01 NEW OFFSHORE RUNWAY AT HANEDA AIRPORT

Haneda Airport takes a major step towards becoming one of Asia's hub airports. Kajima's cutting-edge civil engineering technologies were used for the D-Runway, which has substantially augmented arrival and departure capacity.

KAJIMA'S CIVIL ENGINEERING TECHNOLOGIES

CONNECT

MOVEMENT OF RECLAIMED ISLAND AND PILED-ELEVATED PLATFORM ABSORBED BY 424-METER LONG EXPANSION JOINT

The D-Runway at Haneda Airport is the world's first offshore runway with a hybrid structure combining a reclaimed island and piled-elevated platform. The 424-meter long "connector" joining the two different structures is a vital component for allowing aircraft to safely utilize the runway. Various Kajima technologies were adopted for the construction of this connector.

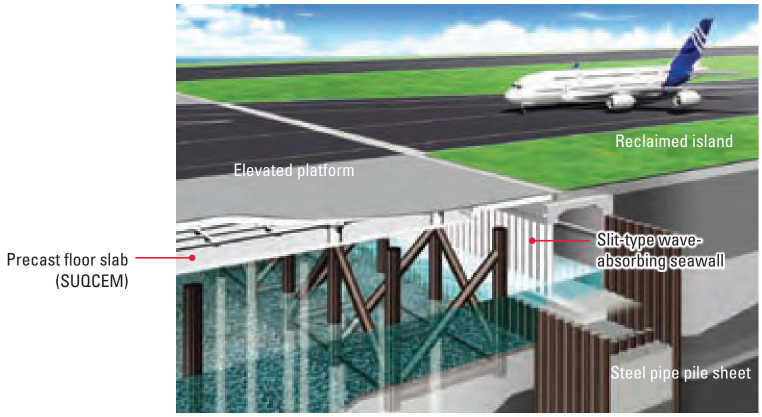
Construction started with foundation work on the sea floor of the reclaimed land. We concentrated on minimizing the impact of the shifting of the ground on the piled-elevated platform's steel pipe piles caused by the foundation work. Along with packing in a number of steel pipe piles deep into the earth, we tightly linked these pipes together to build a solid foundation.

Wave-absorbing seawall during construction. 229 concrete pillars were installed for the seawall (428 m) on the reclaimed island side.

Next, we built a wave-absorbing seawall using slit-type circular columns along the part of the runway on the reclaimed island. By doing so, we successfully minimized the impact of waves. The seawall also has the ability to withstand water pressure at a depth of 18 meters.

In designing the seawall, the Kajima Technical Research Institute, Kajima's in-house technical research laboratory, used models to measure wave pressure before deciding on the optimal pillar shape and distance between pillars. Steel pipe piles for the seawall were then embedded in concrete. A row of evenly-spaced, concrete pillars—229 in total—was then installed directly in front for the construction of a 428-meter long slit-type seawall.

CROSS-SECTIONAL VIEW OF THE CONNECTOR



Additionally, a type of expansion joint called a "roller-shutter joint" was installed in the runway connecting the reclaimed island and piled-elevated platform. This system expands and contracts with changes in temperature on the piled-elevated platform. When earthquakes cause tremors, the expansion joint can expand or contract up to 60 cm to cope with relative movement between the reclaimed island and piled-elevated platform, allowing runway utilization by aircraft.

The connector component of the runway was not structurally damaged by the Great East Japan Earthquake that struck on March 11, 2011. The expansion joint, in fact, functioned phenomenally, largely avoiding any interruption in flight schedules.

"Roller-shutter type" expansion joint (linking the reclaimed island and piled-elevated platform of the runway) during construction

DRIVE

1,165 PILES—THE MOST IN JAPAN—AND ADOPTION OF VARIOUS TECHNOLOGIES FOR PILED-ELEVATED PLATFORM

Piled-elevated platform during construction. The runway was created after connecting the component to a steel jacket.

The piled-elevated platform of the runway, with expansive dimensions of 1,100 m x 524 m, has steel jackets placed on steel pipe piles to keep them firmly in place. A slab of precast concrete (concrete manufactured beforehand in a factory for later assembly or installation onsite) is then put over the jackets, followed by a finishing layer of asphalt pavement.

A total of 1,165 steel pipe piles were used for this piled-elevated platform, the most ever for a single facility in Japan. The piles were plunged down to a depth of 70 meters into solid ground, beyond the thick but soft clay layer under the seafloor surrounding Haneda. The jackets covering the piles have individual dimensions of 63 m x 45 m x 30 m in size. The weight of this enormous structure is some 1,600 tons. Because part of the runway features an offshore piled-elevated platform structure, large-scale maintenance and repair would take it offline for a protracted period of time. With this in mind, a number of anti-corrosion technologies were employed that should preserve the durability of the jackets for up to a century.

What's more, above the level of the sea, steel pipe piles are wrapped in seawater-resistant stainless steel, keeping the steel pipe piles from direct contact with seawater. The steel girders above the steel pipe piles are covered entirely on the sides and bottom by titanium cover plates, shielding the girders from air above the sea. Dehumidifiers have also been installed in the spaces within the steel girders to help prevent corrosion to the girders.

THE TECHNOLOGY OF KAJIMA

SUQCEM® ULTRA-HIGH STRENGTH FIBER REINFORCED CONCRETE

SUQCEM, a type of concrete reinforced with ultra-high strength fibers, was used for part of the concrete slab used for the D-Runway. SUQCEM offers compressive strength and durability that are a step above conventional concrete. Its defining feature is the mixing of special steel fibers into the concrete, giving it high tensile strength and resilience. This element eliminates the need for steel rod placement in structures. The high fluidity and self-filling properties of the concrete, meanwhile, make it suitable for construction requiring thin materials and those with complex shapes. The concrete also leads to lighter-weight structures and reduces required construction work, as well as allows for reductions in construction costs. Lower lifecycle costs are another expected benefit due to the concrete's high durability.

Opting to use SUQCEM on the D-Runway resulted in a 50% reduction in weight compared to ordinary concrete slabs. This benefit contributed heavily to reducing steel weight from the steel jackets and steel pipe piles used for the piled-elevated platform of the runway.

Test pouring of the concrete slab