Structures That Became Part of Historical Landscapes

Tracing the history of the IHI Group represented by state-designated cultural properties

Buildings and other types of structures have formed part of the scenic landscapes and beautiful views for many years. The IHI Group took an active part in building such structures. For many years, these buildings and structures have played their important roles, and some of them have been designated as tangible cultural properties by the Japanese government. Now, shall we take a brief look at the history of some of those structures？
Cultural properties are valuable properties that have been fostered over a long history and have come to be recognized as having tangible or intangible cultural value. As of January 2023, a total of 2 557 items (5 373 buildings) have been designated as Japan's national important cultural properties including national treasures. This article introduces pieces of the history of some those structures in which the IHI Group was involved in the construction, namely, Tokyo Station Marunouchi Building, Eitai Bridge, Kiyosu Bridge, Kachidoki Bridge, Tsutenkaku Tower and Tokyo Tower.

Tokyo Station Marunouchi Building

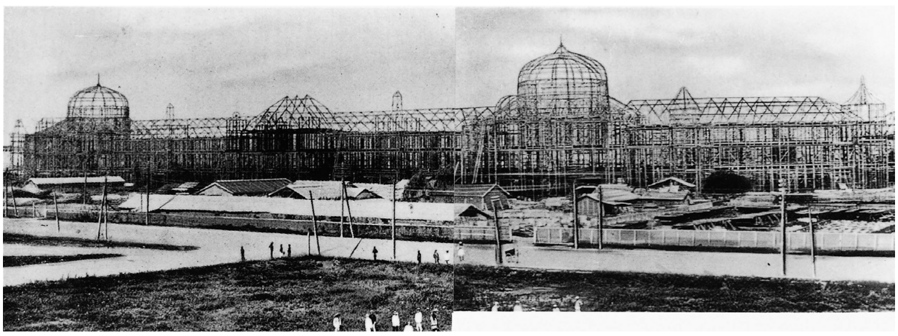
Tokyo Station Marunouchi Building is a steel-framed brick building and designated by the Japanese government as a national important cultural property. This building is one of the largest structures built mainly with brick in Japan and was designed by the architect Kingo Tatsuno, one of the leading architects in Japan at that time. When he undertook the design work in 1903, the station was called Tokyo Central Station.

Tokyo Ishikawajima Shipbuilding & Engineering Co., Ltd. (now IHI Corporation) began fabricating and assembling structural steel frames in 1909. The fabrication and onsite erection of steel frames were completed by 1911. A total of about 3 000 tons of steel was used for the steel frames.

Based on an idea suggested by an employee of Tokyo Ishikawajima Shipbuilding & Engineering, the building was constructed by an innovative method for that time as mentioned in *A 108-year History of Ishikawajima Heavy Industries Co., Ltd.* (Ishikawajima-Harima Heavy Industries Co., Ltd., 1961, in Japanese).

Tokyo Station Marunouchi Building
(Photo courtesy of East Japan Railway Company)

"In those days, it was common practice to erect scaffolds when constructing steel-framed buildings, but we carried out the construction by fabricating and using two relatively simple mobile cranes instead of erecting scaffolds. This was



Steel frames of Tokyo Central Station

an unprecedented approach to tall building construction and was highly praised in the building construction industry. On August 20, 1914, Tokyo Ishikawajima Shipbuilding & Engineering received an award from the Ministry of Railways for the innovative construction project.” [Translated from Japanese]

Tokyo Station Marunouchi Building was completed in 1913. It has experienced the World War II and strong earthquakes but been in use until today thanks to a number of maintenance projects. In 2003, the building was designated as a national important cultural property as a building that represents the leading example of that time or its type and has “architectural excellence” and “significant historical value.”

Eitai Bridge, Kiyosu Bridge and Kachidoki Bridge on the Sumida River

The bridges over the Sumida River, a river running through Tokyo, include some bridges in which Tokyo Ishikawajima Shipbuilding & Engineering was involved in the construction.

Eitai Bridge
(Source : “Historic Iron & Steel Bridges (Kanenohashi.com)” Website of the Japan Society of Civil Engineers)

Kiyosu Bridge
(Source : “Historic Iron & Steel Bridges (Kanenohashi.com)” Website of the Japan Society of Civil Engineers)

The first of the bridges thus constructed was the Azuma Bridge, the first large steel bridge domestically built in Japan. It no longer exists because it was replaced by a new bridge. *A 50-year History of Tokyo Ishikawajima Shipbuilding & Engineering* (Gensui Arai, 1930, in Japanese) includes the following passage:

“The first large public road bridge we fabricated was the Azuma Bridge on the Sumida River, which was completed in 1887. This was actually the first large steel bridge fabricated and erected in this country.” [Translated from Japanese]

Starting with the Azuma Bridge, Tokyo Ishikawajima Shipbuilding & Engineering received orders for fabricating and building bridges one after another and accumulated construction experience. Although the involvement of Tokyo Ishikawajima Shipbuilding & Engineering in the following bridges was partial, the Eitai Bridge, Kiyosu Bridge and Kachidoki Bridge on the Sumida River are all state-designated important cultural properties.

The Eitai Bridge was constructed in the wake of the Great Kanto Earthquake of 1923 as a post-disaster reconstruction project, and Tokyo Ishikawajima Shipbuilding & Engineering participated in its construction. The bridge was completed in 1926 using 3 932 tons of steel. On a side note, Tokyo Ishikawajima Shipbuilding & Engineering also fabricated and built the old Eitai Bridge that existed until the Great Kanto Earthquake. Representing the architectural beauty of a modern bridge of majestic form, the Eitai Bridge was the first steel arch bridge in Japan with a span exceeding 100 meters. This bridge is generally regarded as a structure of historical importance indicating the level of technological achievement of large-scale structure construction.

The Kiyosu Bridge was built as part of the post-quake reconstruction project like the Eitai Bridge, and Tokyo Ishikawajima Shipbuilding & Engineering participated in the construction work. A total of 4 460 tons of steel was used to build this bridge. Completed in 1928, the Kiyosu Bridge shows off the beauty of a modern bridge designed as a mechanically rational structure. Designed by using state-of-the-art technologies in material, structural form and construction methodology, the Kiyosu Bridge is deemed as one of the most important suspension bridges built at that time.

Both the Eitai Bridge and the Kiyosu Bridge have many rivets installed throughout their structures by our predecessors. They add an accent to the structural beauty of the bridges and represent the high level of craftsmanship in those days, but such rivets are no longer used in bridge construction today.

The Kachidoki Bridge is a bridge built between Tsukiji and Tsukishima. Both ends of this bridge form an arch bridge, and its middle section is a bascule bridge that opens upward. Contracted by the Tokyo municipal government, Tokyo Ishikawajima Shipbuilding & Engineering fabricated the girder of the arch bridge on the Tsukishima side. There were only a few large bascule bridges in the world, and the Kachidoki Bridge, which was completed in 1940, was one of them and built using state-of-the-art technology at that time.

The last bascule bridge operation of the Kachidoki Bridge in 1970
(Photo courtesy of the Civil Engineering Library of the Japan Society of Civil Engineering, photo taken by Takashi Yasukochi)

Kachidoki Bridge
(Source : “Historic Iron & Steel Bridges (Kanenohashi.com)” Website of the Japan Society of Civil Engineers)

This bridge is known as an important structure that represents a high level of technology.

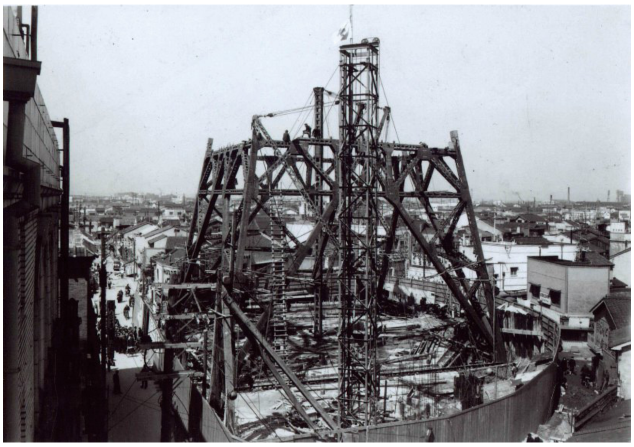
In 2007, the three bridges — Eitai, Kiyosu and Kachidoki — were designated by the Japanese government as important cultural properties to be the leading example of each time period or type. As for the selective requirements, the Eitai Bridge and the Kiyosu Bridge were recognized as “excellent in design and technology,” and the Kachidoki Bridge as “excellent in technology.” In 2017, the bascule bridge mechanism of the Kachidoki Bridge was designated by the Japan Society of Mechanical Engineers as part of Japan’s “Mechanical Engineering Heritage” that forms a cityscape of historical importance.

Tsutenkaku Tower and Tokyo Tower

The present Tsutenkaku Tower, a symbol of Japan’s post-war reconstruction and a well-known symbol of Osaka, was built in 1956 as the successor of the old one. This present tower was designed by Tachu Naito, one of Japan’s leading structural engineers of buildings at that time.

The structural steel materials used for the construction of the Tsutenkaku Tower were fabricated by Matsuo Bridge Co., Ltd. (now IHI Infrastructure Systems Co., Ltd.). The steel materials used consisted mainly of shaped steel such as angles, and they were high-quality galvanized steel materials. The total amount of steel used was about 690 tons.

The people involved in the tower construction project had a hard time calculating three-dimensional coordinates because computers were not available in those days. The design team and the shop drawing team worked jointly to manually perform numerous calculations of the locations of joints and the angles of inclined structural materials. Since there were few structural materials identical in shape and size, a large



Tsutenkaku Tower under construction
(Source : Website of the Tsutenkaku Tower)

Tsutenkaku Tower
(Photo courtesy of Tsutenkaku Kanko Co., Ltd.)

Tokyo Tower
(Photo courtesy of TOKYO TOWER Co., Ltd.)

Tokyo Tower under construction
(Source : Website of IHI Infrastructure Systems)

number of working drawings based on calculation results had to be produced (according to *A 70-year History of Matsuo Bridge*, Matsuo Bridge Co., Ltd. Company History Compilation Committee, 1996, in Japanese).

In 1996, 40 years after its completion, the tower was inspected in preparation for renovation work. The inspectors were surprised because all the steel frames were perfectly in place and free from rust, according to *Tsutenkaku: A Story of People and Town* (City News Department, Yomiuri Shimbun Osaka, 2002, in Japanese).

In 2007, the Tsutenkaku Tower was designated as registered tangible cultural property as a property contributing to the formation of Japan's historical landscapes. Furthermore, the Tsutenkaku Tower has a 30-year maintenance plan and received the BELCA Award in Long Life category in 2018 from the Building and Equipment Long-life Cycle Association (BELCA), a public interest incorporated association that promotes extending service lives of buildings by gathering knowledge of various industries.

The Tokyo Tower, another structure symbolic of Japan's post-war reconstruction, has served as a broadcast tower since its completion in 1958. It was designed by a design team led by Tachu Naito. At the time, its height of 333 meters was 13 meters higher than the Eiffel Tower in Paris, France, and it was the tallest self-standing steel tower in the world.

In the Tokyo Tower construction project, Matsuo Bridge fabricated the structural steel frames for the section from the ground level up to a height of 140 meters (about 10 meters above the main observation deck). The total amount of steel materials fabricated by Matsuo Bridge was about 2 860 tons, about 75% of the total weight of the steel used.

As soon as the contract was awarded, the construction staff members went to Osaka to ask for advice from the staff members who participated in the construction of the Tsutenkaku Tower. The calculation work required for working drawings and the number of working drawings subsequently produced were by far greater than those in the Tsutenkaku project. The structural steel used was carefully treated in order to maintain soundness for a long period of time. To be more specific, to enhance the rust prevention effect by uniforming the paint finish, structural members that had undergone primary treatment were shot-blasted to completely remove steel surface rust and mill scale and to be given primer coating just before erection (according to *A 70-year History of Matsuo Bridge*).

In 2013, the Japanese government designated the Tokyo Tower as a registered tangible cultural property "contributing to the formation of Japan's historical landscapes." In addition, the Tokyo Tower is being properly maintained as a broadcast tower for public broadcasting and received the BELCA Award in Long Life category in 2009.

A final word

There are structures that have become part of beautiful landscapes, and we can enjoy their views for many years. Thanks to the efforts of our predecessors, this has been possible. In closing, we would like to take this opportunity to express our heartfelt appreciation to those individuals who have made painstaking efforts to give those structures life.

(Text by IHI Engineering Review Editorial Office)