

COMPANY

Environmental Protection Department, HKSAR
China Harbour Engineering Company Limited
Keppel Seghers – Zhen Hua Joint Venture

PROJECT

Integrated Waste Management Facilities Phase 1

LOCATION

Artificial Island near Shek Kwu Chau

TYPE

Waste-to-Energy Facility

SCHEDULED TIME OF COMPLETION

2025 (Construction) + 15 years Operation

BIM Application in WtE Project under a Design, Build and Operate Contract

“BIM serves as a cornerstone throughout the project lifecycle, aiding in planning, design, construction, and ongoing operation in the IWMF1 project. It plays a crucial role in facilitating effective collaboration within this large scale Design-Build-Operate project. We are committed to adopting innovative approaches to ensure the delivery of a high-quality project.”

— William Chan

Project Manager, Keppel Seghers
- Zhen Hua Joint Venture

BIM PARTNERS

AECOM Asia Company Limited
Asia Infrastructure Solutions Limited
Integrated Design Limited

AUTODESK PRODUCTS USED

Autodesk® 3ds Max®
Autodesk® Advance Steel
Autodesk® BIM 360® Docs
Autodesk® Civil 3D®
Autodesk® Navisworks® Manage
Autodesk® ReCap® Pro
Autodesk® Revit®
Autodesk® Robot™ Structural Analysis Professional



Overview of the IWMF
Image Courtesy of Environmental Protection Department, HKSAR and China Harbour Engineering Company Limited and Keppel Seghers – Zhen Hua Joint Venture

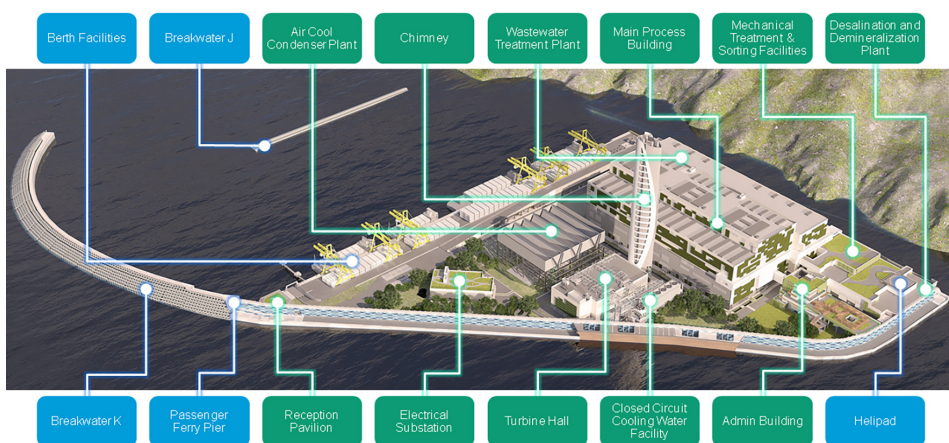
Project Background

The Integrated Waste Management Facilities Phase 1 (IWMF) project is a Waste-to-Energy (WtE) facility in Hong Kong, aiming to significantly reduce the volume of mixed municipal solid waste (MSW) while recovering valuable resources. With a Design, Build and Operate contract of approximately HK\$31 billion, the facility, located near Shek Kwu Chau island, features marine reclamation, Keppel Segher’s proven incineration technology, and robust pollution control measures. The main processing building houses six moving grate MSW incinerators, ensuring compliance with

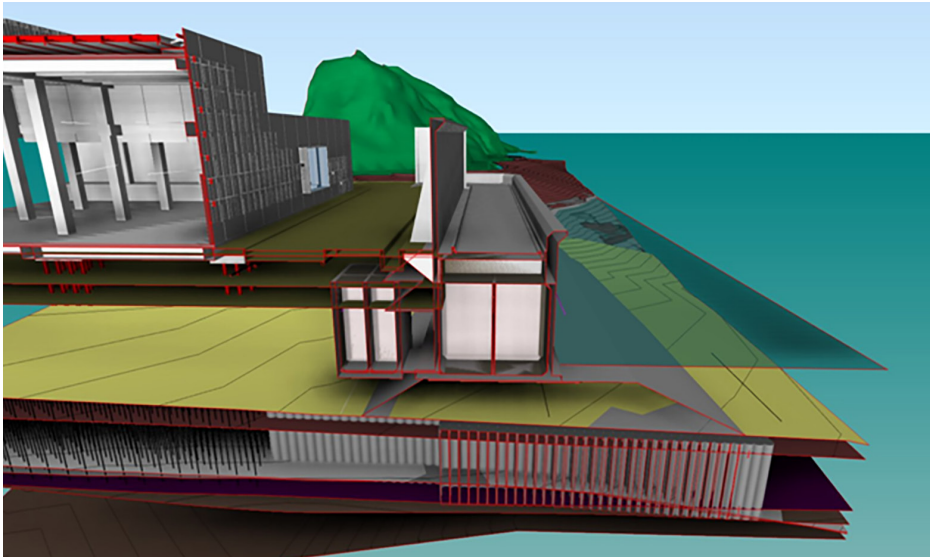
strict emissions standards through chemical scrubbing and activated carbon filtration. The WtE is capable of producing approximately 480 million kilowatt-hours (kWh) of net electricity per year with surplus beyond plant consumption exported to the grid. This green energy will power up 100,000 households and help reduce 0.44 million tonnes of carbon dioxide per year. This initiative will minimize landfill usage, extend landfill life, and support sustainable waste management practices in Hong Kong.

Constraint & Challenges

The IWMF project faces several



Project Site Layout
Image Courtesy of Environmental Protection Department, HKSAR and China Harbour Engineering Company Limited and Keppel Seghers – Zhen Hua Joint Venture



Project BIM Model
Image Courtesy of Environmental Protection Department, HKSAR and China Harbour Engineering Company Limited and Keppel Seghers – Zhen Hua Joint Venture

constraints and challenges. The tight 80-month timeline for reclamation and construction complicates project planning and resource management. Its remote offshore location limits land access, resulting in significant logistical difficulties. Additionally, the involvement of international stakeholders from countries like Singapore and Belgium requires a platform for effective communication and collaboration owing to the inability to always have physical meetings. Finally, with over 140 companies from various disciplines – including civil, structural, architectural, and mechanical engineering involved, the project encounters complex management challenges that require careful coordination and oversight to ensure successful execution.

Advantage of BIM in DBO Contract

The adoption of BIM in the DBO contract for the IWMF provides numerous advantages. It ensures a coordinated approach throughout all project phases, enhancing constructability assessments and reducing variations and clashes during construction. Utilizing 3D and 4D components facilitates effective reporting, review, and decision-making. The integration of 6D BIM with Computerized Maintenance Management Systems (CMMS) enhances operational efficiency post-construction. With over 200 stakeholders collaborating through Autodesk’s BIM 360 platform, communication and coordination are significantly improved. To resolve the design issues in this mega project, weekly BIM Coordination and CSD/CBWD meetings involve construction and operation team representatives, ensuring designs are suitable for implementation; by Q3 2024, more than 250 BIM Coordination and 130 CSD/CBWD meetings have been conducted. Innovative applications, including 4D planning, quantity take-offs, and virtual reality for public engagement, further

enhance project delivery, reduce risks, and improve lifecycle management.

Innovation Adoption in Maritime Project

While BIM adoption is common in civil and building works in Hong Kong, examples in maritime projects are limited. Our project was initiated in late 2017 and without detailed BIM requirements. We have proposed several BIM applications to minimize onsite issues and ensure effective project delivery, enhancing overall efficiency and coordination.

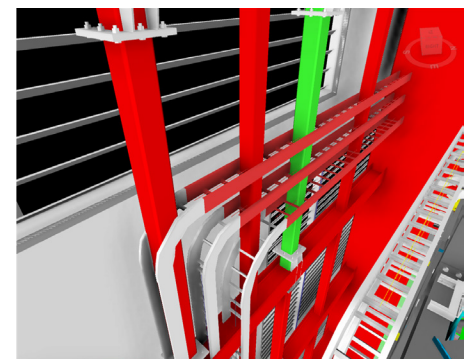
a) Caisson Design and Installation

To initiate the project, we first needed to reclaim an artificial island before constructing the Waste-to-Energy (WtE) facilities. For this project, we

adopted a caisson-type seawall, which were prefabricated in mainland China. We utilized Autodesk Robot Structural Analysis and Revit for the design and modeling of the seawall caisson. Due to the COVID-19 pandemic, site visits to the prefabrication yard in mainland China were not allowed. As a result, we relied on the BIM model to coordinate with the yard, ensuring that the prefabricated caisson conformed to the approved design and minimizing errors caused by insufficient details and sections. Before the caisson’s delivery via a semi-submersible barge, we conducted a 3D seabed scan to verify the current seabed conditions. If the seabed level was found to be higher than the design level, we would perform seabed trimming to ensure proper installation of the seawall caisson. This approach enhances safety performance and quality control.

b) Modular integrated Construction (MiC) Approach

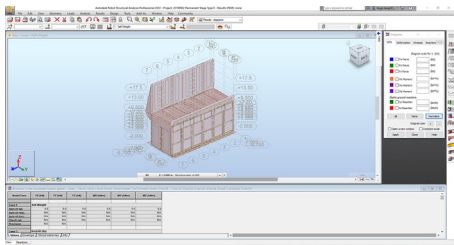
As previously mentioned, the remote location of our construction site presents challenges for on-site building activities. To tackle this issue, we aim to



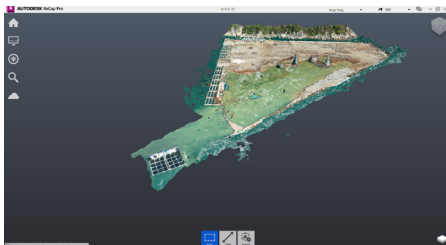
Clash Analysis
Image Courtesy of Environmental Protection Department, HKSAR and China Harbour Engineering Company Limited and Keppel Seghers – Zhen Hua Joint Venture



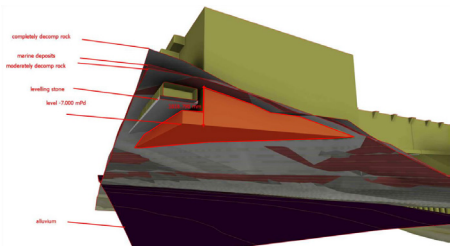
Project Progress Photo
Image Courtesy of Environmental Protection Department, HKSAR and China Harbour Engineering Company Limited and Keppel Seghers – Zhen Hua Joint Venture



Caisson Design with Autodesk Robot Structural Analysis
Image Courtesy of Environmental Protection Department, HKSAR and China Harbour Engineering Company Limited and Keppel Seghers – Zhen Hua Joint Venture



3D Scanning by UAV
Image Courtesy of Environmental Protection Department, HKSAR and China Harbour Engineering Company Limited and Keppel Seghers – Zhen Hua Joint Venture



Caisson Model Review with 3D Seabed Scanning
Image Courtesy of Environmental Protection Department, HKSAR and China Harbour Engineering Company Limited and Keppel Seghers – Zhen Hua Joint Venture



4D Simulation for MiC unit Delivery
Image Courtesy of Environmental Protection Department, HKSAR and China Harbour Engineering Company Limited and Keppel Seghers – Zhen Hua Joint Venture

maximize offsite prefabrication. Given the requirement to complete reclamation before starting building construction, we propose adopting modular integrated construction techniques. The equipment within the process building is divided into 17 modules, consisting of 6 boiler modules, 6 flue gas treatment systems, and 5 pipe gallery modules, totalling 50,000 tonnes. These modules include over 110,000 structural components and 270,000 equipment parts, all connected by nearly 2 million bolts. Each module requires approximately one year prefabricating and employs about 500 workers simultaneously during peak periods, making it one of the largest components of its kind in the world.

To effectively implement this innovative construction method, we resolved all potential clashes during the project's early stages. Once approved, the modules were prefabricated in Zhuhai. Each module, measuring 58x25x50 meters and weighing 6,000 tons, required meticulous planning of delivery routes for the Self-Propelled Modular Transporters (SPMT). Prior to delivery, we conducted a 4D simulation to evaluate the interaction of various on-site activities and mitigate construction risks. We also utilized 3D printing to demonstrate the installation sequence to the management team. Ultimately, all modules were successfully delivered to our site. This innovative construction method enhances production efficiency,

construction quality, site safety, and environmental performance, while significantly improving digital visualization and project management efficiency, leading to a 20% reduction in the construction period.

BIM Adoption in Operation

In the operation phase of the IWMF project, BIM adoption enhances efficiency and asset management. The 6D BIM model integrates operational data with Computerized Maintenance Management Systems (CMMS), allowing for real-time monitoring and management of assets. This integration facilitates predictive maintenance, improves resource allocation, and optimizes operational workflows. Additionally, the BIM model provides a comprehensive visual representation of the facility, supporting training simulations and operational planning. By leveraging BIM throughout the operational phase, the IWMF project ensures sustained performance, reduces downtime, and enhances overall facility management effectiveness.



Actual MiC unit Delivery on site
Image Courtesy of Environmental Protection Department, HKSAR and China Harbour Engineering Company Limited and Keppel Seghers – Zhen Hua Joint Venture



Project Artist's Impressions

Image Courtesy of Environmental Protection Department, HKSAR and China Harbour Engineering Company Limited and Keppel Seghers – Zhen Hua Joint Venture

About Environmental Protection Department, HKSAR

The Environmental Protection Department (EPD) of the Hong Kong Special Administrative Region (HKSAR) is the government agency responsible for safeguarding the environment and promoting sustainable development. Established in 1986, the EPD implements policies and regulations related to air quality, waste management, water resources, and noise control. The department aims to enhance environmental quality through various initiatives, including pollution prevention, public education, and community engagement. By collaborating with local and international stakeholders, the EPD strives to address environmental challenges and promote green practices across Hong Kong, ensuring a cleaner, healthier, and more sustainable living environment for current and future generations.

About China Harbour Engineering Company Limited

China Harbour Engineering Company Limited (CHEC) is a leading global construction enterprise specializing in marine engineering, infrastructure development, and urban construction. Established in 1980 and as a subsidiary of China Communications Construction Company (CCCC), CHEC has extensive experience in designing and executing large-scale projects, including ports, bridges, tunnels, and airport facilities. The company is recognized for its innovative engineering solutions and commitment to quality, safety, and environmental protection. With a strong international presence, CHEC has successfully undertaken projects across Asia, Africa, the Americas, and Europe, significantly contributing to infrastructure development and fostering economic growth in various regions around the world.

About Keppel Seghers – Zhen Hua Joint Venture

Formed by Keppel Seghers Hong Kong Limited and Zhen Hua Engineering Company Limited. Established to leverage their combined expertise in Waste-to-Energy (WtE) technologies, this joint venture focuses on the design, construction, and operation of advanced waste management facilities. By integrating innovative engineering solutions and sustainable practices, the partnership aims to address environmental challenges and promote resource recovery. With a commitment to delivering high-quality projects, the Keppel Seghers - Zhen Hua Joint Venture plays a vital role in advancing waste management and sustainable development in the regions it serves.