 71.



Pic. 15. Stone gallery.



Pic. 13. View from the tunnel No. 16.



Pic. 16. Bridge over Berezovaya bay.

Circum-Baikal Railway, 2 years and 5 months passed, and that was a record time, given the extremely difficult construction conditions.

The railway was also put into permanent operation by separate sections: Mysovaya—Tankhoi — August 2, 1903, Tankhoi—Slyudyanka — March 15, 1905, Slyudyanka—Baikal — October 15, 1905 [9].

Even during the construction period and at the beginning of operation of the railway, it

became clear that the real growth in traffic would force a much increase in the transit and carrying capacity of the line. Already in 1905, the issue of laying the second main track was resolved. The second track was laid on the lake side. At the same time, unreliable slopes of the bed and rock cuttings of the first track were strengthened, thereby making it possible to make the necessary changes, including reducing the limiting radii of curves. During the period



Pic. 17. Earthworks.



Pic. 18. Prince M. I. Khilkov, Minister of Railways in 1895–1905.

of operation of the railway in 1905–1910 powerful rock falls often destroyed the track, and the second line was built bypassing the bay, laying a double-track tunnel No. 9 in the rock, leaving aside the dangerous single-track section. The metal girder of the bridge across the Vydrino River – the longest on the Circum-Baikal Railway – was transported and installed on new bridge supports.

Three versts from the Marituy station in the area of Cape Kirkirey-3, due to the constant mountain falls and the indomitable nature of the Kirkirey River, the track had to be shifted into the depths of the cape and, parallel to the old tunnel No. 18, a new double-track tunnel No. 18-bis was cut. At the same time, the previously built tunnel, metal bridge and retaining walls at the first track remained away from the new route.

The second track of the Circum-Baikal Railway was put into operation on October 9, 1915, and on December 9 of the same year, the line was transferred to the Trans-Baikal Railway. So, the construction of the railway was completed, which at the beginning of 20th century was called the «Golden Buckle of the Steel Belt of Russia»: «buckle» – because it connected the Trans-Siberian Railway torn by Baikal, and «golden» – because it demanded huge financial costs and had a unique, unparalleled appearance, combining a wonderful engineering complex

and a beautiful coastal landscape of Baikal [10].

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