

The seismic retrofitting of the Kamihirai Flood Gate

Member company

NIPPON STEEL Stainless Steel Corporation

The Challenge

1. In recent years, natural disasters have occurred more frequently and more severely, which causes great damage to people's lives.
2. In preparation for Tokyo Inland Earthquake, the Tokyo metropolitan government is proceeding with seismic retrofitting of flood gates installed for tsunamis and storm surges. The Kamihirai Flood Gate is 30m wide and 9m high, making it one of the largest of them.
3. Since the Kamihirai Flood Gate is located in a residential area, it is particularly difficult to coordinate the repainting of the gate leaf. Therefore,

the Tokyo metropolitan government decided to renew the gate leaf to all-stainless steel to meet the latest standards.

4. However, when conventional stainless steel such as SUS316L is used, the weight increases significantly, resulting in insufficient strength of the flood gate post. For this reason, it was initially considered difficult to make the Kamihirai Flood Gate entirely stainless steel.

Why?

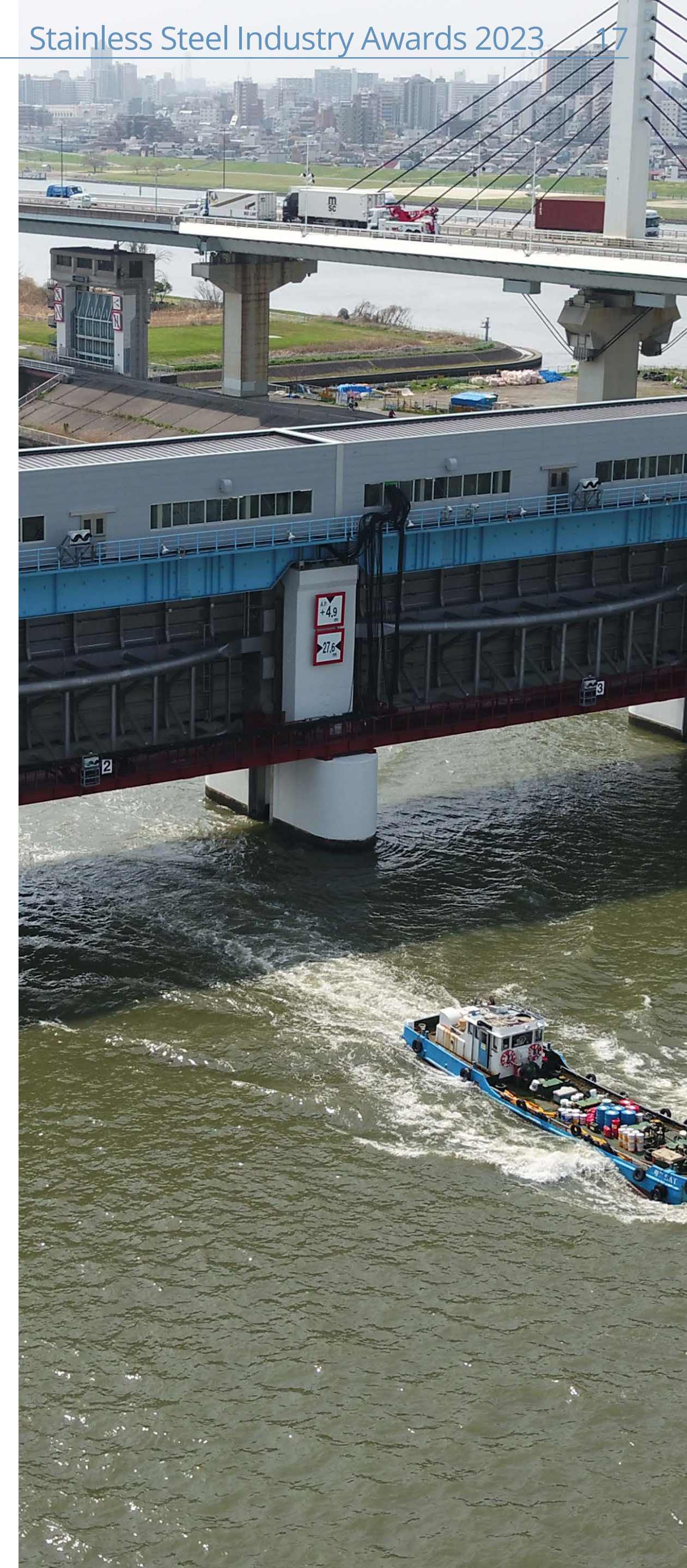
1. There are many flood gates in Japan for tsunami or storm surge, including the Kamihirai Flood Gate. Since most of the large flood gates are made of carbon steel, regular repainting maintenance work is required.
2. However, in Japan, the working population is rapidly declining, and the

number of young people who want to work in the construction industry is decreasing. There is a serious shortage of workers for repainting maintenance of steel structures.

3. Making the gate leaf entirely stainless steel provides a radical solution to these problems. Switching the material of large scale steel structures to stainless steel was rare and technically difficult. However, if this challenge could be overcome, we believe it would be possible to contribute to the national resilience of Japan, and at the same time, it would lead to the creation of a large demand for stainless steel plates.

Needed action

1. In order to ensure the seismic performance of the flood gate post, an increase in the weight of the gate was





Kamihirai Flood Gate (Temporary assembly at fabrication plant)

not allowed. In addition, the stainless steel used for the gate leaf needed to be of high strength to comply with the latest stringent seismic standards

3. Therefore, a welding technique was developed for Uranami welding of large-diameter duplex stainless steel pipes, especially a high-level technique

2. For meeting these requirements, it was decided to use duplex stainless steel as the material. The Kamihirai Flood Gate was particularly difficult to manufacture because it is the only structure in Japan that uses a Vierendeel structure with large diameter pipes.

that enables the production of high-quality welded joints by on-site welding.

Action Review

Specific: 1. In order to comply with the latest seismic standards, it was necessary to avoid increasing the weight of the gate leaf, and materials with high strength and high corrosion resistance were required. For that reason, duplex stainless steel was adopted for the entire gate leaf.

2. In examining the adoption of duplex stainless steel, we developed an Uranami welding technique for large-diameter pipes with a diameter of 1 meter, and confirmed that the required corrosion resistance, strength, toughness, and appearance could be secured.

Measurable: The gate leaf became larger and lighter; The weight of the gate leaf

before the renewal was 210 tons. Even after the renewal with duplex stainless steel, the weight was kept at 210 tons, despite the fact that the area of the gate leaf was increased by about 22%.

Achievable: 1. By adopting high-strength duplex stainless steel, the weight of the gate leaf was not increased. Therefore, it was able to meet the latest seismic standards.

2. The use of highly corrosion-resistant duplex stainless steel eliminates the need for repainting maintenance and reduces future maintenance costs.

3. The Kamihirai Flood Gate is the only flood gate in the world with an elegant appearance of the pipe Vierendeel structure made of duplex stainless steel. It is popular with residents as a local landmark.

Realistic: 1. In order to produce high-quality welded joints, we optimized the groove shape of the welded part, selected the optimum welding material, the composition of the shielding gas, and controlled the amount of welding heat.

2. Established Uranami welding technology for duplex stainless steel large diameter pipes.

Time-bound: The renewal work of the Kamihirai Flood Gate was completed within the original deadline as the main construction work, excluding related work.

Horizontal Expansion Capability

Through the renewal of the Kamihirai Flood Gate, the manufacturing technology and construction technology for structures using duplex stainless steel have improved. These technologies can be used

horizontally on a global scale as measures to improve the LCC of river structures that are becoming larger scale.

Outcome

The success of the Kamihirai Flood Gate renewal project has demonstrated that duplex stainless steel is suitable as a material for large-scale steel structures and has great potential as a structural steel. Duplex stainless steel is becoming the standard material for river structures in Japan. Through this project, we are proud to have contributed to the national resilience of Japan by working together with the people involved in the project.

Other comments

1. It is worthy of praise that the Kamihirai Floodgate has been renewed for five years without losing its function as



Kamihirai Flood Gate (Full view of flood gate(from upper stream side))

1. As the flood gate became larger, the
2. As the flood gate became larger, the

a tidal gate and protecting the local residents.

opening of the gate was widened, which contributes to the improvement of the safety of ships passing under the flood gate.