Incorporated Administrative Agency
Japan Water Agency

Technologies to construct a canal

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There are various technologies needed for the construction of a canal. Those are explained, as follows:

Technologies to select the site to construct a canal

In order to provide water users stably with water taken from a river and at a low cost, it is necessary to study where we have to build a canal. We need to grasp the topographical and geological features of the possible site, the status of land uses, including railways, roads and residential areas, etc. and also the possible impact on the surrounding environment. In addition, we need to have the technologies to study the system of how to deliver water economically and efficiently. It is also necessary to buy or lease the required land and compensate for it.

Technologies to determine the type of a canal

There are different types of canals such as an open canal, a pipeline and a tunnel, etc.

Such technologies are needed to study how to deliver the necessary amount of water efficiently at right timing. For that purpose, we have to determine the type of a canal, the structure and/or combination of different types, etc. depending on the topography and geology of the land and its use conditions, etc.

Technologies to repair/reinforce/reconstruct a canal

When a canal takes on aged status after a long use, it is also likely to have water transmission trouble. In addition, there is a high risk of a large-scale earthquake occurring anytime soon. Because of such a possibility, it is necessary to have the technologies to keep supplying water stably by repairing, reinforcing, and reconstructing the canal even after such an earthquake.

Technologies to construct a canal in consideration of surrounding environment

When constructing a canal, construction works such as excavating mountains affect the environment. So, it is necessary to have technologies to minimize the environmental impact of building a canal and preserve flora and fauna, landscape, and reduce noise and vibration.

Technologies to reduce the construction cost of a canal

It is important to design the facilities, and select materials, methods, and the procedures of the works for construction properly so that the completed canal can be managed safely and efficiently.

We need the technologies that can reduce these costs as much as possible.

The Japan Water Agency (JWA) has the capacity to implement those technologies comprehensively.

The following slides show some examples of technological development and ingenuity the JWA has independently worked on.

(1)Technologies to control the water flow

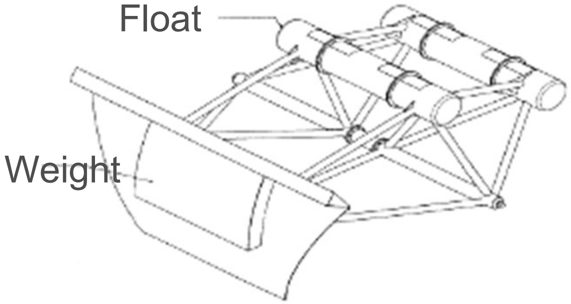
To deliver irrigation, domestic and industrial water stably to the users, it is necessary to control the flow of water properly.

For example, in an open canal, the flow of water is controlled by gates.

As there are many types of gates, it is necessary to select the most suitable type of gate for the purpose. So, we need to grasp the characteristics of the canal as to how water is used and how water flows in a canal, etc.

The JWA has been selecting the most appropriate shape of the canal and the best suitable gates through its management for over a half century.

Gate requiring no power with constant upstream water lever(Type I)



- The water level upstream of the gate is regulated automatically for keeping a constant level by the buoyancy of the float of the gate body.

Electric radial gate

- This is the gate operated to shut off and discharge the water in the canal to the outside in an emergency or for canal inspection..

Technologies to control the water flow

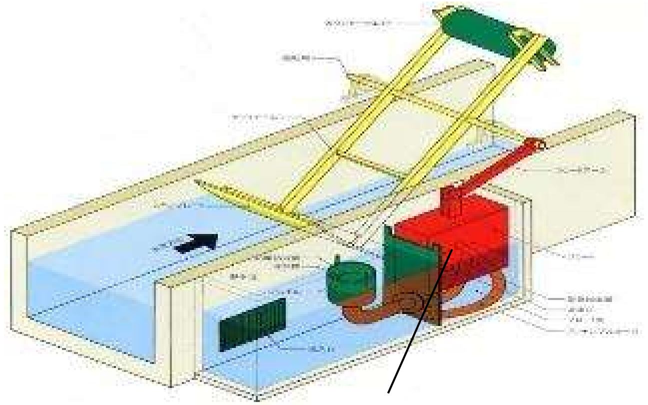
Example

Aichi Canal, which was constructed between 1964 and 1936, was reconstructed from 1981 to 2004 due to the increase in water demand accompanied by the development of the region and the progress of aging of its facilities.

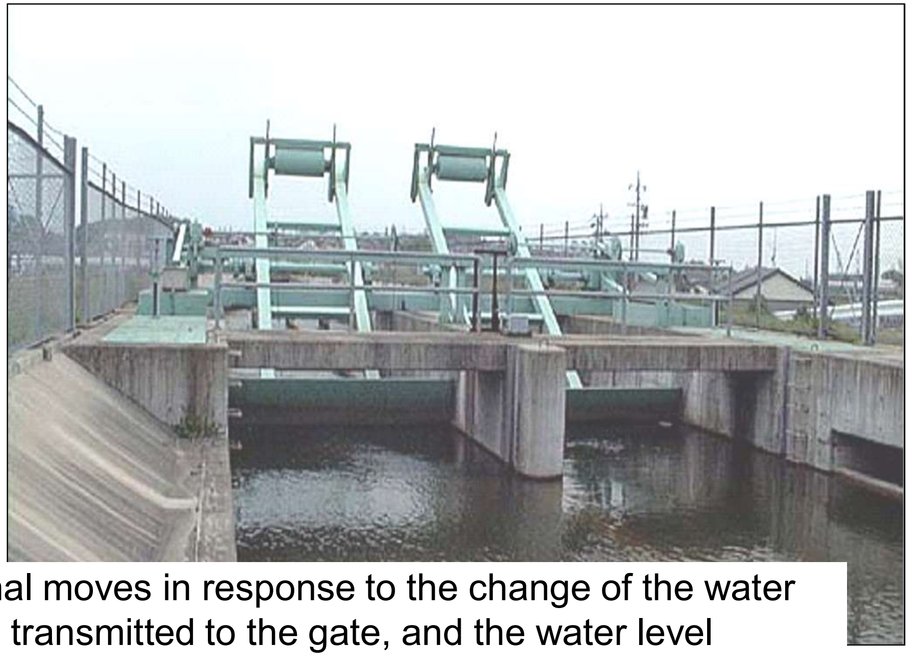
The system to control water flow in Aichi Canal employed the mechanism that "automatically keeps the water level upstream of the gate constant, using buoyancy". At the time of the reconstruction, we installed a new gate (Type I → Type II) that can control the water flow without changing the basic mechanism.

This gate moves in response to the change in water level upstream of the gate, which increases the reliability of operation and does not require manual operation, so management cost can be reduced.

The gate (Type 2 gate) keeps the water level upstream constant, using buoyancy



The float to detect the water level upstream of the gate)



- The float inside the water tank installed beside the canal moves in response to the change of the water level in the water tank, and the movement of the float is transmitted to the gate, and the water level upstream of the gate is automatically adjusted to a constant level, using buoyancy.

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(2)Technologies to take water from a stream

As there was no large river for a water source in the area where Mie Canal was constructed, it was planned to take water from the mountain stream. It was built between 1964 and 1992.

When constructing intake facilities in the mountain stream, it was necessary to design them in consideration of the followings:

-Stable water intake regardless of sudden changes in the stream flow

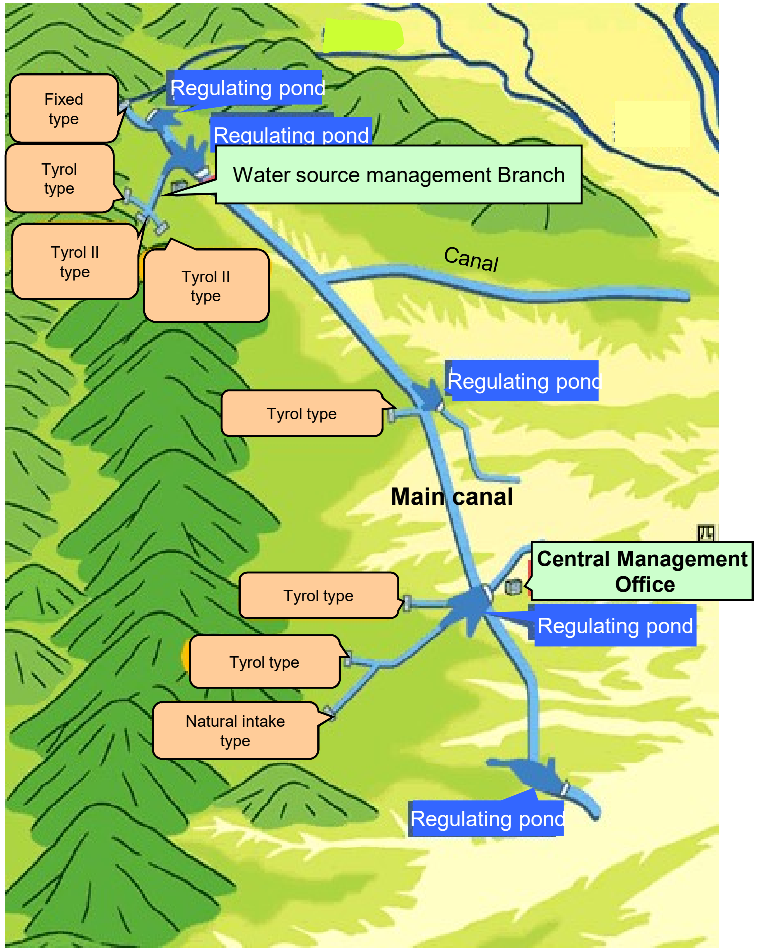
-Sturdy facilities against rocks and woods that flow down the stream at the time of flooding

-Simple structure for easy maintenance

-Structures not ruining the surrounding environment and flow regime

Stream Intake Works in normal time

Stream intake works in flood time



Plan view of Mie Canal

(Types of stream intake works are shown on the next page.)

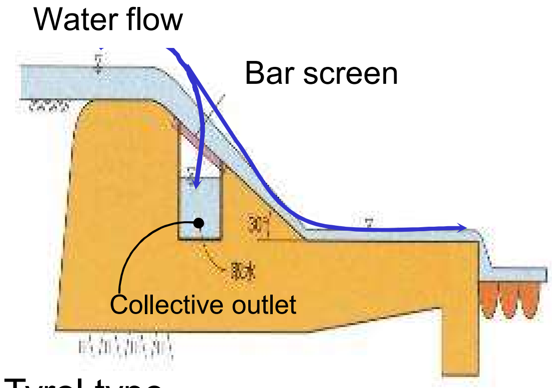
Technologies to take water from a mountain stream

Technologies to build a canal

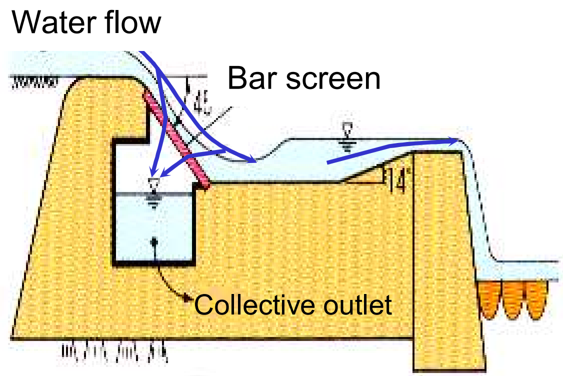
Japan Water Agency

When taking water from the stream, it is important not to violate existing water rights of those who already have used the water.

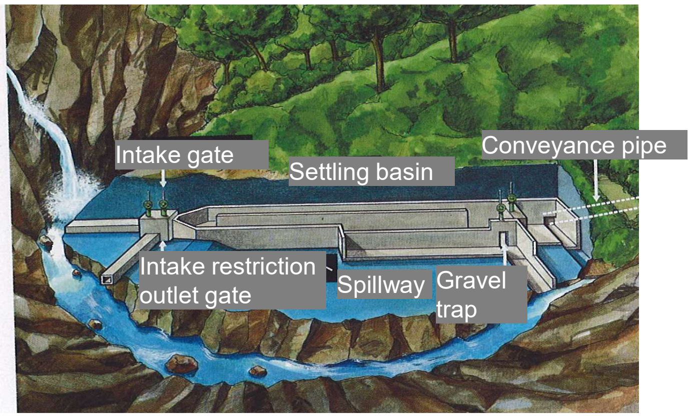
So, when we take the water, we employ the mechanism to limit the amount of water we can take in summer and winter respectively and also to return excess water back to the stream.



◆Tyrol type
Applied to a stream that has small amount of sediment inflow from the upstream.



◆Tyrol II type
Having advantages of both Tyrol type and Backstream type.



◆Natural intake method
Water is taken from the basin bottom of a waterfall through a tunnel.

◆Intake gate method
Adopted at the location where complicated intake operation is needed.

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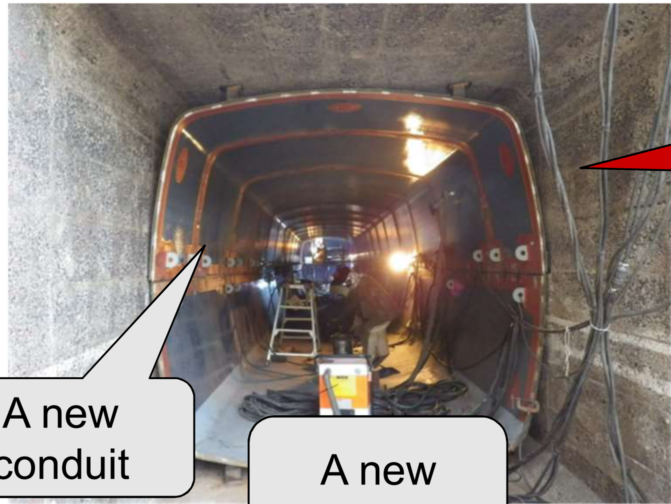
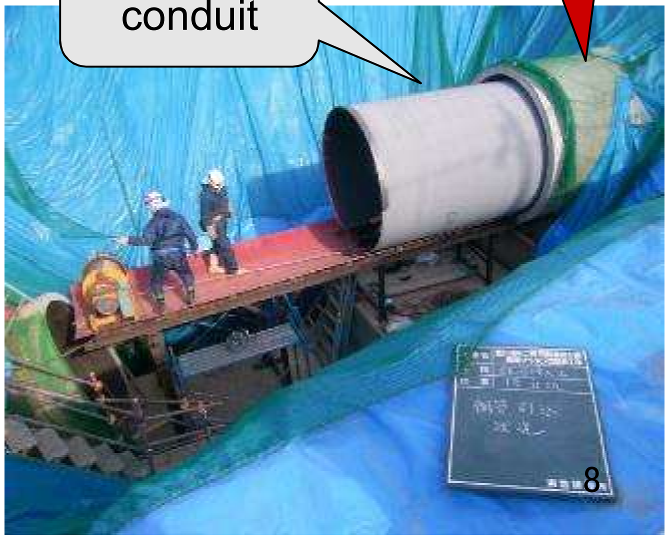
(3)Technologies to upgrade an existing canal to be more earthquake-resistant (1)

Reconstruction of more sturdy canal without suspending water supply.

Installation of a new durable conduit inside the old one.

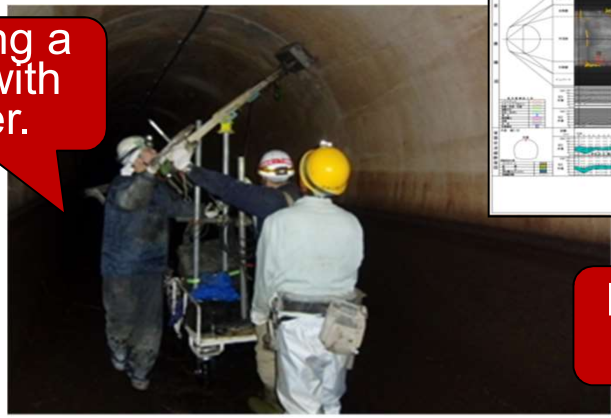


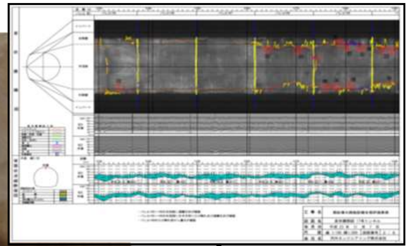


(3)Technologies to upgrade an existing canal to be more earthquake-resistant (2)

Replacement work of an existing pipe with a new one that can correspond to ground displacement.

Maintenance works to fill filler in the cavity behind the tunnel wall.





(4)Technologies to strengthen the facilities to be earthquake-resistant

Reinforcing the structure by inserting steel bars to make it sturdy against an earthquake.

Drilling

Reinforcing an embanked dam body by inserting steel pipe piles into the ground just upstream of the dam body.

Inserting series of steel pipe piles

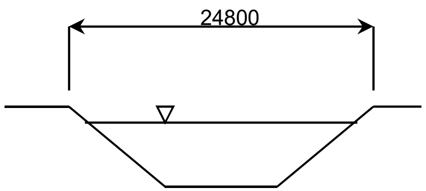
(5)Technologies to construct a environment-friendly canal suited to the locality

The JWA gives extra considerations to the local environment, including scenery and ecosystem and its conservation when constructing a canal.

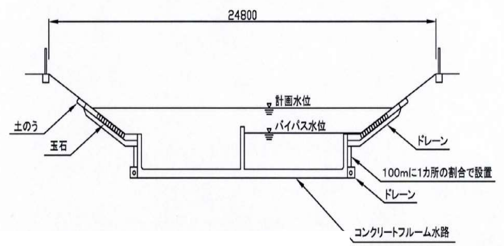
Applying an arch design on the bridge crossing over Musashi Canal, we created an attractive appearance.

When reconstructing Saitama canal, we built a walkway with embedded tiled pictures drawn by local school children.

We implemented conservation measures for the fireflies living in the stream, which was running into the regulating pond. （Kagawa Canal）



Before reconstruction



After reconstruction

We reconstructed aged Aichi Canal, taking a special care not to ruin the natural environment along the canal.