Bosai Solution ID : JBP00128

AUTO GATE

Non-powered automatic opening/closing gate

Hazard

Tsunami Cyclone Storm Surge Flood

Solution Purpose

Prevention & Mitigation Preparedness

Solution Theme

Infrastructure Technology Building Technology Products & Goods

Technology Subject

River & Basin Coast Port Facility for Disaster Prevention Emergency Base & Back-up Facility Machinery & Equipment

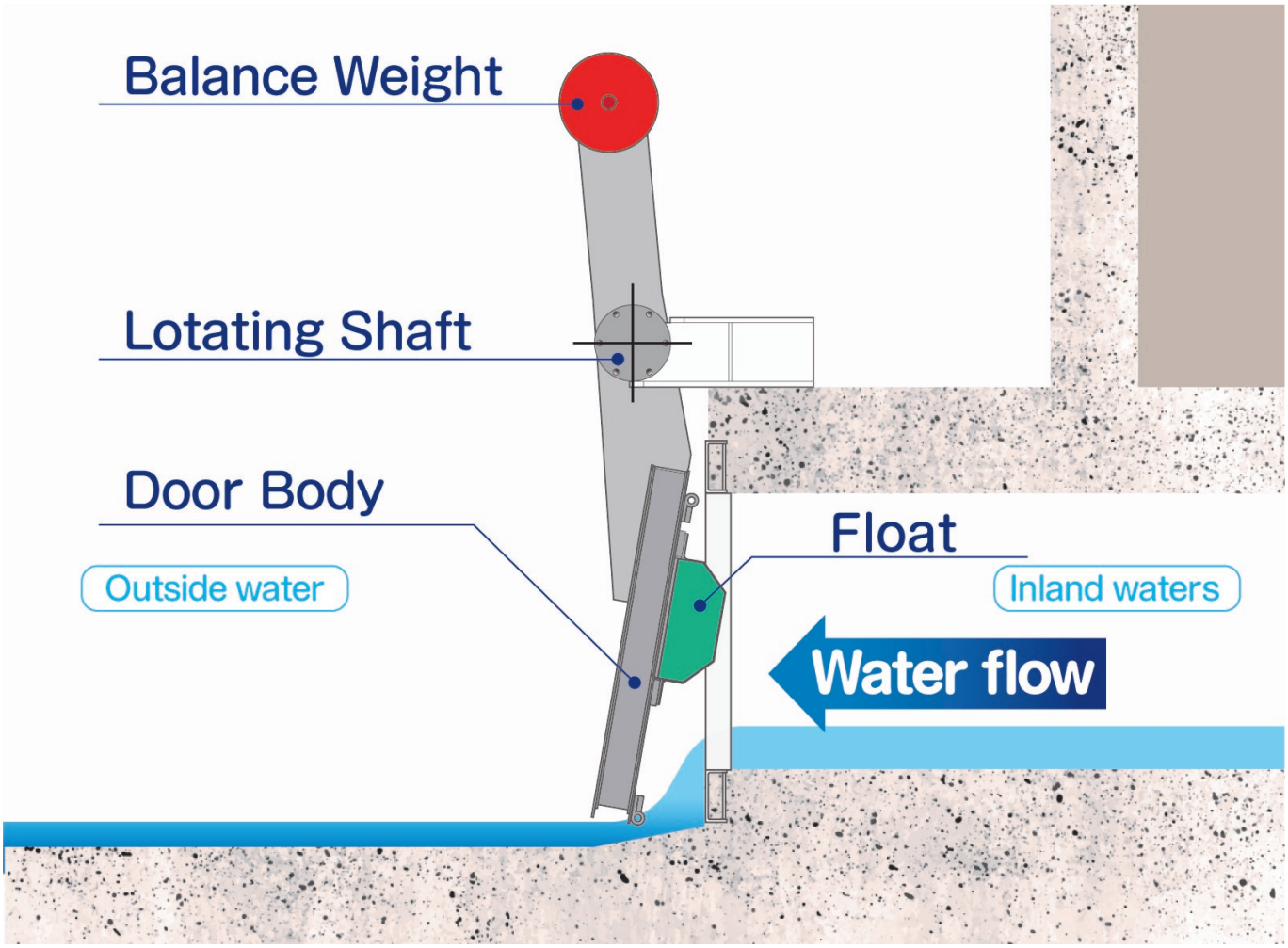
Advantages

【AUTO GATE（Non-powered automatic opening/closing gate）】
Comparison with pull-up gate
・Since it opens and closes automatically according to water level conditions, you will not miss the timing of opening and closing even in the event of a sudden flood.
・This reduces the administrator's workload and eliminates human errors such as operational delays and operational errors.
・Gate pillars and maintenance bridges are no longer required, reducing costs and construction time.
・Since it is non-powered, it can be installed in locations where power sources such as electricity cannot be secured.
・The automatic opening/closing mechanism is simple and easy to maintain, reducing maintenance costs.
・The gatepost-less structure reduces the impact on the landscape.
・This eliminates the need to work at heights during construction, improving worker safety.

Solution Illustrated

【Auto gate structure】

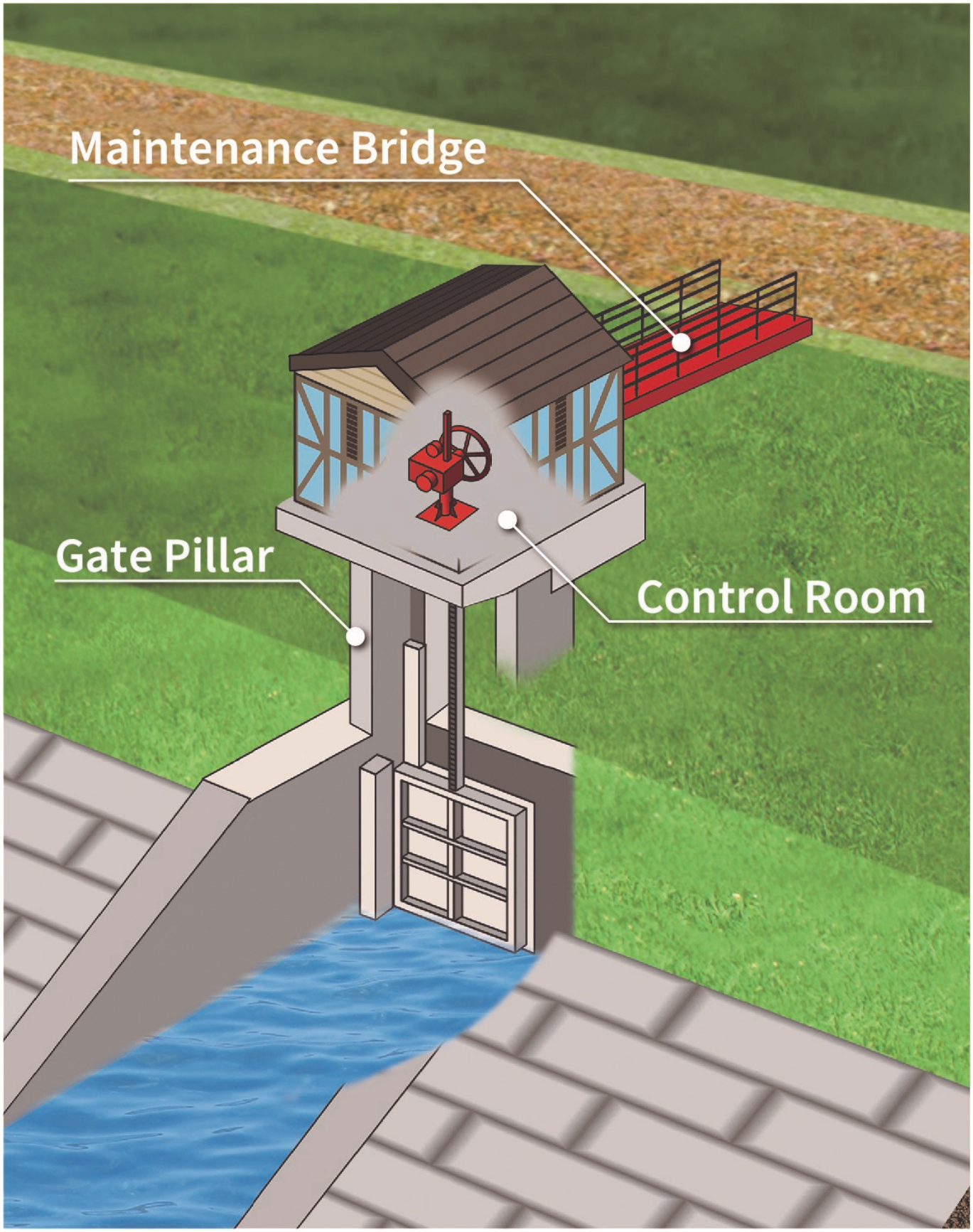
The auto gate (drawing below) is a gate equipment that has various improvements made by attaching balance weights, floats, etc. to a flap-type gate to solve the problems of conventional flap gates and improve the reliability of automatic opening and closing. is. Normally, the door body and balance weight are balanced by opening approximately 8 degrees. A balance weight is attached to the opposite side of the door via the rotating shaft, reducing the opening and closing force of the door using the see-saw principle. Due to this balance function, it has quick drainage performance even under normal conditions, and when removing inland water, the door body can be opened wide to allow a large amount of drainage to flow, and floating matter such as garbage can also flow down at the same time. In addition, when the outside water level has risen to prevent backflow, this gate equipment can automatically close the gate without power by using a float attached to the back of the gate.



Background

【Popularization of auto gates】

Sluice gates temporarily close the gate to prevent backflow into tributaries (inside the levee) when the water level (outside water level) of the river rises due to heavy rain or typhoons, etc., to prevent flooding within the levee. Masu. As for the types of gates installed in sluice gates, pull-up gates such as roller gates and slide gates (drawing below) are often used, but the power for these gate opening and closing machines is electric (motor) or human power. It will be. Gates are operated by experienced operators, and in order to minimize damage, it is important for the operator to judge whether to open or close the gate. However, operating gates during floods is dangerous, and the aging and shortage of operators is also a problem, so automatic opening and closing of sluice gates is attracting attention. Especially for small-scale sluice gates, the installation of non-powered automatic opening/closing type gate equipment is increasing.



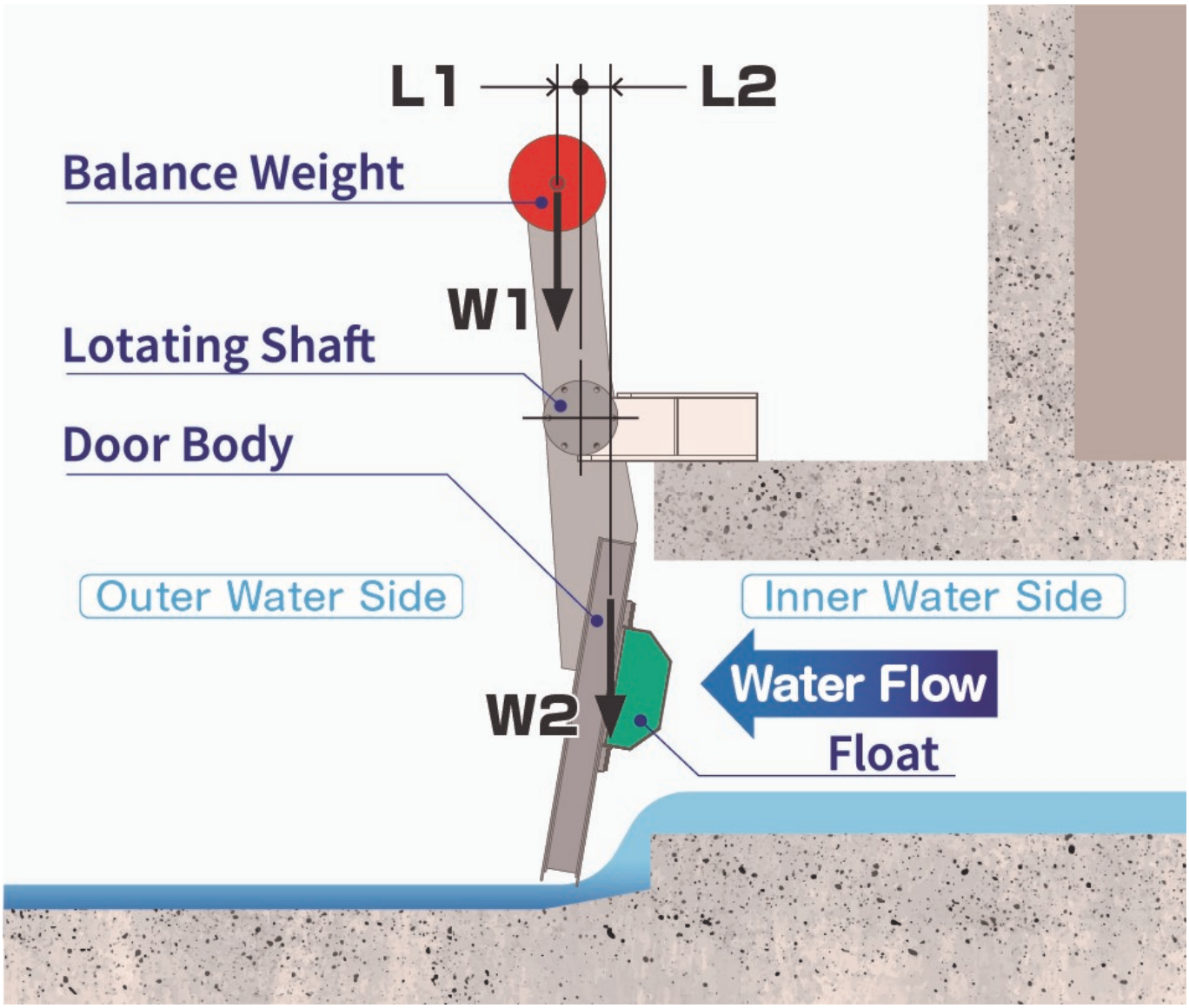
Exposition of the Solution

【How the auto gate works】

The automatic opening/closing mechanism of the auto gate is achieved by placing balance weights and floats in a well-balanced manner. Due to the function of the balance weight, the opening/closing force of the automatic gate is approximately 1/5 of that of a flap gate.

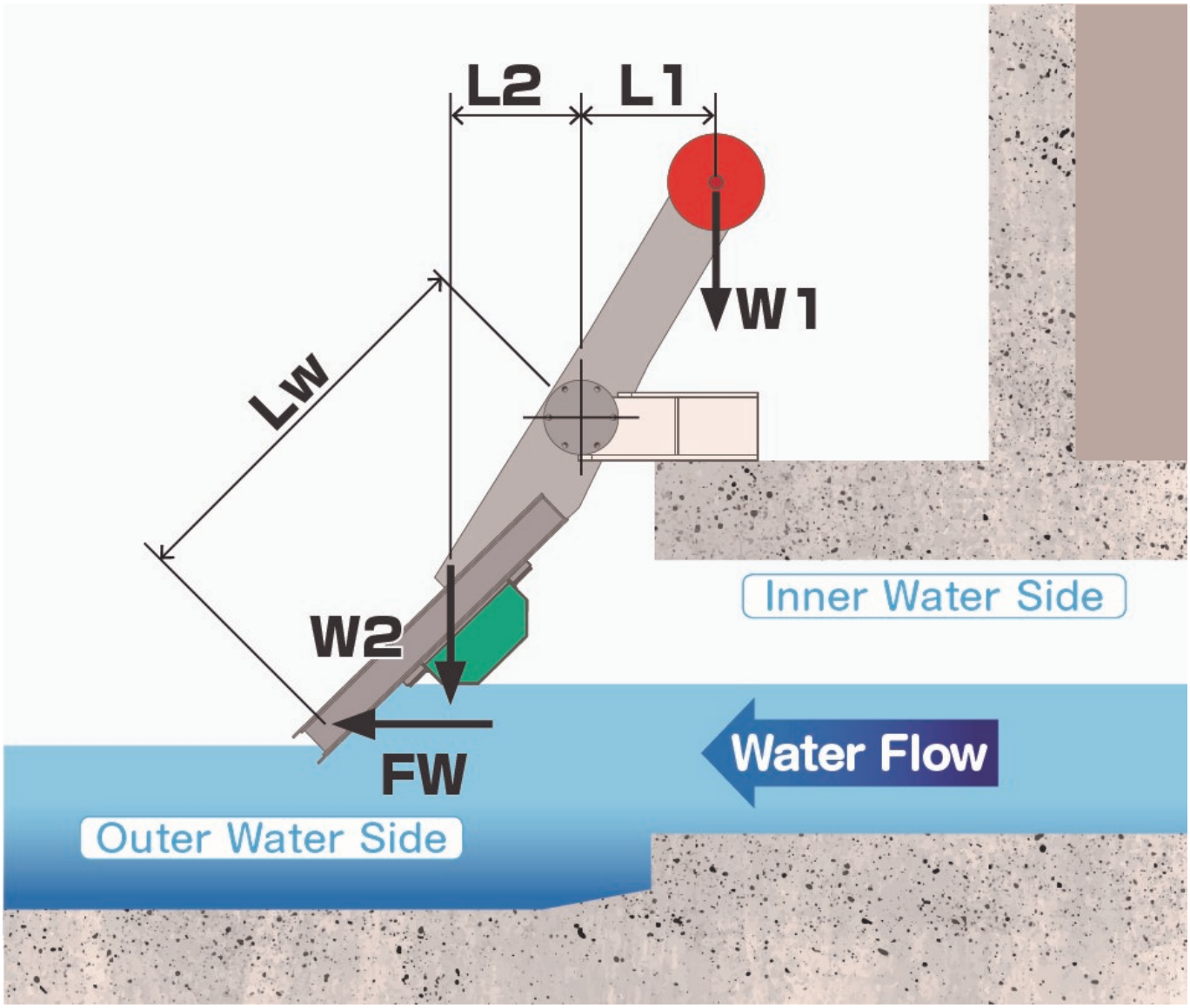
「Normal time」
By placing the rotation axis in front of the door body, the center of gravity of the door body moves below the rotation axis, but the position where the door body stops in balance with the forward-tilted balance weight is as shown in the figure below. It will be open approximately 8 degrees.

W1 × L1 (Weight self-weight moment) = W2 × L2 (Door body weight moment)



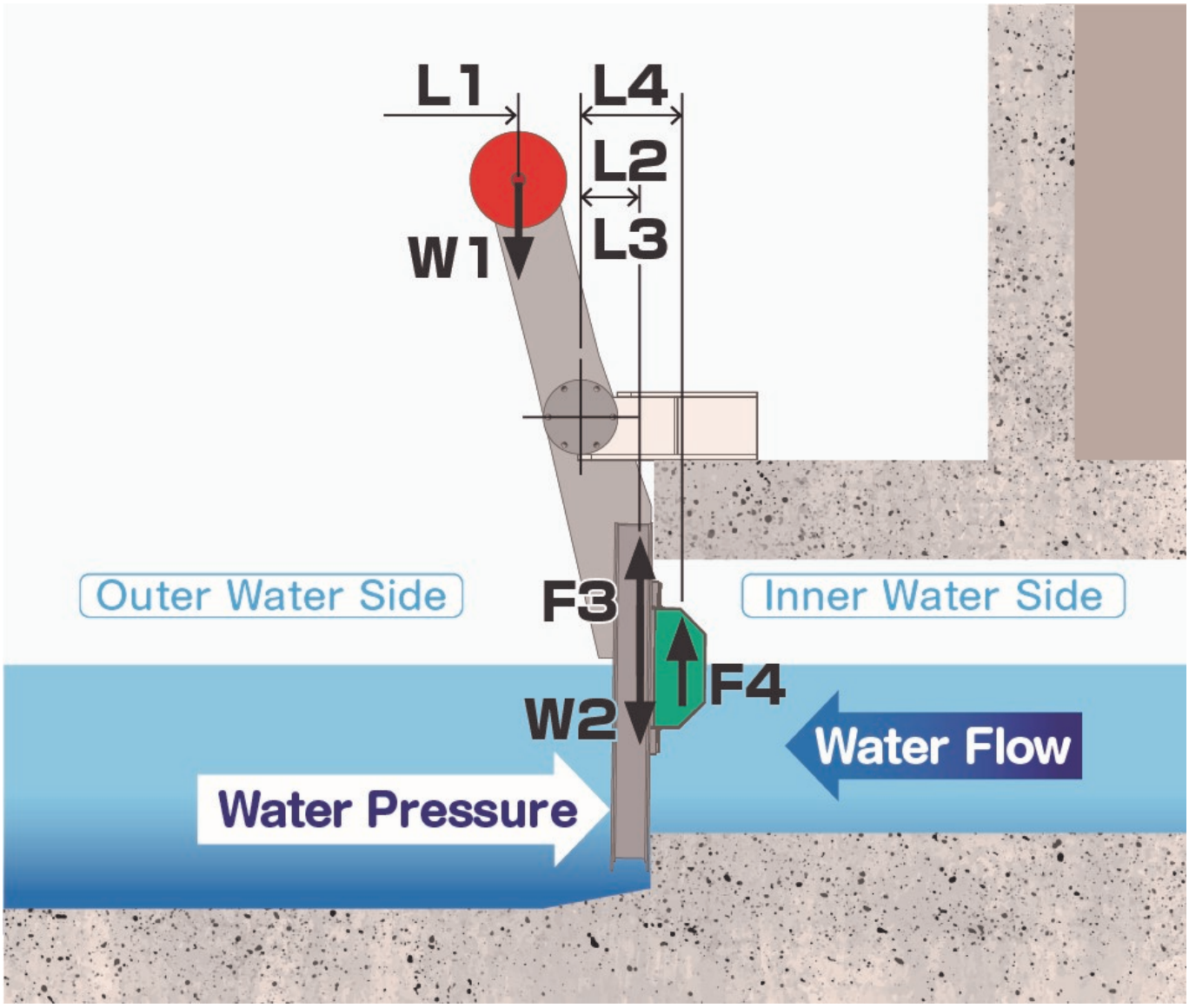
「When removing internal water」
When the door opens under the dynamic pressure of the flowing water, the rotational moment of the balance weight acts in the direction of opening the door, making it possible to open the door wide with a small difference in water level. When the float comes into contact with water, the door opens further, but when the flow of water stagnates, the opening of the door quickly returns to its normal state.

W1 × L1 - W2 × L2 = Fw × Lw（Opening moment due to water pressure）



「When preventing backflow」
When the water level rises, the buoyancy of the gate body and the buoyancy of the float act as a rotational moment in the direction of closing the gate body, completely closing the gate. The water depth at which the valve is fully closed is normally designed to be 70% of the outlet height, but by changing the float installation position, the water depth at which it is fully closed can be changed (30 to 80% water depth).
Even when the gate is fully closed, if the internal water level rises above the external water level, the gate opens slightly and drains the internal water.

W2 × L2 - W1 × L1 ≦ F3 ×L3 + F4 × L4（Closing moment due to buoyancy of door body and float）



【Auto gate effect】

The function of automatically opening and closing without power not only reduces the labor of the operator, but also enables reliable flood control management without missing the timing of opening and closing the gate. Heavy rains have been occurring frequently in recent years, and we can respond accurately to such sudden flooding. Additionally, when river water levels rise, local residents, including operators, may be advised to evacuate, but even in such cases, the gate has a function to automatically close, minimizing damage to the local area. It is possible to quickly stop the water and deal with it after the water rises.

Achievements of Examples

Facility name：Yasashi Sluice
Gate size: 4.50m x 2.70m , quad
Location: Asahi City, Chiba Prefecture

Facility name：Kamikura River Drainage Sluice
Gate size: 3.20m x 2.00m , double
Location: Yamada Town, Iwate Prefecture

Facility name：Izaributo Minami No. 22 Sluice
Gate size: 3.20m x 2.00m
Location: Titose City, Hokkaido

ASAHI PIERLESS GATE

AUTO GATE

Balance-type non-powered gate

Won the Prime Minister Prize
The 5th Manufacturing Japan Grand Prize
Development of a non-powered automatic gate (auto gate) that protects people from flooding

- Realization of unmanned gate operation
- Countermeasure for tsunamis and tidal waves
- Use of pierless type to prevent the obstruction of scenery
- Reduction of costs

Certifications obtained ISO 9001 ISO 14001 ISO 45001
ASAHI INOVEX CORP.

AUTO GATE Balance-type non-powered gate

Proposal for the balance-type non-powered gate, a revolution in the advancement of sluice gates

Thanks to automated operation and a maintenance-free structure, Auto Gate has reduced the cost of public works. This eco-friendly gate does not spoil the surrounding scenery and excels in safety.

Merits of the balance-type non-powered gate

Merit 1 Unmanned operation became possible by an automatic gate structure.

The gate automatically opens and closes using a balance weight and float even when the difference in water level is minimal. This automatic gate has been used to realize unmanned operation without a sluice supervisor even in places where a power source such as electricity is unavailable.

Merit 2 Countermeasure for tsunamis and high waves

Since Auto Gate automatically opens and closes depending on the water level, it eliminates the need for gate operators even in the event of a tsunami or high water and prevents operators from engaging in such dangerous work.

Merit 3 Pierless gate does not spoil the surrounding scenery.

This pierless structure is perfect for places where importance is placed on riverscapes. It also helps ensure adequate visibility.

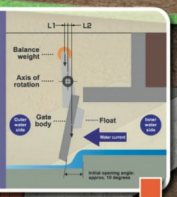
Merit 4 Reduced costs

The pierless structure does not incur cost for constructing piers and control bridges. The costs can be reduced 30 to 40% by combining the gate and flexible caissons.

Mechanism behind Auto Gate's automatic operation

Mechanism 1 Normal times

The gate remains stationary where the torque at the center of gravity of the gate body (opening direction) and the torque at the center of gravity of the balance weight (closing direction) are equally balanced.

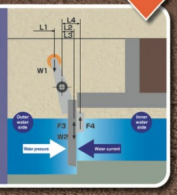


Mechanism 2 When inner water is discharged

The balance weight helps the gate to open by principle of leverage downward and the float also helps the gate to open by principle of buoyancy.

Mechanism 3 When backflow occurs

When outer water level rises, causing backflow pressure to increase, both the balance weight and the float begin to work to close to the gate.



- The balance weight installed above the gate creates a mechanism with small gating power. Accordingly, the gate opens and closes automatically even when there is little water-level fluctuation.
- The axis of rotation is set above and in front of the gate body. This helps keep the gate open even under the initial condition when the water level is low, so water discharge is not hindered even when the water is shallow.
- A float is installed on the inner water side of the gate body. Accordingly, if the inner and outer water levels rise simultaneously, buoyancy acts along with the weight to quickly close the gate.

AUTO GATE Balance-type non-powered gate

The balance-type non-powered gate achieves various effects.

Non-powered sluice gates, countermeasures for tsunamis, and consideration for scenery

Renovation of a conventional lift-type gate to a non-powered Auto Gate


Existing sluice


Renovation to create a non-powered Auto Gate

Non-powered gate as a countermeasure for tsunamis and tidal waves (sluice equipment at the river mouth)

Auto Gate is installed in front of the existing slide gate as gate equipment used as a countermeasure for tsunamis.


Existing gate


Installation of Auto Gate in front of the existing gate

Auto Gate is open at normal times, but is automatically and effortlessly closed by the action of a balance weight if the water level suddenly rises due to a tsunami or torrential rain.
In addition, when the outer water level lowers, the gate automatically opens to discharge the inner water, protecting gate operators against dangerous work.

Countermeasures for ocean waves (installed on coasts)

When installed on a coast, the gate body of Auto Gate is shaken by ocean waves. Measures are taken to reduce damage to the gate body and noise from clashing between the gate body and the door stopper.

New non-powered sluice that does not spoil the surrounding scenery


Front view

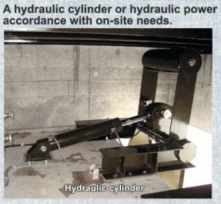

Side view

AUTO GATE Balance-type non-powered gate

Various optional functions can be added to Auto Gate in accordance with on-site needs.

Emergency gating devices

A hydraulic cylinder or hydraulic power unit (e.g., manual, electric or engine type) can be installed in accordance with on-site needs.

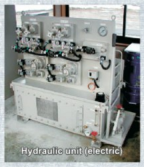

Hydraulic cylinder


Hydraulic unit (manual all-purpose product)


Hydraulic unit (manual all-purpose product)


Hydraulic unit (manual)


Hydraulic unit (engine)


Hydraulic unit (electric)

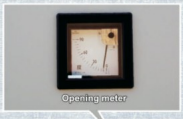

Control board

Measuring devices (solar power)

The opening of Auto Gate can be displayed using solar power alone (commercial power source unnecessary).


Transmitter


Rotating warning light (for confirmation of full closure)


Opening meter


Solar panel


Cabinet

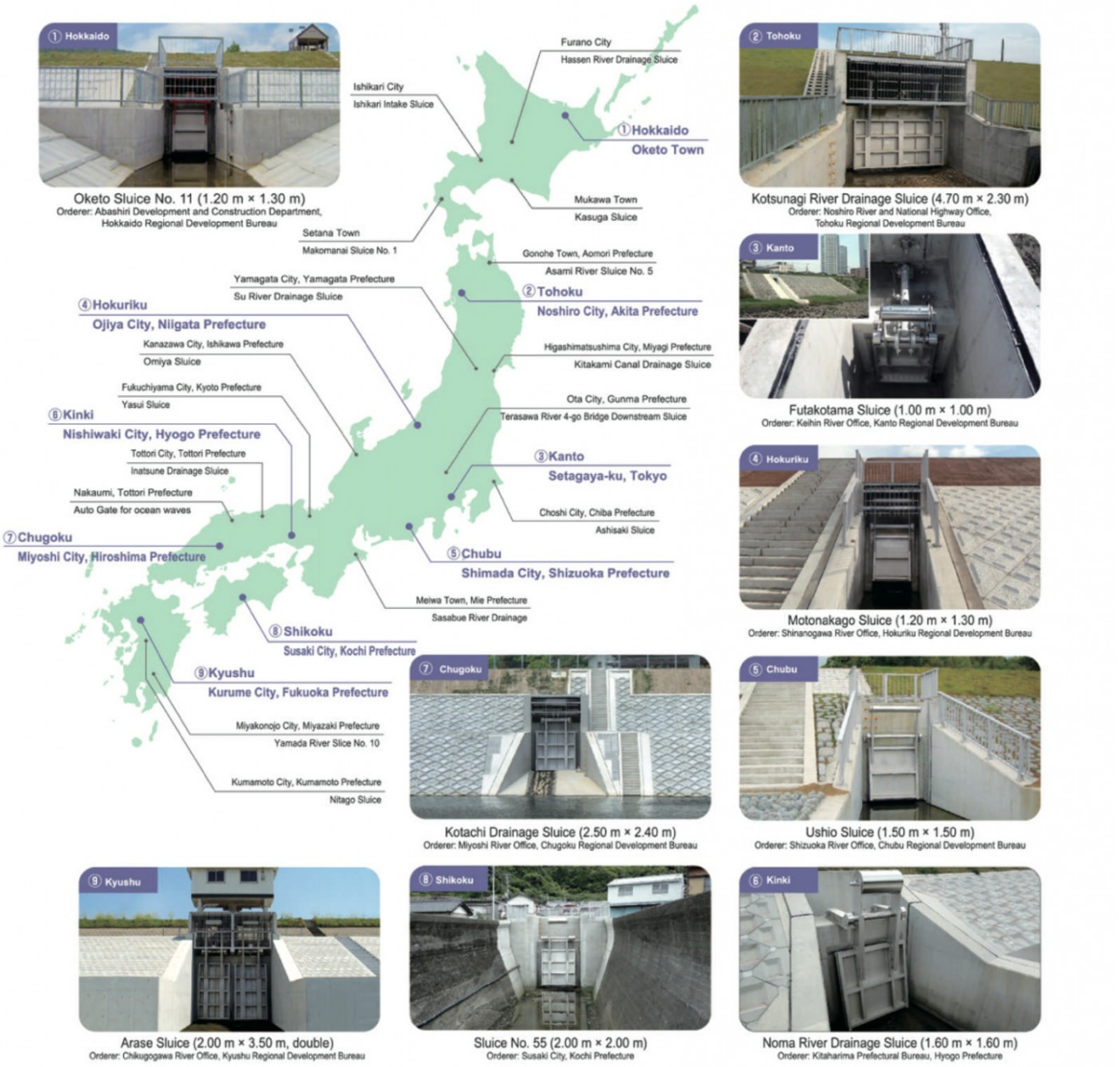

Display board (self-supporting type)


Display board (wall-hanging type)

Major installation results

2001	Tohoku Regional Development Bureau	New construction of Tawara Maki(俵巻) drainage sluice gate	2.00m×2.00m	1 gate
2004	Tohoku Regional Development Bureau	Equipment construction of Okawa Bata(大川反) drainage sluice gates	3.00m×2.75m	2 gates
2005	Kinki Regional Development Bureau	Construction of Yasui(安井) gutter pipe installation and others	2.00m×2.00m	1 gate
2006	Chugoku Regional Development Bureau	Renovation of the small water gate in Sendaigawa River(千代川)	1.70m×1.80m	1 gate
2007	Ibaraki Prefectural Government	National project for supporting wide area rivers: Drainage and gutter pipe renovation	2.25m×1.25m	1 gate
2008	Hokkaido Development Bureau	Environmental improvement project on Ishikarigawa River(石狩川): New construction of the mechanical equipments in Ishikarigawa River's water intake facility	4.00m×3.00m	1 gate
2009	Tohoku Regional Development Bureau	Construction of Kotsunagi(小繋) sluice gate in Yonesirogawa River(米代川): <Kotsunagi sluice gate>	4.70m×2.30m	1 gate
2009	Kanto Regional Development Bureau	Embankment construction in Bessho(別所)	1.20m×1.20m	2 gates
2009	Hyogo Prefectural Government	National river project by special emergency acts for severe disaster countermeasures in Nomagawa River(野間川)	1.60m×1.60m	1 gate
2010	Chubu Regional Development Bureau	Embankment, riverbank reinforcement and construction works for gutter pipes in Ushio(牛尾), Oigawa River(大井川):<Ushio gutter pipe>	1.50m×1.50m	1 gate
2010	Gunma Prefectural Government	National general grant for social capital development, division NO.3	1.00m×1.00m	4 gate
2011	Yamagata Prefectural Government	National maintenance subsidy project for wide area rivers of FY2011: Drainage and sluice gate construction in Sukawa River(須川)	1.50m×1.50m	1 gate
2012	Kyushu Regional Development Burea	New construction of gutter pipe gates and other works in Haizuka(灰塚), Kosegawa River(巨瀬川)	2.60m×2.10m	2 gates
2012	Miyazaki Prefectural Government	Prefectural independent project of FY2012, revision NO.110-24-03-4: Construction of a sluice gate outside Sin Beppugawa River (新別府川)	3.00m×3.00m	1 gate
2013	Saitama Prefectural Government	Improvement works by national general grant for social capital development for rivers: <gate construction>	2.10m×2.10m	1 gate
2014	Tohoku Regional Development Bureau	Sluice gate construction in Kawai(河井) area, Mogamigawa river (最上川) upstream: <Kawai drainage sluice gates>	3.20m×2.10m	2 gates
2014	Wakayama Prefectural Government	Governmental port coast maintenance project of FY2014 NO.5-2-3 and FY2015 NO.5-3: Coastal maintenance works for ports in Urakami Port Coast(浦神港海岸)	2.50m×2.00m	1 gate
2014	Shimane Prefectural Government	Prefectural independent project: Emergency river maintenance works for Gozugawa River(牛頭川), constructions in the lower part of Ochiai Bashi Bridge(落合橋) and sluice gate of Hiraikegawa River(平池川)	3.10m×1.50m	1 gate
2015	Hokkaido Development Bureau	Improvement works of Sarugawa River(沙流川): Construction for mechanical equipment renewal and other works on Tomigawa River's (富川) sluice gate D	4.50m×2.50m	2 gates
2015	Fukushima Prefectural Government	Fishing port construction by governmental regrant on sluice gate:<Hamakawa (浜川) sluice gate>	5.40m×2.80m	1 gate
2015	Shizuoka Prefectural Government	Governmental river project for earthquake and storm surge countermeasure of FY2015(NO.27-K2530-011)(Disaster prevention and safety grant)(Appurtenant works for the second-rank river,Ninogawa River(新野川):<Sluice gate construction of Ochaigawa River(落合川)>	4.40m×2.40m	1 gates
2016	Hokuriku Development Bureau	Kaesa(替佐) embankment and new construction of sluice gate	1.60m×1.50m	1 gate
2016	Iwate Prefectural Government	Post-disaster construction and damage repairs in Yado fishing port and coast(宿漁港海岸) <NO.23disasters-K39 Seawall machinery and equipment construction>	4.50m×3.40m	2 gates
2016	Chiba Prefectural Government	Coastal infrastructure maintenance works(Reconstruction): <Gatter pipe gate construction in Yasashigawa River(矢畑川)>	4.50m×2.70m	4 gates
2017	Ibaraki Prefectural Government	National support project for wide area rivers(NO.27-05-692-O-002): River improvement works on Ookitagawa River(大北川) (Part2)	2.50m×2.25m	1 gate
2018	Kanto Development Bureau	Improvement works in Funatama(船玉) and Isayama(伊佐山) area on the left bank of Kinugawa River(鬼怒川) in FY2018	3.00m×2.50m	1 gate
2019	Kyusyu Development Bureau	Emergency measures construction for machinery equipments in the jurediction of Kikuchigawa River(菊池川) in FY2019	2.50m×2.25m	1 gate
2020	Chugoku Development Bureau	Improvement works for the equipments and other works of Iogawa River(伯尾川)'s NO.1 sluice gate in FY2020	3.00m×3.00m	1 gate
2021	Chubu Development Bureau	New construction of sluice gate equipments of Kakogawa River (加古川) in Daimon(大門) area	3.10m×3.10m	1 gate
2022	Chugoku Development Bureau	Embankment and riverbank reinforcement construction of Sabagawa River(佐波川), Sano(佐野) area in FY2022	2.70m×2.10m	1 gate

Major installation examples



Corporate Profile

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