

A Study on the Differentiation of “Tatsuno Style” Architecture between China and Japan -- Taking Tokyo Railway Station and Shenyang Railway Station as Examples

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Abstract. Modern architecture in China developed late, through the stage of wholesale westernization and discovery of traditional architectural styles, and embarked on the road of returning to its own culture after a bumpy ride. Japan, which has gone through a similar process in the development of modern architecture. Japan developed its own architectural style first and absorbed other cultures while exporting its own culture to the Asian countries to complete the practice and refinement of the architectural style. The Fengtian Station and the Tokyo Railway Station were built during the same period of the Tatsuno style, and the similarities and differences in building materials and design details can reflect that the Japanese designers did not copy the Tatsuno style, but rather, combined the design of the site to design according to local conditions. Conducting research through literature review and comparative analysis of case studies. Exploring the development trajectories of architecture in China and Japan to provide a reference for the development of Chinese architecture.

Keywords: Tatsuno Style; Railway station; architectural design.

1. Introduction

In 2010, more than 600 cities in China basically implemented a ban on the use of solid clay bricks in urban areas to avoid the environmental pollution caused by the production of clay bricks. This is a sign that the red brick buildings in the Chinese region are about to become a thing of the past. In contemporary China, red brick is mostly used as a rural building and a variety of temporary building materials, while in modern Japan and China, red brick architecture once represented advanced culture.

The modern Tatsuno architecture, with red brick as its core feature, led the architectural style of an era in China and Japan. The representative buildings are Fengtian Station and Tokyo Railway Station. Because of the same architectural style, the two buildings have high similarities in design techniques, but there are differences in details based on different cultural backgrounds. The paper intends to analyze the differences between the two from the perspective of historical comparison, so as to better enshrine the memory of red brick architecture and compare and analyze the development of this period of history and architectural style to a certain extent.

There are abundant papers on the direct style comparison between Chinese and Japanese architecture and Tatsuno architecture, which mainly take colonial architecture as the starting point to study the influence of Japanese architecture on colonial architecture.

On the basis of the analysis in this direction, how the traditional Chinese technical means affect the modern Japanese Tatsuno architecture design was studied in this paper. The historical factors behind the subtle differences in architecture were analyzed, the objective laws were summarized, and the history was supplemented by analysis from the aspects of worker differences, technical exchanges, and the progress of designers' concepts.

2. The Definition of “Tatsuno Style” Architecture

Tatsuno architecture originated from Tatsuno Kingo (1854-1919), the first Japanese architect. Tatsuno Kingo was taught by the English architect Josiah Conde (1852-1920) and studied in London, so the main body of architecture designed by Tatsuno Kingo was influenced by the style of Queen Anne [1]. At the same time, Tatsuno Kingo was also influenced by Dutch classicism, so the Tatsuno-style building is decorated with red brick and white stone strips. Applying design to the tower to make the buildings look more magnificent. This presents a different style from traditional British architecture.

Earthquakes are frequent in Japan, so Japanese buildings must be strong enough to withstand the effects of seismic waves. Tatsuno-style large public buildings are thick and solid. As one of the fifteen great architects of Japan, Tatsuno Kingo had many students, and his students designed works consistent with the style of the buildings designed by Tatsuno, which are collectively referred to as Tatsuno architecture. Since the Meiji period, Japan invaded foreign countries. Therefore, the Japanese architecture built in Taiwan, northeast China, Korea, and other places is Tatsuno architecture.

3. Literature References

3.1. Background Introduction of Tokyo Railway Stations

3.1.1. Development history

Tokyo Railway Station, an important building of the Japanese nation, has been regarded as an important transportation hub and put into use since its construction. In the 37th year of Meiji (1904), after receiving the commission for the construction of Tokyo Station, Tatsuno designed the first version of the plan with a strict symmetry of the central axis. The first version of the building had two levels, divided into five horizontal sections and five towers, which were connected by corridors to form a main body. Each tower was designed with a different dome to highlight the symmetry along the central axis. In the second version of the plan, the changes focused on the central tower. The number of floors of the central tower was raised to highlight the importance of the royal passage. The remaining minor changes were significantly different from the first version of the plan in order to increase the feasibility of the construction. The third version was proposed in 1907. After Japan's victory in the Russo-Japanese War, the country needed to promote its image, so spending on the landmark Tokyo Station was increased, and the height of the building was raised from two to three stories. Horizontal eaves ran through the entire third floor, reducing the vertical character of the tower and enhancing the monumental significance of the building. After the final implementation plan was finalized, construction of Tokyo Station began in 1908, the year of Meiji 41, and was completed in 1914, the year of Taisho [2]. The three stages indicated that Japan was in an era of change at that time, and the changes in the three plans reflected the Japanese government's pursuit of new architecture and the pursuit of promoting the advanced technology of the Japanese Empire. Thus, in the design, Tatsuno asked for the integration of foreign culture and Japanese local architectural culture to build a unique Japanese Tatsuno landmark building.

3.1.2. Planning ideas

In the early Meiji period, the occupation of the Tokyo metropolitan continued to expand, and the number of railways was also increasing. The need for rail connections between the Shin-Bashi and Ueno areas of Tokyo increased, and there was also a need for the royal family to travel by rail. Therefore, in 1912, the city of Tokyo was planned with the Imperial Palace as the center, and the radioactive road from the Imperial Palace led directly to the Tokyo Railway Station, reflecting the dominance of the imperial family [1].

3.2. Function and Structure

Tokyo Railway Station is an important landmark in Tokyo, Japan, and an important hub of the national transportation network. Its design needs to meet the functional demands of travel and display at the same time. Therefore, on the first floor of the functional arrangement, there are station master's room, royal lounge, waiting rooms 1, 2, and 3, canteen, and small luggage delivery room; The south of the second and third floors is the hotel, and the north is the office area. Tokyo Railway Station is a complex of stations, hotels, and exhibition halls. This is also the reason why Tokyo Railway Station is slightly different from Mukden Station in plan and function [3].

3.2.1. Layout and functions

The Tokyo Railway station designed by Kino Tatsuno is in the style of Victorian Renaissance architecture. Its facade is richly decorated and constructed from a patchwork of red brick and white granite [4]. The facade can be divided into three parts and arranged horizontally and vertically. The facade is decorated with mountain flowers and two octagonal domes in the north and south. The ingenious design of the minaret forms the undulating roof contour.

Tokyo Railway Station is one of the largest train stations in Japan, with thousands of passengers daily. For Tokyo Station, the scientific and rational functional one-line streamlined design was adopted to facilitate passenger travel and improve efficiency. The interior gallery layout, widely used in Japan at the time, was also adopted. Firstly, there were multiple entrances and exits on both the north and south sides of the station to provide convenience for passengers. In addition, Tokyo Station also had underground shopping malls and passageways that allow travelers to enter and exit comfortably regardless of weather conditions. Moreover, the functional areas within Tokyo Station were clearly defined. In the waiting hall, different waiting areas were set up according to the railway company and train type, so that passengers could quickly find the destination train. With the development of The Times, Tokyo Station also gradually set up self-service ticket machines, ticket machines, and other equipment. At the same time, Tokyo Station was later equipped with several elevators and escalators to allow passengers to quickly reach different floors. Guidance signs and navigation systems were set up at the elevator entrance for passengers to find the correct way [5].

3.2.2. Building structure

Earthquakes happen frequently in Japan. Therefore, for safety reasons, all public buildings adopt shock-absorbing building structures. At the same time, the construction of brick walls and steel frames is utilized to reduce the need for new reinforcement. Tokyo Railway Station underwent several renovations after 1945. Its overall structure was reinforced concrete soil with surface brick. The Japanese government's new seismic requirements included inserting steel rods into wooden piles after they were driven to strengthen the foundation. And the walls were reinforced, and shock absorbers and dampers were used to strengthen the earthquake resistance. The specific structure is shown in Figure 1.

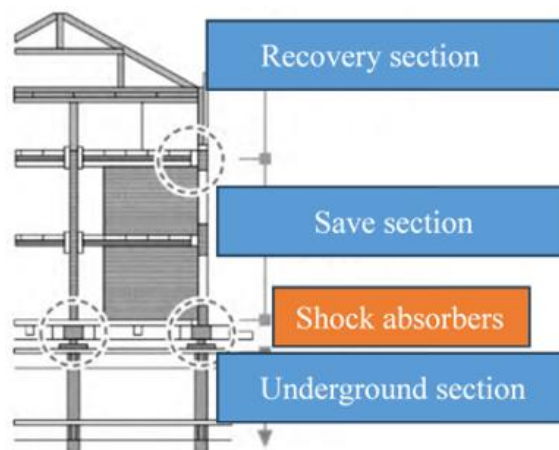


Fig. 1 Vertical structure profile of Tokyo Railway Station after renovation [3].

3.3. Architectural Details

In the use of materials, the main body was cast into columns with reinforced concrete. The facade was made of red brick and white granite. As for the roof, the natural slate roof of Tokyo Station was completely destroyed in World War II, and the iron sheet was used as a temporary repair material. Until 1990, it was refurbished with natural rock slabs. The north and south domes and the central part were covered with Japanese sheeting, which perfectly presented a straight line. The whole project was laid out by hand. Inside Tokyo Station, in addition to the facilities, there were also elaborate decorations, such as murals and sculptures on the ceiling of the waiting hall and metal casting decorations at the elevator doors. The floor was also inlaid with different colored marble patterns.

4. Overview of Fengtian Station

4.1. Details Construction Background

The construction drawings of Fengtian Station were initially designed by Takashi Ota in 1908, but he died in the middle of the course, and Sotaro Yoshida took over the design and completed the design of the main building and other auxiliary buildings in front of the station on July 2, 1910.

After the completion of construction, Fengtian Station was expanded in 1919, 1926, and 1934. Four waiting rooms were built, and Fengtian Station became the most important railway junction in Northeast China at that time.

4.1.1. Construction purpose

In 1904, the Russo-Japanese War escalated. In 1905, the Japanese won the final victory on the Liaodong Peninsula. After the war, Japan and Russia signed the Treaty of Portsmouth, which stipulated that the railways and stations formerly belonging to the Russian side were owned by Japan. In 1907, the Japanese government tried out the “Street Development Plan” in Shenyang to meet the traffic and material needs of Shenyang for the purpose of building the annex of the Manchurian Railway, so the construction of “Fengtian Station” (today’s Shenyang Station) became necessary. After 1910, the Japanese government’s demand for the plunder of material and cultural resources in the three provinces of Northeast China increased, and Fengtian Station was relocated and expanded. Since then, it became the most important railway hub of the Japanese government in the three eastern provinces.

4.1.2. Planning ideas

The Japanese design of the Manchurian railway annexed area in Fengtian mainly took Baroque formalism and functionalism as the basic model, and strengthened the form composition; the material form of urban planning was used to express the colonists’ ruling will and political ideal, and its planning purpose was always to serve the colonists’ plunder of material wealth.

In 1905, the Japanese government put forward the idea of building Shenyang into an international metropolis and Manchurian transportation hub on the basis of the “City Street Development Plan”, and planned the construction of the annex of the Fengtian Manchurian Railway with the “Fengtian Station” as the center. The planning centered on Fengtian Station but ignored the spatial mechanism and connection of the old city of Shenyang. Moreover, its use of Baroque formalism was too mechanical, which made it difficult to coordinate the new planning between the old city of Shenyang and the Fengtian Manchuria Railway [6].

In 1932, the Puppet State of Manchukuo was established with the support of the Japanese government. In 1933, the Manchurian government issued the Outline for the Economic Construction of Manchuria, which decided to build Shenyang into a commercial and industrial metropolis following the Osaka model. In February 1938, the Large Fengtian City Plan was completed. The plan adjusted part of the railway line through the city and built the Fengtian North Station to the north of Fengtian. Although the Fengtian North Station was newly designed in this planning, the affiliated

subway lines of the Manchurian Railway were complex, so the “Fengtian Station” in the planning was still regarded as the core of the puppet government.

4.2. Function and Structure

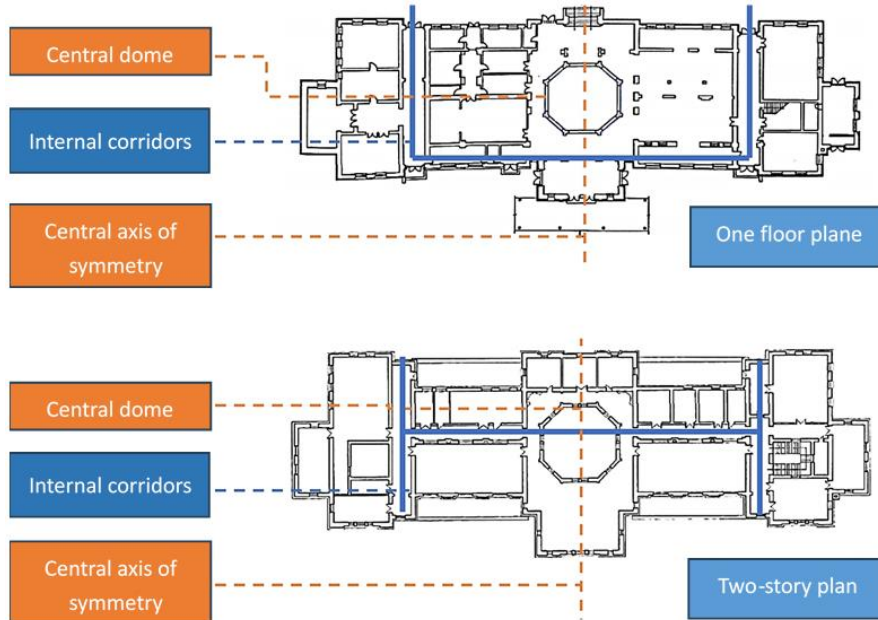


Fig. 2 The original Fengtian Station plane structure.

The plane layout of Fengtian Station is symmetrical with a linear corridor, and an octagonal dome is set in the center. The dome is the core of the building, acting as the visual center of the whole building in the composition, as well as the center of the functional flow line.

Since the opening of canals in Japan in the 1860s and 1870s, Western architectural ideas have spread to Japan. In the early 20th century, influenced by Western classical architectural ideas, Japanese designers were keen on formalization and geometry in urban planning and architectural design. Compared with Tokyo Railway Station, the overall layout of Fengtian Station is symmetrical in axis, and the spatial layout of the linear inner corridor is designed, as shown in Figure 2. Linear gallery layout is a layout method that was often applied to public buildings in modern times. The internal space organization mainly relies on the corridor to realize. The advantage of this layout is that it can form a central centralized space while ensuring smooth traffic. The disadvantage is that the overly complex gallery structure would reduce the space utilization rate.

4.2.1. Architectural structure

The main building of Fengtian Station was a brick-concrete structure. The roof was made of iron, and the dome was made of brick and concrete. The station garage adopted the structure of the reinforced concrete truss. In subsequent use, some cracks appeared in the Fengtian Station building due to human and natural factors, and the rigidity of the building was difficult to maintain. The following steps were adopted to repair them:

As for the crack, high-strength concrete was used, and at the same time, steel mesh was added at some joints.

Reinforce both sides of the wall to ensure the vertical wall. When expansive concrete was used in the wall, external tensioned steel mesh was used to ensure the safety of the wall [5].

4.2.2. Internal function layout and internal traffic flow line

The first floor of the interior of Fengtian Station was mainly a waiting hall, with a ticket hall, a private room, a police room, and an internal special passenger waiting hall. In addition, the station work service rooms were set up separately; the second floor was mainly occupied by office areas,

servicing railway staff. Special offices were set up to coordinate passenger and freight transport. In terms of time, there were also interrogation stations and isolation rooms to deal with emergencies.

In the center of Fengtian Station, there was a hall connected with the foyer, and the dome of the hall was covered; the functional areas on both sides were spread out in a horizontal direction with built-in linear corridors. The departing crowd of Fengtian Station mainly walked to the arrival hall through the east and west squares, and then entered the waiting hall, and then went to the ground platform for boarding through the elevated waiting hall.

4.3. Architectural Details

Shenyang Station is one of the representatives of “Tatsuno style” architecture. Its overall style is British Victorian Renaissance architectural style, red and white. The vertical brickwork is made of red brick, and white stone decorative window frames are used. The composition of the door, cornice, and facade is a three-stage composition. A triangular cornice in the center controls the composition. The two-sided symmetrical tower makes the original symmetrical layout lively. The central axis of the facade is a circular green dome, which also serves as the commanding height of the entire building and controls the overall style. On the facade, the use of circles expresses the Japanese designer’s passion for geometric elements, matching the style of the period. On the whole, the outline of the building is both varied and unified. The design of the circular dome forms a strong geometric contrast with the design of the triangular gable.

4.3.1. Line use of materials

For a long time, the main materials of Shenyang's traditional architecture are mainly blue brick wood. Since modern times, Japanese designers’ requirements for new buildings have led to the rapid development of modern building materials in Shenyang. The exterior wall materials of modern buildings in Shenyang are mainly face brick, clean brick wall, stone and cement mortar, and red brick and green brick are used in a lightweight clean brick wall. Artificial stone and natural stone are mainly used; the use of tiles is divided into unglazed tiles and glazed tiles according to whether the surface is glazed. Under this premise, a large number of red bricks and white stone natural stones are used. The subsequent renovation of the four-seat waiting hall was constructed using the advanced reinforced concrete of the time.

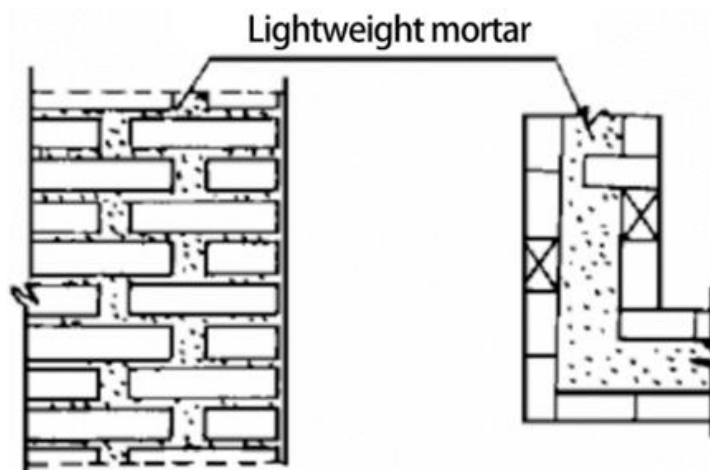


Fig. 3 Masonry method of Fengtian Station’s wall [3].

The main body of Fengtian Station was built with brick and concrete structures. Although the brick-firing technology was developed, the Japanese designers’ planning requirements for the Manchurian annex building where Fengtian Station was located led to the adoption of the red brick material walls that were popular in Japan at that time. And the wall thickness was adjusted according to local climate conditions. The maximum wall thickness was increased to a half-thickness of 420mm and a two-brick thickness of 540mm [6]. As shown in Figure 3. Thus, the red walls and white finishes of Tatsuno architecture could meet the local climate conditions.

5. Comparison and study of similarities and differences

5.1. Historical Elements

In history, modern railway stations are key transportation hubs with very important traffic and strategic value and occupy a vital position in the whole country. Therefore, when they were designed, they naturally became important nodes of cities. In terms of urban positioning, Tokyo is an important city in Japan, and the Imperial Palace of Japan exists here.

In the case of the high status of the Japanese imperial family in modern times, Tokyo was planned as a whole with the Imperial Palace of Japan as the core. Tokyo Railway Station is an important node in it. In modern times, Shenyang, as a Japanese colony, took Fengtian Station as the center to plan the city. In 1905, the Japanese government conceived the idea of building Shenyang into an international metropolis and Manchurian transportation hub based on the “City Street Development Plan”. First of all, it planned the construction of the annex of the Fengtian Manchurian Railway with “Fengtian Station” as the center [7]. Planning differences between the two cities led to a gap in the positioning of the two stations. In terms of urban planning, Fengtian Station occupies a more central position than Tokyo Railway Station.

In addition, at that time, Japan paid special attention to the spread of colonial culture, and its policy towards Manchukuo also showed a clear tendency to export its own culture. Politically, the rule of the Kwantung Army was stipulated to be above everything else, and all decisions were in the hands of the Kwantung Army headquarters. Economically, Japan occupied all the mineral resources in northeast China and controlled the lifeline of the industrial economy [8]. Culturally, Japan emphasized the uniqueness of the emperor and the absolute leadership of Japanese culture. According to statistics, a large number of colonial buildings, such as the Governor’s Palace in Taiwan, the National Taiwan University Hospital, and the Fengtian Station studied in this paper, are oriented to the southeast, which means the submission to the emperor, fulling of absolute militaristic cultural tendencies. Tokyo Railway Station, as a native building, faces southwest, which makes it directly facing the Imperial Palace of Japan. The difference between the two orientations comes from the influence of the same thought [1].

In terms of functional flow lines, there were three entrances to Tokyo Railway Station. The entrances under the central roof were for the royal family, while the entrances under the towers on either side were for civilians. Fengtian Station’s functional flow line did not subdivide the user’s identity. The entrance was located on both sides of the train station, and the exit was in the middle. At that time, the forces in Manchuria were complicated, including the Russian colonists, the local warlords of Manchukuo, and the Japanese colonists, who jointly controlled the Manchukuo region. The Japanese royal family had the supreme position in Japan, so there was a slight difference in the streamlined planning and design of imports and exports. However, in the overall use, it still followed the geometric layout commonly used by Japanese designers.

5.2. Climate Elements

In terms of climate, Shenyang is located in the North Temperate Zone and has a temperate continental climate. It has a long winter time and cold climate, and the sun's height Angle is small, which has a great impact on lighting [9]. In summer, Shenyang has high temperatures and large evaporation of rain. Tokyo has a subtropical monsoon climate with a slightly maritime climate. In one year, the precipitation is relatively average, and the climate is milder than that of Shenyang, with better lighting conditions. Climate differences are an important factor in architectural design. Shenyang’s colder and drier climate led to the use of stronger and dense bricks to build thicker walls than Tokyo Station when constructing Fengtian Station. There are obvious differences in the production process of the red bricks used in the construction of walls in China and Japan. For the design of Fengtian Station, Japanese architects used the red brick material popular in Japan at that time to build walls. The climate of Shenyang is colder and drier, so the maximum wall thickness was increased by half to 420mm and the second brick to 540mm [6]. On this basis, the red brick firing

process was adjusted, the bulk density and compactness of the red brick material were increased, and the lightweight mortar bonded between the bricks to create a closed-air interlayer was used to increase the heat resistance of the wall.

5.3. Material Elements

This caused a series of problems after coming to China, such as the reduction of the quality of bricks. Kenjir Harada, N.D., concluded after his research that Manchuria was drier and windier than Japan and that the colder climate difference caused the bricks to crack during the drying process. The Japanese, therefore, had to learn the traditional Chinese method of making blue bricks. Japanese manufacturers observing Chinese brick make noticed that Chinese workers would lay a clay mixture directly on the ground to better dehydrate hand-cast molds and would not fire bricks on windy days, which were also sensitive to the climate. The Chief Inspector conducted field studies to comprehensively document local brick production practices. They found that Chinese producers typically dig clay during the winter to prepare for brick production the following spring. From March to October, the same producers fired the bricks. The recorder observed how the Chinese workers prepared the clay. At the Zhoushuizi branch of Yingkou Red Brick Factory near Dalian, they observed Chinese worker day and night using iron pipes to pump water from the accumulated clay in the factory [10]. Harada's report provided a scientific explanation for this practice. By adding water, workers hydrated the clay and prevented it from turning into smaller particles in the windy winter climate. The clay was kept moist and thick so that bricks could be fired in the spring. Many operational improvements resulted in the red brick used in the construction of Fengtian Station being heavier and denser than the red brick used in the construction of Tokyo Railway Station.

For the roof material, Fengtian Station's roof is iron, and the dome is a brick-concrete structure. Tokyo railway station used natural slate for the roof, which was produced by Japan. China did not produce this kind of stone, so the principle of local materials made the two railway stations in the roof material different. On the other hand, in the presentation of style, Fengtian Station's roof used a green collection-form dome, which was more Russian style; In contrast, Japanese railway stations used octagonal roofs, which were more inclined to Victorian architectural style and Japanese traditional style [4].

6. Conclusion

In conclusion, Tatsuno architecture can be found both in Japan itself and in its colonial countries. In general, the core of Tatsuno architecture - red brick walls and white lines - tends to be preserved, and the functional flow and structure of the interior are also mostly in the interior corridor and geometric layout, which makes most Tatsuno buildings have signs of convergence in facades when they have the same architectural function. However, the fact that a building has the same facade and expression does not mean that the building is the same. As mentioned in this paper, Tokyo Railway Station and Fengtian Station were built almost at the same time and in the same Tatsuno architectural style, with similar facade expressions, but the two are completely different in terms of materials and construction methods. The factors that lead to the difference between them come from historical factors on the one hand and local climate on the other. There are also material and other considerations. These combined factors have forced Japanese designers to rethink building materials and layouts when building in the same style.

From the perspective of design techniques, Japanese designers reshaped the internal layout of the building according to local characteristics and material differences when constructing the Tatsuno-style buildings, just like the concrete used in Tokyo Station for earthquake resistance and the thick red brick walls used in Fengtian Station for cold resistance.

Although these two buildings were built at the same time, their building materials and structures are so different, which shows that Japanese designers at that time were not copying construction machinery, nor simply pursuing "foreign fashion", but systematically creating a new architectural

style tailored to local conditions. This also marks a new stage for Japanese designers from complete imitation and spontaneous design to local design. The process also represents the transformation of Japan from absorbing the culture of advanced countries to absorbing the excellent ideas of all countries simultaneously.

Authors Contribution

All the authors contributed equally and their names were listed in alphabetical order.

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