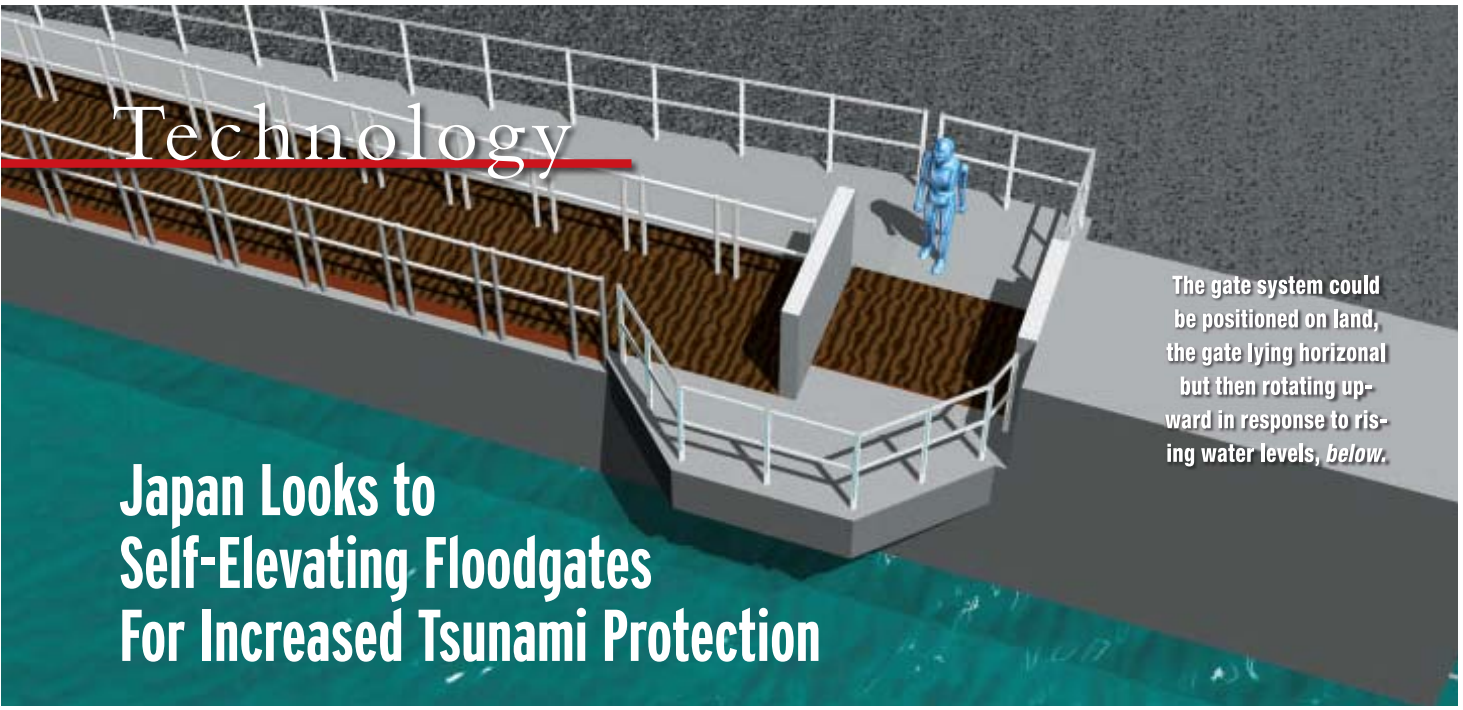


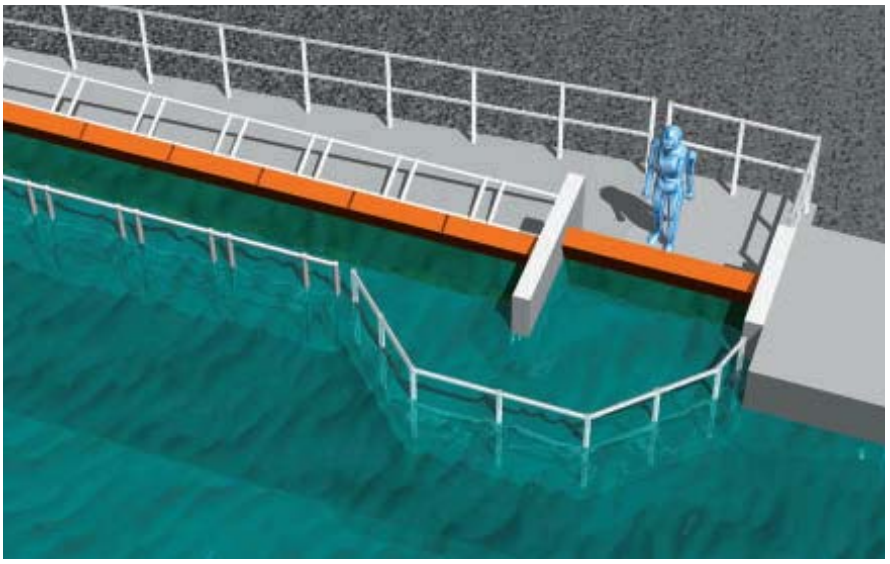
The gate system could be positioned on land, the gate lying horizonal but then rotating upward in response to rising water levels, *below.*

Japan Looks to Self-Elevating Floodgates For Increased Tsunami Protection

A COASTAL BARRIER system that is being developed in Japan elevates automatically in response to unusually high water levels and holds promise for protecting people and property from such disasters as the one that struck the northeastern part of the country in early 2011. The so-called flap-gate tsunami breakwater system would operate without electric power, rising into position through its natural buoyancy in the event of unduly high tides, floods, or tsunamis.

The gate would normally lie flat in a horizontal position within a box structure, tension rods connecting the gate to this structure. Multiple box structures could be placed adjacent to one another, and they could even be placed on top of conventional seawalls. The gate would be held in its horizontal position by a hook, and when a flood or tsunami was anticipated, the hook would be released, enabling the gate to rise into position as the water level increased. The tension rods would then be at work.

Researchers at Nagoya University, Kyoto University, and the Osaka-based engineering company Hitachi Zosen Corporation are developing the technology, which they say could provide time for safe evacuation even under the most extreme conditions. They also note that the relatively simple, motor-free design would make it possible to produce the system at low cost and to operate it with little need for maintenance.



"The low cost would allow it to be installed at various points," Norimi Mizutani, D.Eng., a professor in Nagoya University's Coastal and Ocean Engineering Laboratory, explained in written responses to questions posed by *Civil Engineering.* "We want to realize a society where people do not suffer from these disasters."

Scientists began developing the breakwater system early in the last decade, and its need became all too evident in 2011. In March of that year the most powerful recorded earthquake in Japan's history sent tsunami waves as tall as 40.5 m into the northeastern coast. The disaster caused more than 15,000 deaths and as much as $300 billion in damage and has brought the need for improved flood mitigation systems into sharper focus.

Mizutani said that the breakwater system that is being developed could increase the amount of time available before total inundation in such severe cases and could mitigate or even prevent damage during lesser events. Multiple gates could be installed at sea to protect harbors or on the shore to protect individual buildings or key facets of infrastructure.

Holding the gate in its horizontal position, the hook ensures that marine traffic is not affected. It can be removed by remote control in advance of an emergency, eliminating the need for manual intervention. At present operators risk life and limb when they have to manually engage flood control devices.

The researchers have conducted several tests of the system in recent years using scale models. A test model in April at Nagoya University found that the technology is capable of

HITACHI ZOSEN CORPORATION, *BOTH*

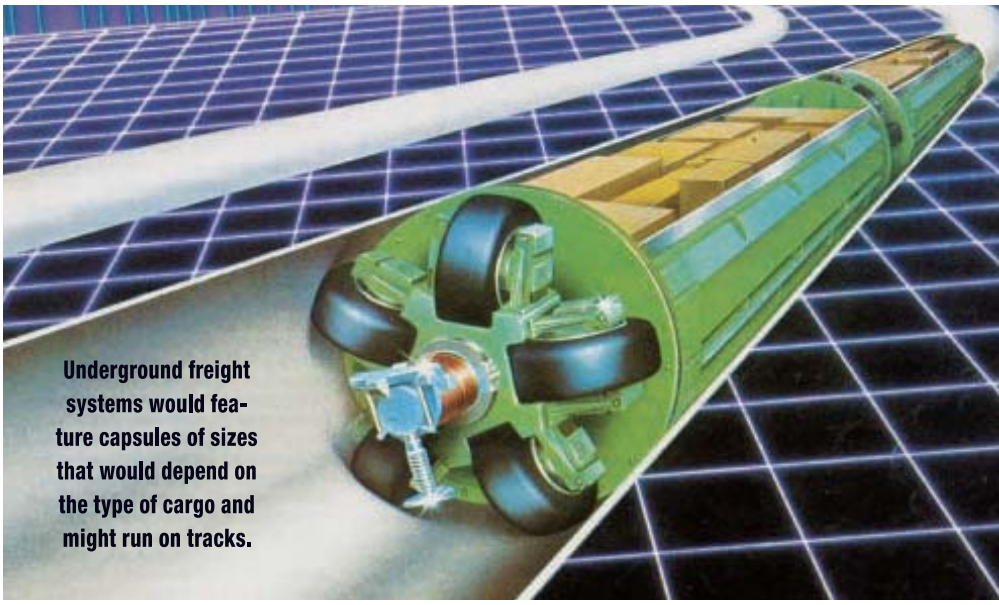
withstanding waves up to 10 m high and hundreds of meters wide.

Mizutani said that the technology has been designed to provide greater reliability and require less maintenance than is the case with other methods. He added that it has been tested extensively and has been shown to work properly in the face of diagonal currents and also to have the ability to withstand debris impacts.

Mizutani further explained that the technology has mainly been tested in straight-line configurations and that additional work will be needed so that it can be used along more complicated shorelines. He declined to predict when or where the system might be deployed, but he said that it has great potential to save money and lives. "We inspected the strength of the components, stability of the base, response against tsunamis, and capability of disaster prevention," he said. "Applications for straight coastal lines are already ready for construction, but in the future it must be improved for installation on curved coastal lines."

—DAVID HILL

MOHAMMAD NAJAFI, PH.D., P.E., F.ASCE/INTERNATIONAL SOCIETY FOR UNDERGROUND FREIGHT TRANSPORTATION



Underground freight systems would feature capsules of sizes that would depend on the type of cargo and might run on tracks.

Underground Freight Tubes Could Alleviate Congestion on Roads

THE PNEUMATIC TUBE that carries your bank deposit from the drive-through to the teller is serving as the inspiration for an underground freight system that one day could transport tons of cargo without the use of roads or trucks. Researchers at the University of Texas at Arlington have received $247,000 in funding from the Texas Department of Transportation to study the technology, which could confer immense safety, environmental, and cost benefits.

A faculty research team launched the project in April. In addition to