

One of the greatest accomplishments Outstanding wisdom and skill of waterworks

"I was bathed with waterworks right after being born." This was a boastful expression often used by those born in the Edo Period. At the time when most water used at home was drawn from reservoirs or other natural sources, waterworks to people was a symbol of Edo, the city with a million people. Though it was not equal to our modern waterworks in which water comes out as soon as we turn the faucet, supplying water to the whole town of Edo was a marvelous accomplishment.

The history of waterworks in Edo dates back to 1590. When Tokugawa Ieyasu entered Edo to establish it as his new capital, he began city planning in preparation for the founding of the Edo Shogunate. As Edo lay on marshy land close to the coast, the ground water contained a great deal of salt, making it unsuitable for drinking water. Accordingly, Ieyasu immediately began a project to secure drinking water, as it was essential to the people's lives. He assigned his retainer, Okubo Togoro, to build a waterworks, called the Koishikawa Channel the first waterworks in Edo (later known as the Kanda Channel). This temporarily provided an ample supply to the town of Edo for the first 50 years, but with the population increasing, the Kanda Channel became insufficient to support the water needs of Edo people. In 1653, construction of a new water supply route, the Tamagawa Channel, was implemented, bringing water from the abundant supply of the Tama River.

The distance between Hamura (present day Hamura City, Tokyo), located in the northwest of Edo, and Yotsuya Okido (present day Shinjuku Gyoen National Garden) at the center of Edo was approximately 43 km, about twice as long as the Kanda Channel. At that time, the flow of water depended on its natural flow from a higher to lower place, but the slope between the two locations was at a very low angle of only about 92 m, far too small in comparison to its long distance. They had no choice but to measure the altitude of the route foot by foot. A weir made of bamboo, wood or stones as well as floodgates was built in the upper stream of the Tama River. Water guards checked the

changeable water flow at the gate, thus controlling the opening of the floodgate according to the needs of the population and the volume of river water. Once this water reached Edo, it was distributed through the underground *toi* (conduit) system constructed using superb technology.

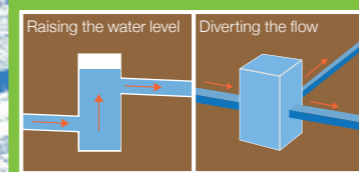
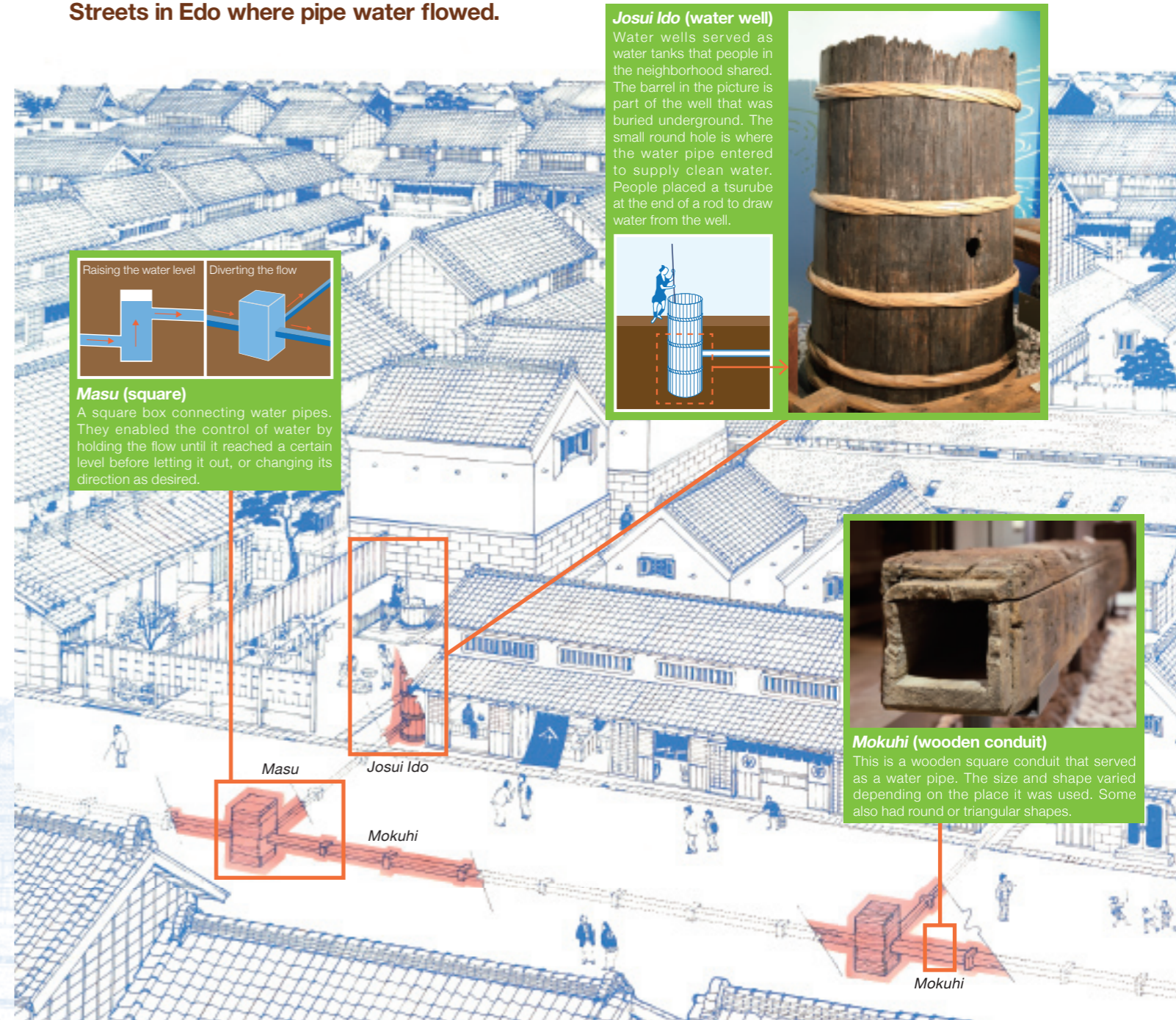
Toi were usually made of wood, stone or bamboo, but the degree of perfection of the *mokuhi* was outstanding. In *mokuhi*, pine and Japanese cypress were most frequently used due to their hardness and resistance to decay. They were hollowed out and spliced together carefully to make water pipes leakproof. At the joint, a *makhada* (filling made of crushed and softened Japanese cypress or cedar endodermis fibers) was used for prevention of leakage, just as in ship building. A device called a *masu* placed between the water pipes played a crucial role in water control: the *masu* enabled control of water. They could hold the water until it reached the desired level before releasing it, or change freely the direction of flow.

Surprisingly, it took only eight months to build the waterworks between Hamura and Yotsuya Okido. It is easy to imagine how tough the work must have been. The records show that such a large number of peasants and craftsmen were called out to work for the construction that a part of the town where many masons cut out stone everyday to build *sekihi* (stone conduit) during the construction was called "Ishikiri-yokocho (stonemasons' street)," and the area where bathtubs for workers were prepared was called "Yuya-yokocho (bath-tub street)."

Water delivered to the town of Edo was then stored in *Josui Ido* set at each district and lifted with a *tsurube* (well bucket) for daily use. Hygienic management was well established. *Mizumi-masu* (squares used to view the water), set throughout the system, allowed examination of the flow volume and water turbidity to keep the drinking water safe for the people of Edo.

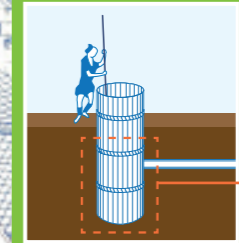
The construction of this waterworks was indeed the culmination of the wisdom and technology of people of that time. Without these waterworks, Edo could not have prospered.

Streets in Edo where pipe water flowed.



Masu (square)
A square box connecting water pipes. They enabled the control of water by holding the flow until it reached a certain level before letting it out, or changing its direction as desired.

Josui Ido (water well)
Water wells served as water tanks that people in the neighborhood shared. The barrel in the picture is part of the well that was buried underground. The small round hole is where the water pipe entered to supply clean water. People placed a *tsurube* at the end of a rod to draw water from the well.



Mokuhi (wooden conduit)
This is a wooden square conduit that served as a water pipe. The size and shape varied depending on the place it was used. Some also had round or triangular shapes.

[7- Waterworks]

TECHNOLOGY IN THE EDO PERIOD



The waterworks of Edo
This is a map showing the distribution of the waterworks in Edo around the end of Shoutoku (1711-1715). Water taken from the Tama River was diverted to supply water for farming in its midstream. On entering the Edo of the time, a great network of water pipes would have spread out before one's eyes, as can be seen in this map.

Various devices used to run the water



Water pipe using the principle of an inverted siphon
The principle of a siphon is a theory of how to take liquid from one place to its destination via a place higher than its starting point. The water pipe in the picture used the inverted version of this principle. In order to apply the principle, it was necessary to form something close to a vacuum inside the *mokuhi*. Therefore there are many innovations to make them almost airtight.



akehi (aqueduct)
The town of Edo developed an extensive network of roadside canals, obliging the water pipes sometime to run underground or over the bridges to deliver the water. The picture shows an aqueduct over the Kanda River, which was built to supply water through the Kanda Channel (the model is 1/50 scale). Katsushika Hokusai and Utagawa Hiroshige chose this bridge as one of the famous spots of Edo in their works.