

DX Initiatives in the Civil Engineering Business Unit

▶ Our DX Initiatives in Civil Engineering Work is Selected for the PRISM program

Kumamoto No. 57 Sasawara Tunnel

The consortium represented by POC has been selected by the Ministry of Land, Infrastructure, Transport and Tourism for the "Project on Introduction and Utilization of Innovative Technologies for Drastic Improvement of Productivity at Construction Sites" (PRISM*1) for FY 3/23.

- Data-based proposals for "Field I. Technology to improve labor productivity in construction" and "Field II. Technology to sophisticate quality control of construction"
- Consortium: Field I. Penta-Ocean Construction Co., Ltd., Osaka University, Shoji, NSW Inc., Nextscape Inc.

Field II. Penta-Ocean Construction Co. Ltd., Osaka University, Nextscape Inc.

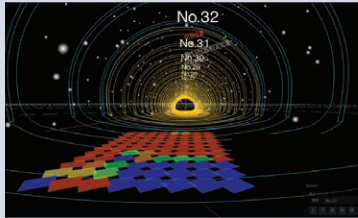
*1 Public/Private R&D Investment Strategic Expansion Program

Field I: Improvement of labor productivity

- Consolidation of information on construction work utilizing an AI-equipped digital twin, and remote site visit on VR platform
Achieved efficient construction management and smooth communication
- Automated operation is controlled based on the on-site information collected in the digital twin (digital twin control of construction equipment)



Automated operation of construction equipment



On-site information in the digital twin



Unmanned driver seat

Field II: Sophistication of quality control, etc.

- Broad-scale measurement of lining concrete shape using an automated patrolling robot*2
- Automatically calculates measurement results and visualizes concrete thickness
- ➔ Saves labor through automation of finished shape management
- ➔ Prevents overlooking of defects by "testing all samples" instead of "random sampling".
- *2 Equipped with a 3D laser scanner



Autonomous four-legged walking robot



Point group data of lining surface collected by an autonomous four-legged walking robot

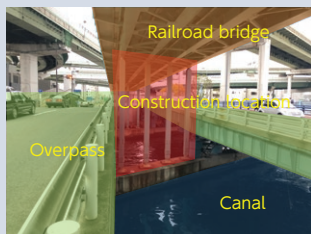
▶ Using 3D Models to Solve On-Site Problems

Seismic reinforcing of the Chibune Bridge and the Kizugawa Bridge on Rapid Electric Tramway Line No. 4

"Visualization" of construction plans and simulation of construction work using BIM/CIM models (3D models)

Features of construction work

- Constraints on construction hours (work can be performed only during downtime of railroad electricity transmission)
- Narrow construction space surrounded by railroad bridges, road bridges, and canals
- Review of efficient construction methods involving construction that does not affect the railroad tracks, proficiency in work procedures, and implementation of safe and reliable construction



Before construction



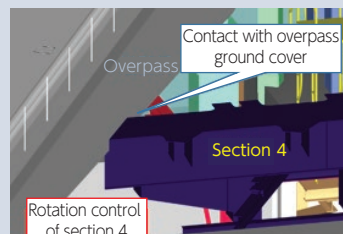
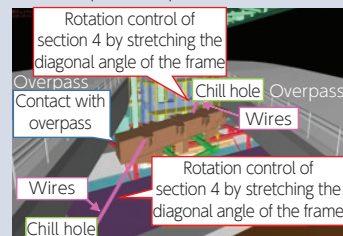
After construction

(1) Construction method using BIM/CIM models

- Review of construction procedures
- "Visualization" of construction plans using BIM/CIM models (3D models)
- Implementation of construction simulations based on a shared understanding with the client and subcontractors
- Collaboration among the three parties to determine the best construction method and procedure
- ➔ Eliminating personal assumptions and facilitating active discussion through sharing of images
- ➔ Implementing construction proficiency training based on shared awareness

(2) Real-time monitoring of bridge pier behavior

- ➔ Work Completed within acceptable displacement limits throughout the entire process



Sharing issues with BIM/CIM models (3D models)

DX Initiatives in the Building Construction Business Unit

▶ Labor saving by Utilizing DX in Large-Scale Construction Projects

Tsukishima 3-chome North District Type 1 Urban Redevelopment Project

We received an order for a large-scale redevelopment project (2 floors below ground, 58 floors above ground, height of approximately 198 m, ZEH-M Oriented (Net Zero Energy House) certification), which will be the largest redevelopment project ever undertaken in Japan. By utilizing ICT and adopting labor-saving construction methods, we will contribute to the realization of shorter construction period and carbon neutrality.



[Project Overview]

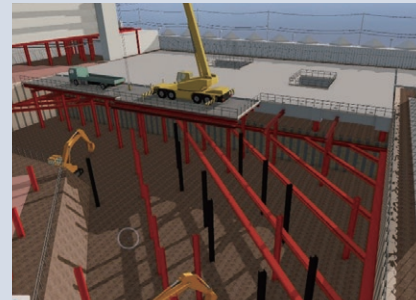
- Client: Tsukishima 3-chome North District Urban Redevelopment Union
- Use: Residential, commercial, public facilities, etc.
- Floors: 2 floors below ground, 58 floors above ground, height 198 m
- Structure: Reinforced concrete (partial steel frame)
- Floor area: 149,450 m²
- Construction period: October 20, 2022 to June 30, 2026

[Building Features]

- Environmental considerations such as CO₂ reduction and countermeasures against massive earthquakes
- Acquisition of ZEH-M Oriented certification
- Adoption of 120N-class ultra-high-strength concrete Applied to columns from the basement to the 10th floor
- Applied to columns supporting the weight of 200-m class buildings
- Adoption of viscoelastic damper (vibration control device)
- Countermeasures against the effects of long-period seismic motion

DX promotion: Improving productivity through the use of ICT

- Introduction of PiCOMS (Penta-Ocean Integrated Construction Management System)
- ➔ "Visualization" of construction progress and information sharing to improve efficiency of construction management
- Use of Digital twin for more efficient execution of construction review
- ➔ Utilizing VR/AR technology to facilitate construction review and information sharing in a virtual space
- "Visualization" of on-site conditions for greater efficiency
- ➔ Centralized management by displaying video and data from the construction site at the construction office



Construction review using VR

Hilton Hiroshima

A full-service hotel (420 guest rooms) that can accommodate international MICE*3 opened in the International Peace City, Hiroshima. The DX initiative shortened the construction period and reduced the workload on human workers.

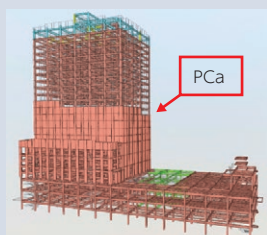
*3 General term for business events that are expected to have high level of crowd turnout and exchanges (Meetings, Incentive Travel, Conventions, Exhibitions/Events)



Addition of exterior PCa management functionality to steel frame construction management PiCOMS*4-S

- Due to the addition of the exterior PCa process from the latter stage of steel frame erection, the PiCOMS-S system was upgraded and a construction management function for PCa work was added
- ➔ Centralized visualization of steelwork progress and exterior PCa progress
- ➔ Prevention of personalization of progress data and real-time information sharing

*4 Penta-Ocean Integrated Construction Management System



Confirmation screen

- Blue: Drawing approved
- Green: Drawing submitted
- Red: Drawing delayed
- Orange: Construction completed

Utilization of construction BIM*5

- Creation of framework drawings and detailed plan drawings from construction BIM
- Building rapid consensus with the client and designers through the use of interior and exterior perspectives
- Optimization of the review process by identifying potential interference areas in advance
- Visualization of temporary construction plans and construction reviews with 3D models
- BIM data can be viewed at any time on an iPad, and model verification was performed on site

*5 Utilization of BIM not only in the design phase but also in the construction phase, and creation of BIM construction drawings

Achieved both shortening of construction period and reduction of manpower load through implementation of cutting-edge initiatives

- While the COVID-19 outbreak continued for most of the construction period, iPads were loaned to foremen for real-time sharing of a variety of information without contact
- BIM perspective was used to quickly reach agreement with the client and designers on finishing materials, etc.
- Application-based inspection system achieved paperless and labor-saving inspections
- ➔ Shorter construction period was achieved and staff members acquired 8 days off per 4 weeks