Maximizing Project Planning Efficiency with BIM and GIS

COMPANY
CECI Engineering Consultants, Inc., Taiwan

PROJECT
SANYING LINE METRO RAPID TRANSIT PROJECT

LOCATION
New Taipei City, Taiwan

TYPE
Basic Design and Project Construction Management Consultant Service

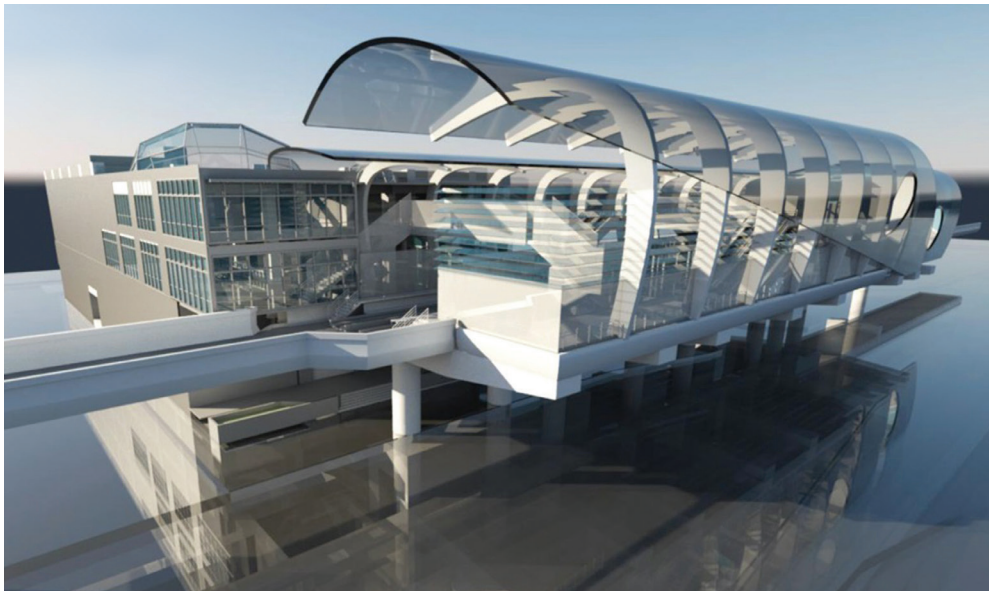
SCHEDULED TIME OF COMPLETION
Q3, 2022

"The combination of BIM, GIS and Infraworks 360 is a major breakthrough that has brought many unprecedented benefits"

—**Shen Chia-Ray**
Deputy Manager, PE
Department of Rapid Transit Engineering at CECI

BIM PARTNERS INVOLVED

Project Owner:
New Taipei City Government



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To provide more convenient public transport and boost local development, the New Taipei City Government has prioritized construction of the Taipei Mass Rapid Transit (MRT) system's Sanying Line, setting a target deadline of Q3, 2022, and contracted CECI for preliminary designs and project management.

The 12 stations and depot of the 15-kilometre Sanying Line cover regions such as Sanshia and Yingge, with plans for further extension to Fengming, Taoyuan. As the elevated MRT line will be built on roads that are merely 15 to 18 metres wide, one priority is minimizing the impact on residents. In addition, the line's length and the two rivers and the two highways that cross will increase the challenges faced by designers. The project team must consider the complex topography, busy traffic, and distribution of underground cables and wires.

Maximized efficiency thanks to the synergy of GIS and BIM

To resolve the multiple conundrums arising with the Sanying Line, CECI designs using software such as Civil 3D and AutoCAD 3D, together with geographic information such as topographic maps, digital Ortho-photographs and UAV-generated colour 3D models. Data is integrated into Autodesk Infraworks 360, allowing engineers and project stakeholders to discuss and coordinate on a single, common interface.

The project team can visualise the Sanying Line's entire route with the BIM 3D model, which shows the relative positions of stations, viaducts and various topographic features. This in turn enables the team to identify potential problems with the construction process, while enabling the owner to thoroughly understand the planning and design of the Sanying Line. With efficient communication and appropriate adjustments, the quality of design, construction and future operation of the Sanying line are ensured.

"By integrating building information models with the geographic information system during design and plan phase, CECI was able to overcome challenges such as the clashes involving complex underground cable routes,

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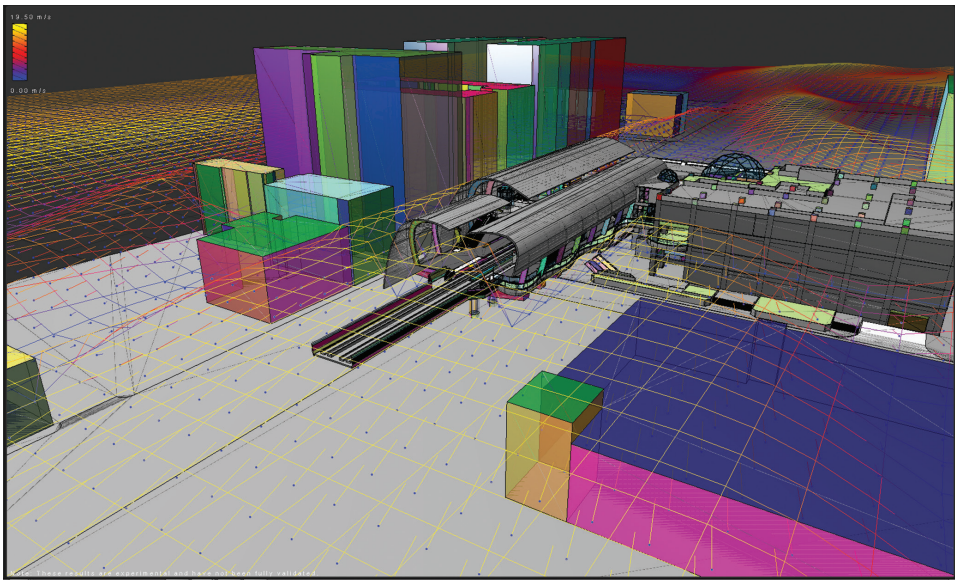
as well as transmission towers and wires," said Shen Chia-Ray, Deputy Manager, PE, Department of Rapid Transit Engineering at CECI. "We were thus able to present suggestions on how these positions or our design could be appropriately adjusted."

Optimized station design with 3D simulations

Featured stations are other key elements of the project. For instance, one Sanying Line terminus is an elevated station that will be jointly structured with the underground Dingpu station, terminus of the Bannan Line. To support this structure, CECI had to design a passageway for passengers to transfer between the two lines. With software like Revit, engineers could divide every level into exploded view drawings, and the project team used these to accurately formulate plans for the passageway.

In addition, with energy simulations and innovative building simulation techniques, CECI could precisely assess the changes of wind directions and sunlight in summer and winter, and then adjust the station design in accordance with green simulation models. For example, the team decided to install more sunshades and wall openings on the south side, so that direct sunlight can be blocked and heat better dispersed from inside. On the north side, glass screens and special paints



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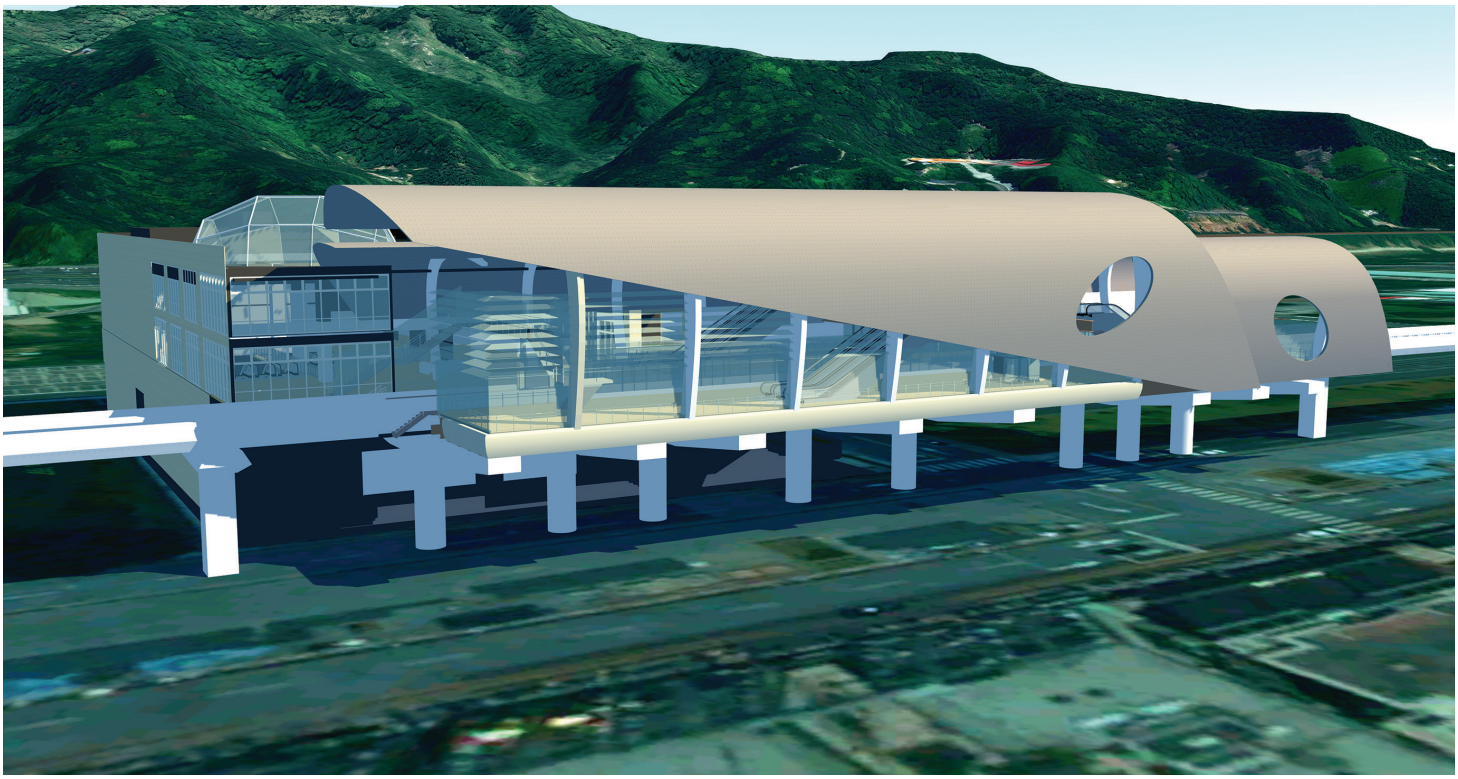
are added, to block northeasterly winds in winter. Finally, the roof design was adjusted to introduce more natural light into the station.

"Autodesk Revit enabled us to readily build a 3D model of stations, and with wind direction, sunlight and heat flow analyses we could decrease the buildings' energy consumption, increase natural lighting indoors and direct natural wind into the buildings, so that passengers can find the stations more comfortable," said Ms. Hsu Li-ting, engineer, Rapid Transit Engineering Department at CECI.

Complete Building Lifecycle Management - From 3D to 6D

With Autodesk Navisworks, CECI built a 4D model for detailed construction planning, error analysis and management, as well as 4D animation demonstrations. Various scenarios were implemented showing the complexity of the underground Dingpu station, the elevated LB01 station and the joint structure, so the contractors could accurately formulate and follow construction procedures.

With BIM 5D scheduling, model data have been linked to the project schedule and cost data to control budgets and assist the project team with formulating the most cost-effective



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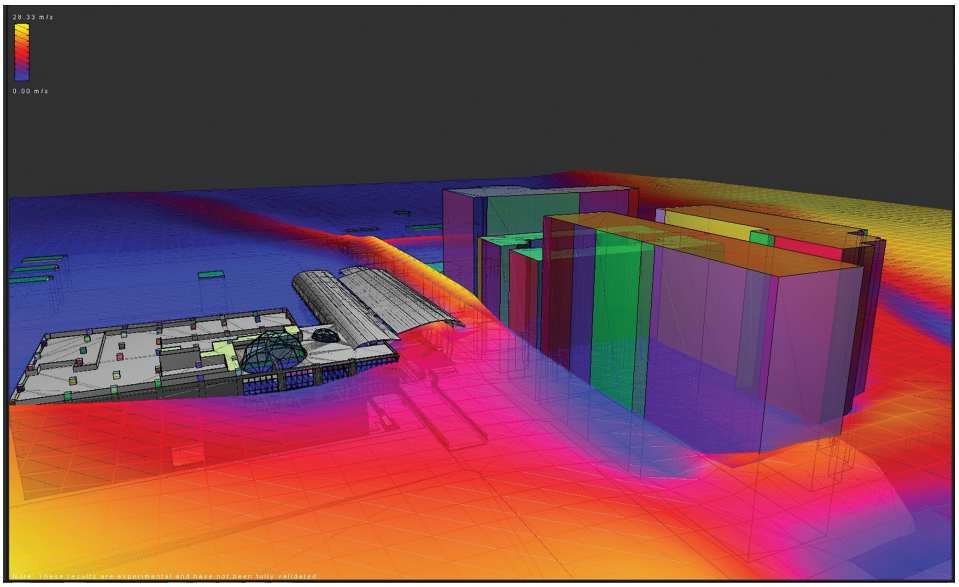

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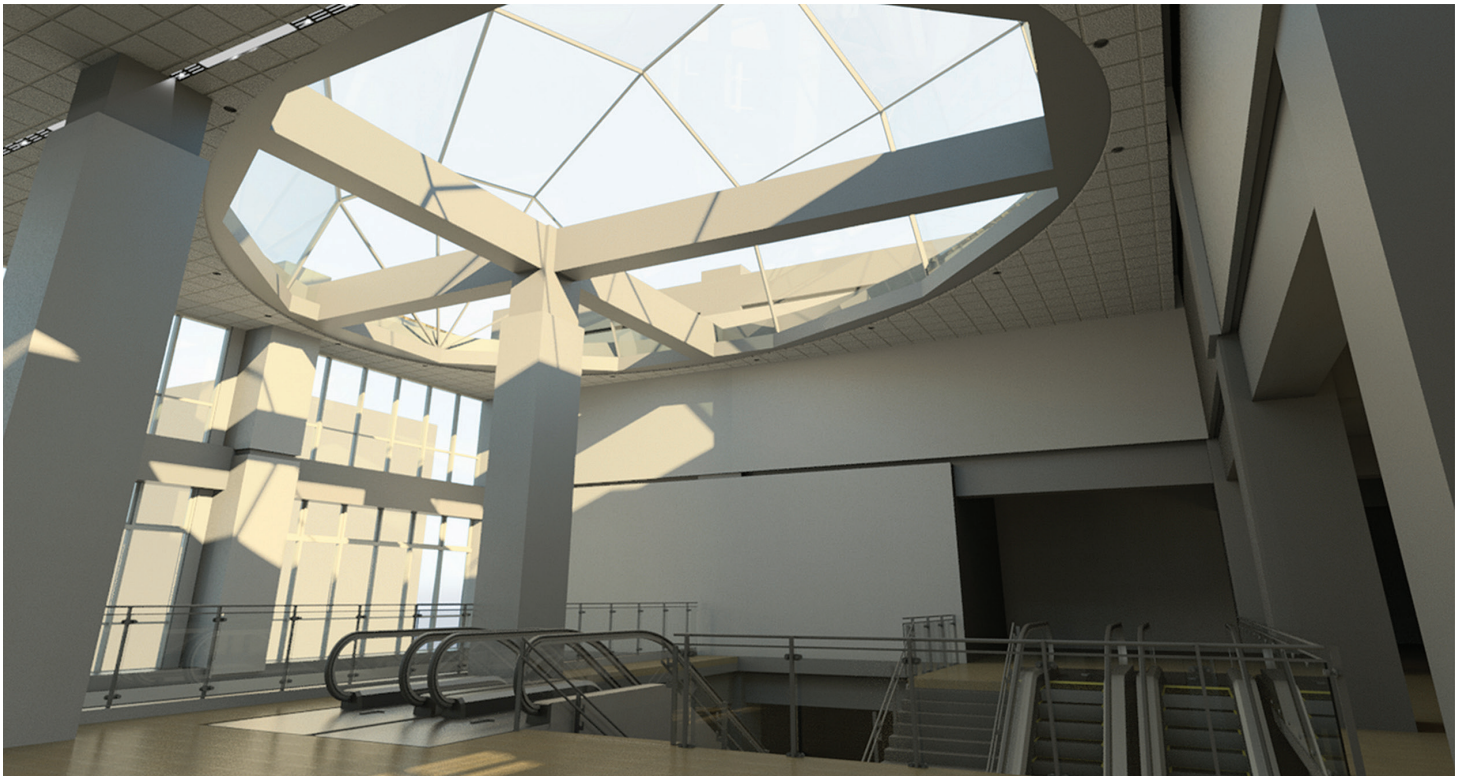
design. When the structures are complete, the BIM model will be given to the operation unit for 6D management.

To extend the application of BIM, CECI further utilized Autodesk Infraworks 360 as a platform to integrate and share all information. Large amounts of geographic information models and building information models were combined – improving efficiency of teamwork, coordination and communication so the design could be more quickly approved.

"Thanks to Infraworks 360, we were able to formulate a plan with a holistic view, and to visualise and dynamically recognise the interaction between the Sanying Line and the local community for further detailed design," noted Ir Hsu. "All parameters will be collected in a database, realising comprehensive 3D to 6D building lifecycle management."

Ir Shen added: "The combination of BIM, GIS and Infraworks 360 is a major breakthrough that has brought many unprecedented benefits and allows us to more accurately predict the operational efficiency of stations, rails and bridges in their ambient environments. In future, CECI will deploy and explore various new techniques to fully capitalise on BIM technologies."



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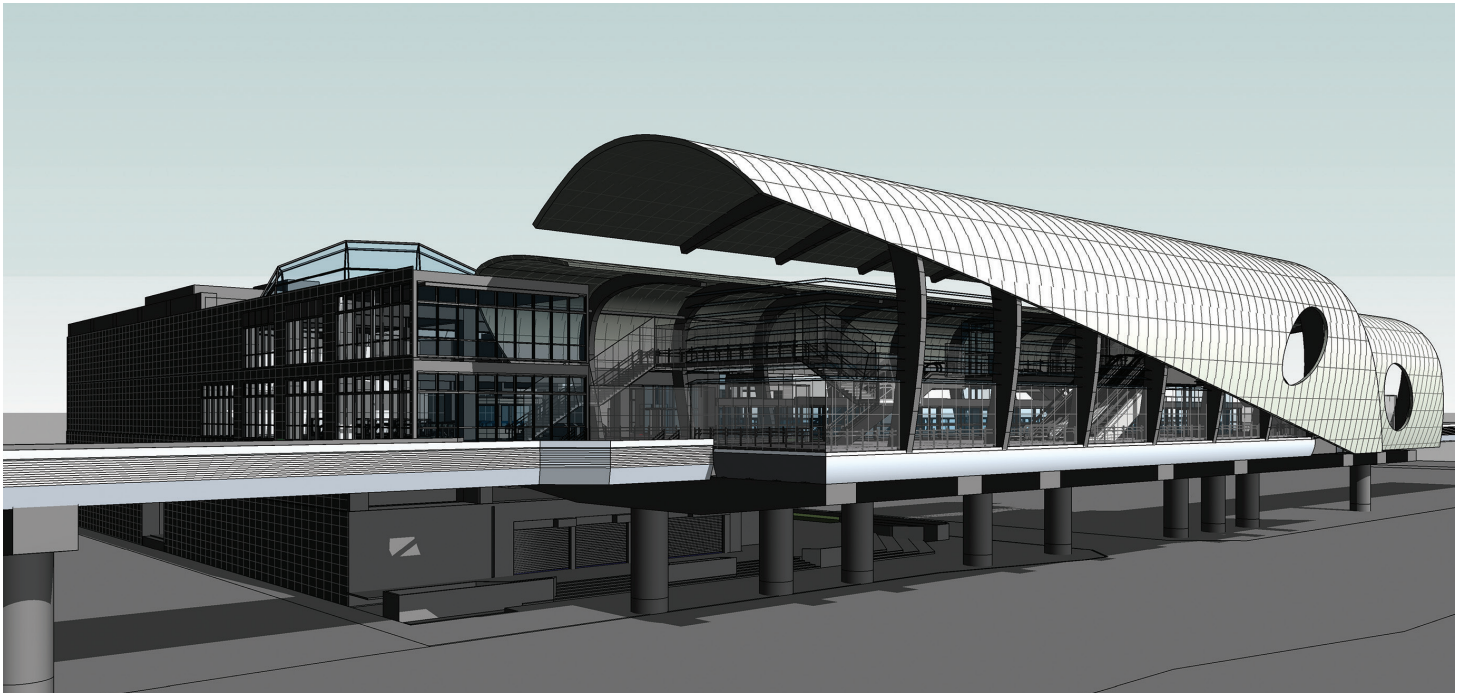

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About CECI Engineering Consultants, Inc., Taiwan

CECI was established in 1969 primarily for the purpose of upgrading Taiwan's engineering technology and assisting in the economic development of Taiwan and developing countries, and has been awarded ISO certification for planning, design, construction supervision, construction management, information technology and system engineering as well as numerous other accreditations.

With its sense of entrepreneurship, CECI has seized the opportunity to participate in Taiwan's most important projects and be a part of the economic miracle which transformed Taiwan and resulted in advanced transportation infrastructure including the nation's first freeway, the world's biggest High Speed Railway BOT project, world class metro systems, and the famous hi-tech corridor of science and technology parks which are home to some of the world's top researchers, developers and manufacturers of cutting edge industries.

Furthermore, with the emergence of the information age, CECI has been actively expanding its scope of services into new technologies and areas of work, including Building Information Modeling (BIM), Geographical Information Systems (GIS), Global Positioning Systems (GPS), Intelligent Transportation Systems (ITS), e-Ticketing and other types of applications which answer to the tendencies and trends of technological advancement.

With a staff of over 1,700 professionals representing virtually all engineering design disciplines, their hard working dedication and support enable us to provide cost-effective solutions with superior quality of service and collaborate with other partners, organisations and societies. We demonstrated our goal of becoming an internationalised firm to assist in the economic development of other countries and share in our commitment to keep a harmonious relationship with nature while using our precious natural resources safely and wisely.

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