Railway Architecture Along the Chinese Eastern Railway at the Beginning of the 20th Century

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Abstract. The article presents an analysis of railway complexes architecture in the settlements along the Binzhou Railway, Binsui Railway and the part of the high-speed line Hada Railway in Northern China. That settlements was built by engineers from the Russian Empire in the early 20th century as stations of the Chinese Eastern railway (CER). To create all the conditions for the operating of the road, it was important not only to lay the track, but also to create infrastructure for servicing trains and ensuring a comfortable housing for the growing population. The tight construction time required the use of standard projects on the road. These buildings that have survived to this day have become objects of close attention of architectural historians and restorers. In a number of cities, former locomotive depots are being converted into museum spaces, old railway stations are being restored and included in tourist guides. This paper examines the history of construction of these objects in order to study the design features of utilitarian architecture on the territory of the CER during the construction of the Trans-Siberian railway. The analysis was based on the material obtained during the work with archival documents and drawings, as well as information obtained during field surveys of towns and cities on the railway line from Manchuria to Suifenhe and from Harbin to Dalian.

1. Introduction

In the North-East of China, railways played an important city-forming role in the development of the region, and the railway complexes under construction along the former Chinese Eastern railway (CER) became an integral part of the planning structure of new settlements. The main task of the CER builders was to ensure uninterrupted train traffic: first of all, the road line was laid on stages, tracks were organized at stations, locomotive depots, workshop buildings, reservoir buildings and warehouses were built. The listed objects have been preserved to this day, are of historical and cultural value, and are protected by the Chinese Government.

This study examines various buildings and structures of railway complexes. These are objects related either to the maintenance of railway tracks or to the service of traveling passengers; the history of their construction is studied, their architectural and urban planning features and current state are considered.

The arrival of the railway in Northern Manchuria became a technical breakthrough in the 20th century. The road opened the way to Europe and contributed to the development of sea transport due to the appearance of two major ports Dalian and Port-Artur.

The basis for the preparation of this article was the results of research by scientists studying the history of the construction and operation of the CER [1, 2, 3] the history of Russian architecture in...
Northern Manchuria at the beginning of the 20th century [4, 5, 6], as well as work on the study of railway architecture in different regions of Russia of the same period [7, 8, 9]. An important component of the research was the study of the archival funds of the Russian State Historical Archives in St. Petersburg and the Russian State Historical Archives in Vladivostok, which contain albums of the CER standard projects, general plans of settlements and projects of structures, documents and orders containing accompanying information to the projects. Funds of the Vladimir K. Arseniev Museum of Far East History store a large number of photographs of settlements and photo albums. Books from the time of the construction of the road and various publications devoted to the history of construction and the first years of operation of the CER, published in the first third of the 20th century, memoirs and diaries, periodicals of different years were also used [10, 11, 12, 13, 14].

2. Railway complexes in the structure of settlements

Railway complexes are a set of buildings and structures for passengers and railway trains that are technologically and functionally related to railway maintenance. They include station buildings, the surrounding area, platforms, locomotive depots and office buildings, workshop buildings, and water towers.

On the territory of Northern Manchuria, railway complexes were located in an administrative settlement, and for a long time they formed the core of stations.

The class of the station depended on passenger traffic, cargo traffic, the size of settlements, distance from junction stations, and geographical location. The class influenced the composition of railway complexes. As on other Railways of the Russian Empire, the CER adopted the division of stations by class. The CER was 5 classes: the first class building only one were built, second class – 9, third – 8, fourth – 47, the fifth – 30. To ensure continuous communication and operation of the road, the line was divided into sections. As a rule, there were 100 versts (107 km) between each major settlement, about 30 versts (32 km) between third and fourth class stations, and 10 versts (10.7 km) between sidings and platforms [15]. Next to tunnels and bridges, watchtowers were built after the Boxer Rebellion in 1898-1901. The class affected which facilities serving the railway would be built.

Complex terrain and a large number of tunnels made it necessary to frequently build water-reservoir buildings, repair shops, wood warehouses, etc. Analysis of a number of city plans revealed the following features [16, 17, 18, 19, 20, 21, 22, 23, 24]. At each station, depending on the size of the locality, railway complexes consisted of two functional parts: for passenger service and for train service. The first included a passenger building with one or two pavilions, a canopy over the platform, a pavilion with boiled water, latrines, and outbuildings for storing inventory. At a distance of about 300 m from the station there were locomotive depots, workshops, warehouses, water-reservoir building and offices. In large settlements of the second and third classes, there were also dormitories for temporary accommodation of road workers and the office of the station master. At the fourth and fifth class stations, the water-reservoir buildings were located directly on the territory of the passenger building. This is due to the small size of the station and the lack of separate production areas: trains were refueled with water during short stops.

2.1. Passenger buildings

95 stations were designed and built along the CER. Not all stations had all the necessary facilities built: due to the transfer of part of the southern branch of Japan after the defeat in the Russian-Japanese war, work was suspended on part of the southern branch to Changchun. Unfortunately, the beautiful project of the railway station building in Dalian was not implemented. Many details of the station design were the same as for Harbin station. Externally, the design of the Dalian railway station was not similar to Harbin, but it was no less expressive. It was planned that the terminal station of the CER would be located on a steep terrain so that the height of the upper point of the central gable would be about 21.5 m from the platform side, and 14 m from the city side. According to the project, the building is three-storeyed, equipped with elevators with halls for three classes on the top floor [23]. The station was built in a more modest size already during the period of Japanese presence: a one-
story building with wood-paneled facades, like the station building in Port-Arthur, with a roof with slants and a long canopy over the platform. The station in the New Town area in Harbin was the only first class building built on the CER, it is the largest passenger building on the road, with a length of about 100 m. It was completed in 1920 [4]. In the first years of operation in Harbin, there were several station buildings, in each district of the city under construction. The projected station was located at Sungari I station in the New Town. The building is two-storeyed with a basement. There were various types of waiting rooms. In the main lobby there were a luggage compartment and ticket offices, and on the left and right side of the aisles you could get to the halls for passengers of first and second class and third class. Each hall had a separate exit to the platform, and for the first and second class halls, a separate entrance was provided to the city [25].

All projects of passenger buildings were developed in St. Petersburg in the shortest possible time and are presented in the album of structures and standard drawings [23]. Not all stations project were standard: for the second class station of Manchuria, Boketu, Hengdaohezi, Pogranichnaya, for station Modaoshi fourth class and fifth class Sanshilipu individual projects were designed [26]. Individual projects were also developed for Harbin and Dalian, first class stations. At important stations of the second and third class, capital, not temporary, passenger buildings, depots and the first workshops were erected. In Harbin, Manchuria, and the Pogranichnaya, wooden temporary railway stations were first built.

According to the project documentation of passenger building projects at railway stations (presumably in 1900), the distribution of projects was carried out according to the principle described below. Table 1 shows the correspondence of projects and stations.

| The class of station | Specifications | Number of floors of building/ buildings A and B | Settlements |
|----------------------|---------------|-----------------------------------------------|-------------|
| I                    | -             | 3 (including the basement)                     | Harbin      |
| II                   | -             | 1                                             | Dalian (not built) |
|                      | -             | 1                                             | Manzhouli   |
|                      | -             | 1                                             | Pogranichnaya |
|                      | +             | 2                                             | Hailar      |
|                      | +             | 2                                             | Qiqihar     |
|                      | -             | 1                                             | Boketu      |
|                      | -             | 1                                             | Hengdaohezi |
|                      | +             | 2                                             | Gunjulin     |
|                      | +             | 2                                             | Laoyang     |
|                      | +             | 1                                             | Wafandian   |
| III                  | +             | 2                                             | Zalantun    |
|                      | +             | 2                                             | Anda        |
|                      | +             | 2                                             | Yimianpo    |
|                      | +             | 2                                             | Murunь      |
|                      | +             | 2                                             | Yaomyn      |
|                      | +             | 2                                             | Tieling     |
|                      | +             | 1                                             | Dashiqiao   |
|                      | +             | 1                                             | Port-Arthur |
For the second and third class stations on the main line and part of the southern branch from Harbin station to Tieling station, one standard design of a passenger building was accepted, which consisted of two independent pavilions A and B. Building A was two-story, on the first floor there were two large halls for first and second class passengers, with restrooms, a buffet, a separate exit to the platform and a hall for third class passengers. On the second floor there were a kitchen and two rooms for visitors, or servants' rooms. Building B contained a Chinese lounge, a luggage compartment, and various service areas (telegraph, post office, and ticket offices). Both in terms of the set of rooms and areas, the projects were the same, with different roof design solutions, interior layout and facade finishing.

For the second and third class stations on the southern branch from Tieling station to Port-Arthur station, a standard design of a passenger building was adopted, also consisting of two pavilions, but the premises of this project included large luggage storage rooms, a post office, and an enlarged covered passage.

For the fourth and fifth class stations on the main line and part of the southern branch from Harbin station to Tieling station, a standard design of a passenger building with one floor and no separate rooms for Chinese was accepted.

Two pavilions were designed to completely separate the premises for Europeans and for Chinese: two-story buildings for Europeans with a buffet and housing for servants at the stations of second and third classes, was located at a distance of 21 m from the premises for Chinese in the direction of the office premises. The service rooms are also built separately from the Chinese rooms and are connected to it by a wide covered passageway through which the passenger platforms communicate with the street, this passageway was also a luggage room. On the main line and part of the South to the Tieling station as with a more severe climate, the designated passages are closed, warm on the southern branch, the passages are open from the platform side, limited by the device of low railings.

The device of cupboards with room for a pantry maid and the barman only at the stations of the first, second and third grades. All passenger buildings were built of stone or brick with tiled roofs [26].

During construction, projects and their connection to a particular station have changed. So, we can say that the buildings at Hailar and Qiqihar stations are different: the pavilion A in Hailar that has survived to this day is devoid of wooden decoration, as on the buildings of most stations, but this was not the result of changes. Photos of 1903 clearly show that the building is built of large stone blocks, the walls are not covered with plaster, there is only a modest decor of door and window frames. There are no carved wooden cornices, and the exposed gables of the end walls are modestly decorated with an imitation truss structure. Pavilion B is made of red bricks, wooden roof structure also simple. The facades of pavilion A of the Hailar railway station have similar external features to the Laoyang railway station (Figure 1): lack of decoration, rough finish. But pavilion B is located not to the right of building A (view from the city), but to the left, and is also completely different: a one-story brick building stretched along the paths with paired projections decorated with pediments, a decorated brick cornice with high parapets, and a hip roof. In turn, apparently identical designs were used for railway stations at Qiqihar and Anda stations on the Eastern section from Manchuria to Harbin. Figure 2 shows that the standard design of pavilion A has the same pattern of cornice and pediment decoration. In Yaomyn and Gunjulin on the southern branch and Yimianpo of the Eastern section (from Harbin to the Pogranichnaya), a different roof structure was used with noticeable elevation of the corners and decorative mythical animals on the edges (Figure 3). In Gunjulin the roofs of both buildings are richly decorated with dragons, the original decision the umbrellas of tubes in Amine – decorated the ends of the skates and edges in Yimianpo decor is modest, and the roof is not such a massive. In Wafandian and Dashiqiao, only pavilions B were built, single-story buildings with paired ledges and decor like at Laoyang station (Figure 4).
Figure 1. The station buildings in Laoyang (a) and in Hailar (b) were built according to the same drawing although there were planned to use differently projects [27].

Figure 2. Standard design of pavilion A in Qiqicar (a) and in Anda (b) has the same pattern of cornice and pediment decoration [28, 27].

Figure 3. In Yaomyn (a) and in Gunjulin (b) the standard station buildings project was transformed, roof structure was used with noticeable elevation of the corners and decorative mythical animals on the edges [27].

Figure 4. In Wafandian (a) and Dashiqiao (b) only pavilions B were built [26].

Platforms at first class stations were developed individually, while standard designs were used for the rest. The station grounds and surrounding buildings were usually fenced off. At those stations where there were two station pavilions, the composition was built along the axis of building B, which contained all the administrative offices, ticket offices, and Luggage compartment. Building A was off to the side. In addition, the station had a kiosk with boiling water, street latrines, a shed for storing fire equipment, glaciers, and luggage warehouses. Utilitarian buildings were used the same for all types of stations, they had the same decorative solution and layout.

2.2. Locomotive depots
The depot was built at major stations, where freight and passenger trains were formed and sent on the road. The first major structures in Russia that served trains were built on the railway line from Petersburg to Moscow and had circular shape plan. Later, circular depots were abandoned in favor of more universal semicircular depots. Along the CER, railway roundhouse with a turning circle operated at 18 stations in the amount of 21 units ranging in size from 4 to 21 stalls. Locomotive building of a rectangular type two stalls built at the stations Madoshi, Maciohe, Silinge, Grodekovo, one in Gunjulin, Erecte, Sidaohezi, Yingkou [23]. Locomotive depots were built of brick and stone. The explanatory note to the project of locomotive buildings describes the advantages of the technology of monolithic concrete arch of the Melan system used in the construction of floors. This design made it possible to avoid the harmful effects of sulfur gases. The buildings were designed so that they could be expanded by adding new stalls. The length of the stall along the axis is 26 m, the width on the side of the turntable is about 5 m, on the outside – 7.5 m. The height of the stall 7.5 m. The size of the stall is allowed to carry out minor repairs. Stables were equipped with stokeholes about 20 m long. Windows for lighting stalls are made in the outer wall above the gate, single, with wooden jambs and bindings. Turning circle at the building with a diameter of the Sanders system with a diameter of 19.5 m. At major stations, in addition to the main depots, there were also rectangular sheds for cars and locomotives. The depot had special equipment: a blacksmith shop, a lathe, milling and planing, drilling and emery [29].

In the plans of many stations, not one, but two semicircular railway roundhouse were planned, but the need for their construction arose only in Harbin, where the buildings of depot was the largest.

Table 2. Projects of locomotive depots of class I, II, and III stations on the main line and southern branch of the CER.

| The class of station | Settlements       | Locomotive depot type | Number of stalls |
|----------------------|-------------------|-----------------------|------------------|
| I                    | Harbin            | Semicircular depot    | 44               |
|                      | Dalian            |                       | 5                |
| II                   | Manzhouli         |                       | 18               |
|                      | Pogranichnaya     |                       | 20               |
|                      | Hailar            |                       | 18               |
|                      | Qiqihar           |                       | 22               |
|                      | Boketu            |                       | 20               |
|                      | Hengdaohezi       |                       | 15               |
|                      | Laoyang           |                       | 15               |
| III                  | Zalantun          |                       | 4                |
|                      | Anda              |                       | 4                |
|                      | Yimianpo          |                       | 5                |

2.3. Locomotive repair shops
Initially, cars were also repaired in locomotive depots, but later car depots and workshops were separated into independent enterprises. Repair shops were located in the main large settlements. There were workshops for small, medium and large repairs. Rolling stock repairs were carried out in the Main railway workshops in Harbin [2]. The workshops in Harbin were located northern part of the
New Town railway station on a vast territory of 600,000 square kilometers between the Pristan and Chenghe districts near the Sungari river. The complex of workshops consisted of various enterprises, including locomotive-Assembly and locomotive-mechanical workshops, tender shops, car-repair shops, boiler houses, foundries, forges, etc. All buildings were built of brick, with concrete floors.

Small repair workshops were in Hailar, Qiqihar, Pogranichnaya, Gunjulin, Wafandian; Middle repair workshops – in Manchuria [23].

2.4. Water towers
Reservoir buildings were necessary not only for the needs of the population of settlements, but to a greater extent for the supply of water to trains. According to the design assignment, up to 10 pairs of trains per day had to pass along the railway, so there were water-filled buildings in almost every station settlement. 48 water towers of various types and 11 stone underground reservoirs were designed on the entire CER line [23]. Many more were built, as a rule, each large settlement provided for two water towers, along the tracks at the beginning of the station and at the end of the station, this was done to reduce the length of pipelines. In Manchuria, where the station building had an island position between the two settlements of the Trans-Seberian and Chinese Eastern railway, towers were built on different sides of the railway tracks opposite each other. The choice in favor of one or another type was made based on the natural conditions and needs of the road. So reservoir buildings were designed for those stations where there was access to open water sources. Most of the water-filled buildings were designed on the South branch, and on the Eastern section of the main line. On the Western section of the main line, water-lifting buildings were built mainly to fill reservoirs with ground water. Underground reservoirs allowed storing large volumes of water, they were built in the mountainous area, in Boketu, on the Eastern part of the road from the station. Maoershan to Pogranichnaya, etc. Two types of reservoir buildings and two types of stone reservoirs were distinguished by volume. Protected water-storage buildings were designed on the southern branch of the road. To the West of Greater Khingan mountain range along the line there were areas with permafrost, where it was necessary to apply a number of special measures for water supply [23]. Reservoir buildings for the needs of the road were built on the territory associated with the maintenance of locomotives: next to the locomotive depots.

3. Conclusion
For the territory of Northern Manchuria, the railway became not only the main means of transportation, but also played a crucial role in the urban development of the region. The railway complex was a complex entity with many functions. Analysis of the emergence and development of architectural and planning solutions and their impact on the city's planning structure allowed us to draw a number of conclusions. Railway complexes contributed to the development of settlements. They have always been the centers of growing cities, today they are the historical center of the city and are interesting to tourists. Made in the same style, they are a whole ensemble. One of the main objects in each locality was passenger buildings – depending on the class, they consisted of one or more buildings, had one or two floors, were made according to standard designs and were similar to each other, or were built according to individual projects. The architectural design of buildings serving locomotives did not differ in variety, but depending on the size of stations and their functional significance, the layout and completeness of depots that can accommodate from four to 22 locomotives at a time differed. There were only four types of water towers, and each settlement originally planned from one to two such buildings, but if necessary, their number could be increased. One of the most important qualities of railway complexes is the commonality of methods of finishing solutions and plastic finishing of facades, compatibility of facades of different objects with each other.
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