The buildingSMART Awards Yearbook

Winners, Finalists and Special Mentions 2023

Extraordinary winning projects from 2023 from the buildingSMART International Awards Program

buildingSMART International

About buildingSMART

buildingSMART is the worldwide industry body driving the digital transformation of the built asset industry, committed to delivering improvement by the creation and adoption of open, international standards and solutions for infrastructure and buildings. buildingSMART is the community for visionaries working to transform the design, construction, operation and maintenance of built assets and is an open, neutral and international not-for-profit organization.

The buildingSMART Awards program was created to recognize outstanding projects that have leveraged openBIM to successfully tackle interoperability challenges.

Over the years, the program has grown, incorporating more projects, a larger panel of jurors, and continuous refinements. This year marked a significant milestone with the introduction of a new “Sustainability” category. A dedicated team of experts was assembled to identify and award the project most deserving of this recognition. Additionally, an “Elite Jury” played a pivotal role in evaluating the finalists and determining the winner for this category.

2023 Highlights

Categories

This program was divided into four broad categories: Project Delivery, Operations, Research and Technology. Each category has sub-categories, which provide the basis for the awards program.

Jurors

This awards program saw a total of 221 jurors across 28 chapters. The role of the juror includes grading project submissions against strict criteria. There continues to be a technical triage team, a sustainability expert team, and an elite jury that grades finalists during the summit.

Submissions

There were 137 submissions, 69 passed through triage and 22 finalists. The breakdown for those who passed triage is outlined below:

- Asset Management: 2
- Construction for Buildings: 5
- Construction for Infrastructure: 3
- Design for Buildings: 2
- Design for Infrastructure: 10
- Facilities Management: 1
- Handover: 3
- Professional Research: 8
- Student Research: 8
- Technology: 22

Special Mentions

Due to the high quality of submissions, there were a number of projects deemed of a high enough standard to warrant a special mention. These projects scored exceedingly high but fell slightly short of the required number to become a finalist. These projects, therefore, qualified as a "Special Mention" and were duly awarded this during the ceremony.

Contents








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WINNER

Digital Twin for the maintenance and operation of motorways: data driven information management along the project life cycle

HOCHTIEF PPP Solutions and HOCHTIEF ViCon,

Germany

Project Overview

The project has established Germany's first-ever Digital Twin to manage the design, construction, operation, and maintenance of federal highways. The project focuses on a 50km highway section of the A6 Federal motorway in Southern Germany, as part of a 30-year management and operation contract between 2017 and 2046. This contract includes a six-year construction project to extend the existing motorway while also managing the existing assets, including 70 bridges, 100 noise protection walls, 12 parking facilities, seven junctions, and 45 rainwater retention basins.

A number of challenges had to be overcome, including the need to assess structures at different stages of design and construction. Additionally, many of the existing assets were over 50 years old and built before the BIM era, adding to a wide range of information maturity from assets that are newly designed, in construction, and in operation. The modelling also had to cope with a wide range of data sources and unify information held in federal authority systems, national databases, and private company systems.

The success of the project came through embracing a clear approach to link the physical twin with the digital twin across the lifecycle of assets. That meant organizing data to effectively compare the as-planned, as-constructed, and as-maintained and operated states.

The key to this information management was to embrace intelligent data linking across the digital and physical twins, clearly supported by buildingSMART standards to ensure that data was consistent and uniformly structured and decisions that needed to be made could be made with access to the correct data.

Core Objectives

The German government has an ambition to use Digital Twins for the management of its highway operations from 2025 onwards. The objective of this project is to create the first Digital Twin for highway operations in Germany and to demonstrate the benefits of the technology.

Highlights

- Germany's first-ever Digital Twin for highways management.
- The government's ambition is to use Digital Twins to manage all highways by 2025.
- The project is based on the use of intelligent data, linked and supported by buildingSMART standards.
- The Digital Twin brings together planning and construction data with multiple external highway stakeholders using uniformly structured data gathered across multiple use cases.
- This data structure enables teams to view and action data from their required perspective, whether focused on schedule, cost, function, or location.

openBIM Solutions used:

Information Delivery Manual (IDM)

Software used:

3D information system from HOCHTIEF ViCon, Desite, Tekla, Autodesk Civil 3D, Autodesk Revit, Dynamo Sandbox

Result

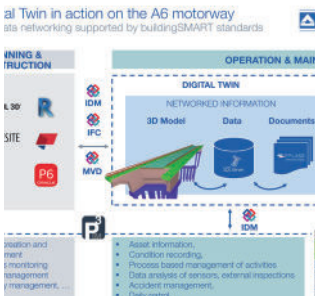
The system focuses on a number of key use cases, based around the inspection, management, and maintenance of the assets. A specially developed app helps the team to capture key asset data in a uniformly structured manner. This data is linked to the Digital Twin of the entire 50km highway network and used to generate actionable outcomes which drive the management of assets and aid the interface with other services such as accident response and fire services. For each use case, a business intelligence component helps the project team to create key performance indicators and a dashboard to monitor performance.

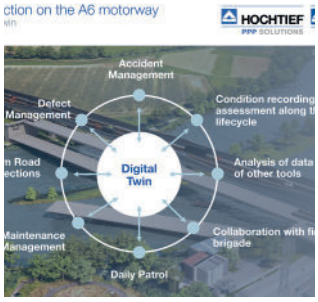
> "Without the standardization ideas of buildingSMART a cross-phase digital twin would be difficult to realize. The data exchange formats of buildingSMART are essential in the controlled collaboration of many project participants."

René Schumann, Managing Director, HOCHTIEF ViCon.

> "We see collaboration on the digital twin as part of a sustainable cultural change. Working processes can be optimized based on its data structure. Information is far easier to access and cross-references can be made to gain new insights. This leads to a more efficient Asset Management."

Dr. Daniela Schäfer, Lead Competence Area BIM, HOCHTIEF PPP Solutions





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SPECIAL MENTION

Intelligent Water Trunk Transfer System with Predictive Maintenance for Smart Water Management

Water Supplies Department (HKSAR), Hong Kong , China

Project Overview

The Water Supplies Department (WSD) of Hong Kong is developing a new Asset Management Information System, designed to integrate the latest openBIM, openGIS, Artificial Intelligence (AI), and Internet of Things (IoT) technologies to simplify management of the trunk main network, boost the customer supply experience, and reduce overall operational costs.

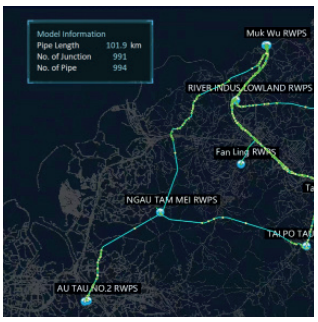
The WSD manages Hong Kong's large trunk mains with diameters over 2m, plus small and large treatment works, pumping stations, and reservoirs, all of which contribute to a daily production of 300 million cubic meters of water, supporting the needs of 7.4 million people.

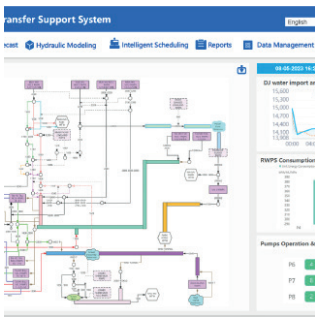
Core Objectives

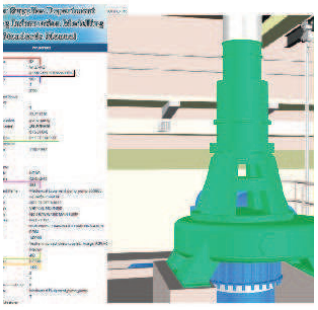
The project set out to implement the Asset Management Information System (AMIS) as a centralized asset repository for all WSD asset classes including, but not limited to, civil assets and mechanical and electrical (M&E) equipment. The aim is to enhance asset management and sharing of asset information among all other WSD application systems.

The AMIS will lay the foundation for the new and existing WSD application systems, which are vital to the future development strategy.

The new AMIS replaces the legacy software and outdated hardware which has been in operation since 2000. The use of modern technologies will safeguard system safety and security, while also helping to guarantee service stability in the face of ever-changing operational needs.







Highlights

- The new Asset Management Information System (AMIS) creates a comprehensive approach to asset management, adhering to international standards such as ISO 9001, 50001, and 55001.
- The AMIS moves Hong Kong's Water Supplies Department from an environment of scattered knowledge and inconsistent actions to now embrace new consistent and organized business process and practices.
- Knowledge and information is captured and used via an easy to access Common Knowledge Repository providing teams with the right information at the right time.
- Artificial Intelligence (AI) can recognize different noise patterns to accelerate identification and location of water leaks. This improves asset management efficiency and reduces response time to critical water main issues, ensuring a sustainable and reliable water supply network.
- AMIS funding approval to invest $18.850 was obtained in November 2022 and the project is now scheduled to complete in October 2024.

openBIM Solutions Used

IFC

Software Used

Autodesk Civil 3D, Autodesk Revit, Bentley Systems

DS Catia

Result

The Water Supplies Department (WSD) places strong emphasis on asset management to maintain a secure and reliable water supply for Hong Kong. The new AMIS is central to securing this objective in the future, using the latest technology to gather and utilize data on assets condition and performance to ensure pumps remain up and running.

The new system ensures that WSD stays abreast of the latest technology and creates an integrated asset management system that is capable of improving service performance.

Two key elements sit at the heart of the project:

1. Adoption of openBIM for Asset Management: AMIS serves as an asset management life cycle and workflow process management system. It enables the management of asset operations and streamlines business processes. WSD has successfully developed and tailored APIs to meet its specific asset management requirements.

2. Adoption of openGIS and AI for Pipe Asset Management and Water Delivery Optimization: the AMIS supports the new Smart Trunk Transfer Support System (STTSS), a cutting-edge system which harnesses the capabilities of AI, hydraulic modeling, and GIS to effectively implement energy-saving measures.

Last year, WSD used the new system to help plana execute the renovation of a 5km section of large diameter water main. Benefits from the new system are already being realised across four key areas:

- Ensuring safety, security and reliability.
- Cost and Energy Saving.
- Workflow and Operation Process Optimization.
- Asset and Facility Management Improvement.

> "The Water Supplies Department of the Hong Kong Special Administrative Region is upgrading its Asset Management Information System by leveraging openBIM, openGIS, AI, and IoT technologies. OpenBIM facilitates data integration from various sources which enables WSD proactively identifying potential issues when operating and maintaining the system, optimizing their asset management practices, and enhancing the reliability and lifespan of their assets. This improved efficiency, and reduced costs and energy but also enhanced safety. Coupled with AI-driven maintenance strategy that reduces downtime, the synthesis of the above-mentioned technologies streamlines operations, boosts asset performance and ensures regulatory compliance, which delivers sustainable asset management."
>
> Ka Kin Tsang, Project Lead, Water Supplies Department Supply and Distribution

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WINNER

Sustainable Interdisciplinary Planning and Construction of a District Police Authority in Germany

Tecklenburg, Germany

Project Overview

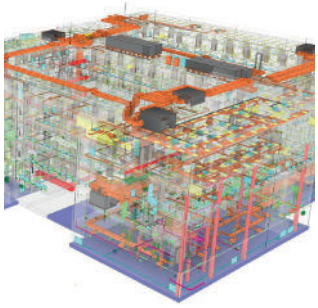
This project piloted the use of openBIM technologies during the design and construction of a new building for the police department of the Rhein-Erft district in Bergheim, North Rhine-Westphalia, Germany. The use of BIM was mandated in the Europe-wide tender, and winning the contract kickstarted construction company Tecklenburg's transformation to embrace open digital technologies.

The €66 million project provides a new building with a gross floor area of 17,000 m², accommodating 430 police officers in 550 rooms. In addition to mandating the use of BIM and thus becoming the first BIM-designed police department in Germany, the client also specified that the building conforms to DGNB Gold certification for sustainability in planning, construction, and building management. As a result, the project also included the provision of new charging stations for electric vehicles and bicycle parking.

As a pilot project for the use of openBIM, the first priority was to break down resistance towards the use of BIM throughout the supply chain and delivery partners. This was achieved by establishing a BIM Steering Committee for the project.

Working with key stakeholders, this committee established the foundations for the digitization of the project design and construction. This included the Employer Information Requirements, the BIM Execution Plan to manage software solutions and define interfaces, and milestones that were set and linked to project deadlines.

Additionally, several BIM use cases were employed to help set priorities on the project. Traditional tasks, competencies, and responsibilities were redefined to align with the needs of digitalization, and training needs were identified across the team.



Core Objectives

• To create an openBIM pilot project for the design and construction of a new police department headquarters so as to achieve the client's mandate for the use of BIM while also creating a digital transformation across the entire project delivery supply chain.

• To use the openBIM process to embed sustainability and circularity into the design and delivery of the project and help the project to achieve the client mandated DGNB Gold certification for sustainability in planning, construction and building management.

• To ensure that the use of openBIM optimised and improved the outcomes across the design and delivery of the new police headquarters.

Highlights

- The project created a BIM Pilot Project for all the delivery stakeholders.
- Created the first Police Department in Germany to be designed and constructed with BIM.
- The use of openBIM accelerated and improved the design concept and process leading to the delivery of more efficient outcomes and overall better a building design.
- Delivery was accelerated – the planning and construction took just 2.5 years.
- Achieved DGNB Gold Certified for sustainability in Planning, Construction and Computer Aided Facility Management (CAFM).
- The new police department has capacity for 430 police officers over a gross floor area 17,000 m² and included charging stations for electric vehicles and bicycle parking.
- Project cost: Euros 66 Million.

openBIM Solutions Used

IFC

Software Used

Allplan Architecture, Trimble MEP, Dynamo, Autodesk Revit, Tekla, Plot24 CDE, Microsoft OneDrive, Dalux, Sitelife, PlanRadar

Result

Core BIM targets were set and assigned to key departments for the design and delivery across the project architecture, design, site management, construction and project marketing and communication.

Key openBIM outcomes included:

- The use of openBIM enabled model-based structural calculations, earthquake analysis, for heating, air supply, water supply, lighting and cooling.
- The efficient production of formwork and structural drawings, reinforcement design and drawings for the mechanical, electrical, and plumbing (MEP) system.
- MEP models merged into a coordination model and checked for geometric collisions. Issues were processed as BCF format via BIMCollab Cloud interface, directly in the authoring program.
- Working with Hilti the MEP planning was optimised with anchor channels installed before concreting and the addition of an earthquake-proof anchoring concept.
- The planning and acceptance of the fire insulation was significantly simplified with IFC interface.
- The documentation for DGNB GOLD certification was automatically created from the model and greatly simplified its process.
- Using DGNB-certified building materials, a cycle for further use is ensured as sustainable parameters were stored in the IFC Model. All building components were selected as per DGNB Material Catalog with IFC-Interface.
- The result was hugely positive and enabled the optimisation of the structural design including an earthquake-resistant structure plus the delivery of collision-free planning for MEP assets and smooth workflows leading to record breaking delivery times.

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FINALIST

openBIM for Achieving Urban Sustainability in Hong Kong - Refurbishment of The South China Hotel

ZS Consulting Co. Ltd., Hong Kong, China

Project Overview

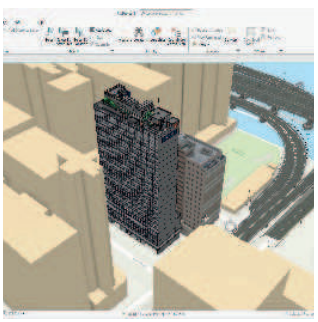
This project to refurbish the South China Hotel in North Point, Hong Kong, successfully embraced the openBIM methodology and transformed the project's coordination and delivery processes. It serves as a best practice example to encourage the construction industry to adopt this technology in future renovation projects in Hong Kong.

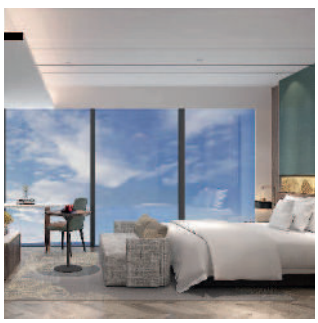
The project included the refurbishment of over 200 standard, superior, and deluxe rooms to create a 5-star hotel with a new glass façade design, a luxury lobby with a large-scale LED display wall, comprehensive new gym facilities, an indoor swimming pool, a new air conditioning chiller system, and a roof-mounted signboard.

By digitizing the existing building using techniques such as hand-held 3D laser scanning and openBIM, the project was able to preserve and reuse much of the existing structure in the design. The point cloud models created were also key to improving on-site coordination, and the use of BIM Coordination Format (BCF) streamlined information transfer.

Core Objectives

- To use the openBIM methodology during the refurbishment of Hong Kong's South China Hotel as a key to delivering greater outcomes from the project investment.
- IIntegrate openBIM with openGIS to transform and improve the project's design, procurement, coordination, and delivery processes.
- To promote innovation and the use of openBIM processes for future refurbishment projects in Hong Kong.
- To embrace sustainability in the design and construction stages of the project.
- To reinforce software interoperability through the use of openCDE and promote greater automation in the BIM process.





Highlights

- The use of openBIM methodology has transformed the project's coordination and delivery processes.
- By digitizing the existing building using techniques such as hand held 3D laser scanning the project was able to preserve and reuse much of the existing structure in the design.
- The point cloud models were key to improving site coordination.
- The use of BIM Coordination Format (BCF) streamlined information transfer across the project stakeholders.
- Integration of openGIS elements enhanced the project by incorporating geospatial data analysis into the design and improving spatial coordination.
- Development of TEA.time app to boost communication and coordination across the supply chain and workflow.

openBIM Solutions Used

Information Delivery Manual, IFC Data Model (IFC 2x3), BIM Collaboration Format, Model View Definition

Software Used

Autodesk Revit, Autodesk Navisworks, Autodesk Recap Pro, Autodesk Civil3D, Trimble Connect, HKBIM, BIM track, Openspace, Hololens/MR, Cyclone 3DR, Rhino, Dynamo, Fuzor, ArcGIS

Result

The project has demonstrated the value of embracing openBIM technologies, particularly for renovation projects where there is low adoption in Hong Kong. The use of openBIM and, in particular, laser scanning technology to assess the condition of the existing structure has enabled designers to incorporate and reuse much of the existing structure, thereby reducing carbon emissions and the cost of replacement.

Sharing building information across different software platforms was crucial to helping designers and builders make more informed decisions about materials, energy usage, and other factors that impact sustainability. This also enabled the team to preserve more cultural value and memories from the existing buildings and ensure that the building and environment data is embedded in the city's evolving development and resilience plan.

The benefits of using openBIM in the different phases of the project include:

In Design: The use of design with digital twin enabled immersive design visualization to foster genuine collaboration among project team members and BIM users. The openBIM technology established a unified source of information to ensure agreement on project goals and objectives among stakeholders, identified risks and hazards before construction, and kept track of design accuracy and efficiency.

In Procurement: The use of 3D construction coordination, analysis, and automation in drawing generation directly from the openBIM model led to a 50% reduction in manpower and a significant reduction in time.

In Construction and Assembly: Development of the open plug-in "TEA.time" app has been central to increasing communication and coordination across the supply chain and workflow. By establishing a common standard for document and drawing production, it has aided the exchange of information within a multidisciplinary project team. The use of virtual walkthroughs using OpenSpace was a game-changer when fewer workers were allowed on-site due to COVID-19 restrictions.

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SPECIAL MENTION

I-Park - openBIM Application in Hong Kong Integrated Waste Management Facilities Phase 1

China Communications Construction Company Ltd., China

Project Overview

This project involves the design, construction, and operation over a 15-year period for the first phase of a new Integrated Waste Management Facility, the first-ever Waste-to-Energy plant built in Hong Kong.

The project included the design and construction of new buildings on a 16-hectare artificial island to create a facility capable of handling 3,000 tonnes of waste per day, reducing the waste volume by over 90%, and generating 4.8 million KWH of electricity for 100,000 households.

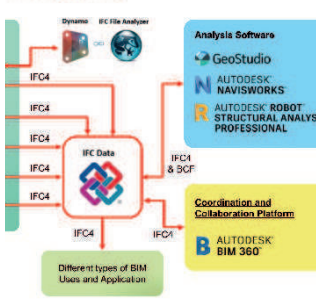
Contracts were signed for the US$4 billion project in 2018, and after a year of planning and scheme design, the project is expected to open in 2024/25 after just 80 months of design and construction work, including three years of land reclamation work and three years of construction.

The client for the work is the Environmental Protection Department of Hong Kong, which set a very tight programme for the project. This caused challenges for the construction team in terms of project planning and resource management. The project's remote offshore location also meant that land access was not possible, adding to logistic challenges.

An additional challenge was maintaining effective communication and collaboration across the international project team of more than 140 companies from many different disciplines and based as far apart as Singapore and Belgium. The global COVID-19 pandemic also restricted the ability to meet physically.

Highlights

- The first ever Waste-to-Energy Facility designed and constructed in Hong Kong.
- More than ten buildings constructed on a newly created 16ha artificial island.
- The treating facility has the capacity to process 3,000 tonnes of waste per day.
- The project will reduce over waste volume by over 90%.
- The plant will generate 4.8 million KWH electricity for 100,000 households.



Highlights

- The use of openBIM was central to enabling this project to be delivered effectively in a challenging physical environment and to a tight timetable.
- As the global Covid-19 pandemic began to restrict the ability of international teams to travel and meet physically, the openBIM technology became vital to enable effective collaborate.
- To date, BIM has been rarely used on marine projects in Hong Kong. This project kickstarted the experimental use of BIM so as to encourage the widespread adoption of openBIM in reclamation today.
- The use of openBIM had to be embedded in the project to assist in design, construction and operation phases of the contract. A federated model based around separate models across these different stages of the project made this possible.

openBIM Solutions Used

IFC

Software Used

Microsoft Teams, Autodesk BIM360, Autodesk Revit, Autodesk Naviswork, Autodesk Civil3D, ArchiCAD, OpenRoads, Tekla Structures, Plant 3D, Inventor, Advance Steet, Robot, SAP2000, Holebase, Leapfrog, Revisto, Fuzor, Synchro 4D

Result

Success started with a clear Exchange Information Requirements (EIR) from the client was driven by a BIM Execution Plan (BEP) setting out data classification standards for each discipline, BIM Level of Development (LOD) requirements for different project stages, and a Responsible, Accountable, Supportive, Consulted, and Informed (RASCI) Matrix to set out responsibilities for each task.

A Common Data Environment (CDE) sits at the heart of the project as the single source of truth. This enabled all parties to access the latest live data and information regardless of their physical location, removing any hindrance to collaborative working and allowing structured data sharing and access across different devices and operating systems.

A master federated model based around Autodesk BIM360, Microsoft Teams, and Navisworks meant that all international stakeholders could collaborate without the need for physical meetings. Over 200 BIM Coordination Meetings and over 100 other BIM-related design meetings were held this way.

In the design and construction phase, 3D scanning and data coordination using openBIM and GIS helped with the review and update of the construction method.

During the caisson design and installation, openBIM was used in design and modeling to accelerate and improve the prefabrication of the concrete seawall caisson, and 3D seabed scanning de-risked the installation process.

The use of openBIM was key to the Modular Integrated Construction design and installation during the construction of buildings on-site and the installation of equipment such as the 6000-tonne prefabricated boiler unit. It allowed 15 months of concurrent activities to be carried out, and the use of a federated model and 4D simulation eased clash detection and project coordination, enabling clear communication with the client on progress.

> "IWMF is a mega-project, involving numerous international stakeholders, PRC, HK, Singapore, and Belgium, in different disciplines. We have adopted openBIM voluntarily since 2017 in the design-build-operate contract and openBIM for design coordination and collaboration, aiding project's future operational requirements. Since IWMF is a marine infrastructure; openBIM is adopted for marine works design and construction including Deep Cement Mixing (DCM), Seawall Caisson, and Modular Integrated Construction (MiC). The 6,000 tonne boiler unit was prefabricated in PRC and subsequent transfer to the site by barges. This approach significantly reduces on-site activities, improves work quality, and enables 15 months of concurrent activities. "
>
> Ran Tao, Senior Engineer, CCCC

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WINNER

The Applications of openBIM in Hangzhou West Railway Station

China Academy of Railway Sciences Corporation Ltd, China

Project Overview

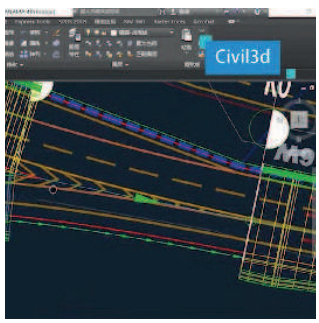
The China Railway Construction Engineering Group Co. is the lead contractor for the US$836 million project to construct the new Hangzhou West Station in Hong Kong.

Working for the client, the Shanghai Kunming Passenger Dedicated Railway Zhejiang Company, and with the China Railway Fourth Survey and Design Institute Group Co. as the lead designer, the new station covers 512,000 square meters to create 11 platforms serving 20 lines, plus a 60.75m high building with five floors above ground and four floors underground.

The project is organized and managed according to the ISO 19650 standard and has embraced the use and development of openBIM as central to its project design, delivery, and operational strategy. The China Academy of Railway Sciences was appointed as the general consultant for BIM management.

Core objectives

- To incorporate full lifecycle openBIM planning into the early stages of the project, fully involve BIM technology from the design stage, and ensure the implementation of BIM technology from the source.
- To place data and information delivery at the heart of the project to guarantee the correctness and completeness of the BIM model and data throughout the entire lifecycle of Hangzhou West Station. This will also improve the delivery quality of Hangzhou West Station and lay a solid data foundation for a future of smart stations in Hong Kong.
- To apply new openBIM technology to the full lifecycle project management for Hangzhou West Station. This will improve collaboration between professionals on the project and all stakeholders involved and reduce the information gap that often hinders effective project management.
- The desire to focus on sustainable design and construction and create a “green railway” during and after implementation was clearly defined in the contract’s overall construction requirements.



Highlights

- The concept of openBIM has been fully embraced across the design construction and operation of the project.
- The application of the ISO 19650 standard has greatly enhanced the communication between the parties involved.
- The use of BIM Collaboration Format (BCF) enabled a coordinated Common Data Environment (CDE).
- Technologies such as openBIM+3D laser scanning, RFID and QR codes boosted data gathering and management efficiency.
- A total of 35 organizations participated in openBIM. The project saved US$32.7 million in direct economic costs as a result of this improved design and construction collaboration.
- Over 56000 tonnes of prefabricated steel was used. The use of openBIM improved the installation quality of steel structures by analysing the deviation between on-site 3D laser scanning and BIM throughout the entire process.
- The energy-saving rate of buildings is 66.86%, saving 520 tons of support steel and 30000 square meters of temporary land.

openBIM Solutions Used

IFC, ISO 19650, COBie standard

Software Used

Autodesk Revit, Autodesk Naviswork, Tekla, Rhino, Grasshopper, Dynamo

Result

The use of openBIM technologies on the Hangzhou West Station building has ensured the smooth implementation of the project and helped to deliver high-quality digital construction of a large spatial steel structure project. This has achieved significant technical, economic, and social benefits, saving an estimated US$32.7 million from the project cost and playing a major role in promoting the project.

openBIM technology has been key to simplifying project coordination and the exchange of information between the participating teams across the project supply chain.

The BIM Execution Plan (BEP) was compiled to ensure the integrity of the BIM model and data used across the whole project lifecycle, including geometric accuracy and depth of information. The information requirements of all project parties were determined for model delivery to ensure effective collaboration.

A Common Data Environment (CDE) was established, and the data integrated with the railway project management platform to ensure that a single source of data was maintained. Design issues were tracked through the CDE and integrated using BIM Collaborative Format workflows.

After three rounds of model review, a total of 475 model problems were found and resolved, among which the largest proportion were linked to information inconsistency.

On project completion, the model files and documents will be released and shared via the railway project management data interface to assist with future quality management.

The use of openBIM has helped to drive the design towards new levels of sustainability of the project and meant it has obtained the three-star green building design. Key measures for this performance include:

- Building energy efficiency rate: 66.86% was achieved.
- Renewable energy utilization rate : The proportion of domestic hot water heat provided by the air source heat pump hot water unit is 60.00%.
- Utilization rate of non-traditional water sources: 10.26%.
- Green space rate: 13.39%.
- Reusable and recyclable building material usage ratio: 15.38%.

SPECIAL MENTION

Eucaliptos: unlocking the power of openBIM

SPOL Architects, Brazil

Project Overview

For this project, SPOL Architects was commissioned by property development client AAM to lead the planning and design for two new towers in São Paulo, both mixed-use buildings with open façade construction. Unusually, the architect was also asked to manage and coordinate the project development, a role more often handed to a specialist project management consultant.

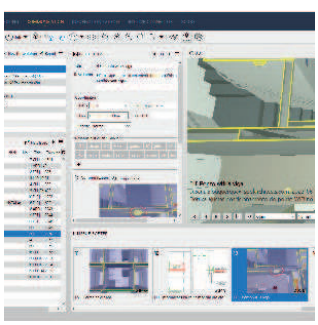
The use of openBIM was embraced by the team as the key to effectively communicating and coordinating the project and to ensuring that all parts of the design team and specialist subconsultants had access to the latest information and design requirement data.

The project consists of two 15-storey residential towers linked by commercial space on the ground level. Each tower is unique in terms of its structure and use. The Monogram tower is designed with four apartments on each floor, while the adjacent NDK tower is arranged with six studio apartments per floor.

The Monogram tower façade is designed to encourage interaction between residents and neighbours and is based on a chamfered diamond-shaped structure designed to ensure both residents' privacy and pleasant visual perspectives on all four open façades. A rooftop level features a pool and leisure facilities.

Core Objectives

The client specified that the architecture office would coordinate and manage the project alongside design duties. This is unusual in Brazil, as normally the client would hire a project management company to carry out this coordination role. The project was an opportunity to use openBIM concepts across the supply chain to ensure the quality of information generated by all disciplines. The client was keen to use technology to better communicate the design to all project stakeholders.



The use of openBIM technology was vital to helping the large project team communicate and coordinate their design activities using the latest up-to-date information. The openBIM data management was central to easing the process of merging 3D printing with traditional model designs so both architects and clients could have a better understanding of the project's geometry.

Highlights

- The use of openBIM allowed the architect to lead the design process while also coordinating the overall project and stakeholder management.
- Greater interdisciplinary collaboration led to better overall outcomes.
- openBIM and IFC made it possible to explore the best that each software has to offer.
- The technology facilitated the work, the visualization of errors, interferences between projects, and highlighted the need for adjustments and solutions.
- The work was accelerated as problems were solved early through clash detection in the BIM model.
- The qualities take off and cost estimation process was made more efficient.
- The team was able to more easily explore constructive alternatives.
- The end result was a better product at a lowest cost.
- The modelling enable the client and stakeholders to easily visualise design options and the final outcome.

openBIM Solutions Used

IFC

Software Used

Autodesk Revit, Augin, Graphisoft BIMx, Rhinoceros, Grasshopper, Archicad, TQS, Twinmotion, Autodesk 3ds Max, Construmanager, Solibri, BIMcollab

Result

A federated openBIM model was created to bring together data from 32 separate IFC models. These were developed to manage the project design and development across different disciplines but were able to refer to common data to enable an integrated and simultaneous design process.

Data was divided into containers of information associated with the basement, tower, and standard floor plan. Some 2,500 BIM Collaboration Format (BCF) issues were managed over design sectors such as architecture, structure, hydraulics, and electrical air conditioning systems.

The IFC model was sent to a free visualization platform, allowing easy and free access by the client and stakeholders to view the model on demand. This information was made available in the project's very early stages and set the pattern for open access to the BIM model across the project from day one.

The design and project management were improved due to having a centralized issue management system with issue tracking and data available to all companies involved in the project.

The system also generated automated project status reports, automated quantitative takeoffs, and so created more efficient cost estimating and enabled rapid simulations and assessment of alternative constructive solutions.

The use of cutting-edge technology to accurately visualize and improve design processes at every stage from project start to finish was central to delivering a quality outcome. The merging of 3D printing with traditional model designs gave both architects and clients a better understanding of the project's geometry.

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WINNER

Helsinki Airport Development Programme Projects 2013–2023

Finavia Corporation, Finland

Project Overview

Airport operator Finavia launched a ten-year development programme in 2013, which set out plans to invest in the airport facilities. The aim was to develop the customer experience and strengthen Helsinki Airport's position as one of the best airports in Europe as it prepared for growth.

Although Finavia had been using BIM in its development and renewable projects since 2007, this programme was the first time that openBIM technology had been placed at the centre of its development strategy.

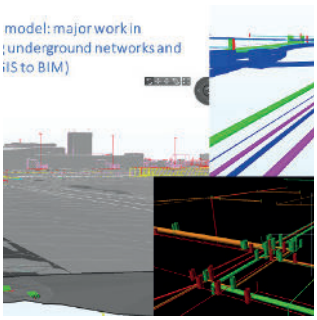
The development programme's use of openBIM focused on improving the performance of two key areas of the airport operation: the airside activities around the apron and the terminal infrastructure performance. However, central to the success of the project has been ensuring that the use of openBIM improves the communication and coordination between these two distinct operations.

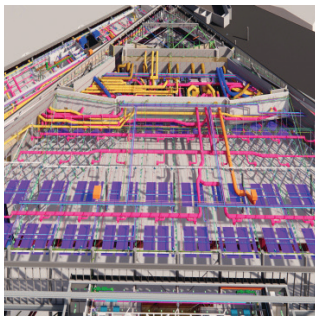
The use of IFC 2x3 enabled the data and terminology to be fully integrated across the requirements of the airport operation with buildings and infrastructure asset management, easing the terminal-apron coordination processes.

Embedding openBIM technology throughout the planning, design, and delivery of new airport terminal buildings has enabled new levels of collaboration across the supply chain.

Core Objectives

- To deliver a 10-year plan to develop the airport customer experience and ensure investment underpinned the plans for growth.
- To ensure that the long-term plan stayed on schedule and delivered to expectation.
- To embrace and drive a consistent BIM strategy with common rules agreed under the leadership of the BIM coordinator.
- To simplify and integration data management across the building-infrastructure-airport activities and improve the terminal to apron coordination processes.
- To increase communication and coordination across the airport's asset management, enhancement and operations teams.





Highlights

- Helsinki Airport's 2013-2023 development plan embraced the use of openBIM for the first time.
- The use of IFC 2x3 helped to integrate data requirements across the airport's operation, building design and infrastructure asset management.
- Embedding openBIM technology throughout the planning, design and delivery of new airport terminal buildings has enabled the new levels of collaboration across the supply chain.
- Up-to-date information models help to improve design and construction communication and coordination.
- Gaming technology helps visualise technical designs and allows everyone, including those with no knowledge of construction, to understand them.
- A consistent BIM strategy and common rules agreed under the leadership of the BIM coordinator kept the long project on schedule.

openBIM Solutions Used

IFC 2x3

Software Used

Autodesk Revit, Augin, Graphisoft BIMx, Rhinoceros, Grasshopper, Archicad, TQS, Twinmotion, Autodesk 3ds Max, Construmanager, Solibri, BIMcollab

Result

The openBIM technology focused on boosting communication and coordination of data and information supporting two main areas of the airport activity: the airside apron infrastructure and the public-facing terminal buildings. The use of technology ensured the overall airport performance was improved by collecting and sharing the critical design and construction performance information needed to assist the management of the assets as a whole system.

The Apron openBIM Model was integrated with and interoperable with GIS data to ensure that the modelling incorporated the airport's existing underground networks and structures. This ensured that the entire built environment information lifecycle was included—from as-designed to as-built.

BIM data was used in the design and construction phases and redefined into a virtual environment and dashboard to help create a common understanding of the data and bring all stakeholders into the decision-making process.

At the heart of the terminal development was openBIM-based design collaboration. This meant that the technical design and construction of the terminals were carried out in parallel with the needs of the construction team able to guide the design process.

The key to success was to use openBIM standard formats, such as IFC and BCF, in data transfer between parties. The project BIM coordinator led the coordination by selecting the areas to be coordinated.

BIM-based models were used as raw material for various visualisations and virtual tours. The visualisations helped the parties to understand the design objectives and to commit to the final outcome.

The airport terminal is constantly changing. Up-to-date information models ensured the design and construction of new commercial spaces and signage, as well as the erection of temporary structures. Gaming technology helps visualise technical designs and allows everyone, including those with no knowledge of construction, to understand them.

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FINALIST

Application of openBIM in the Design and Delivery of the Second Chengdu-Chongqing High-Speed Railway

China Railway Eryuan Engineering Group Co, China

Project Overview

The Second Chengdu-Chongqing High-Speed Railway is located in Sichuan Province, China. The US$9.7 billion project aims to design and construct a new 300 km length of 400 km/h high-speed railway connecting Chengdu and Chongqing in southwest China. The engineering conditions along the project are complex, with many environmentally sensitive areas along the railway line.

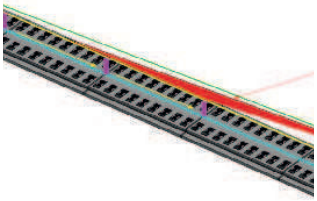
The project is a key part of the "Chengdu-Chongqing Economic Circle" and, due to the need to build across mountains and rivers, has high environmental protection, safety, quality, and sustainability requirements during construction. This has increased the demand for the use of digital technologies to boost data exchange and improve collaboration throughout the project delivery.

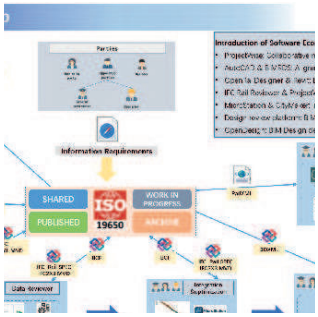
BIM design based on openBIM standards and processes has been used in the design of all activities such as alignment, track, subgrade, bridges, tunnels, telecommunications, and signalling.

The use of openBIM has been embedded into the design stage of the project based on three-dimensional information models from surveying and mapping, geology, and creates the foundation for greater productivity during the construction stage of the new railway.

Core Objectives

- The project owner set out a requirement for the project to use openBIM technology during design and construction.
- The goals is to achieve "whole project, all domains, and all phases" throughout the digital design and by optimised digital application of the design information, to maximize the value of openBIM in the construction of the railway project.





- The ISO 19650 standard has formed the backbone of the information management process from the start of the project.
- A BIM execution plan has been created by using openBIM methods such as IFC, IDM, BCF, MVD, etc. and brings together the information requirements of each stakeholder, to support collaboration and interoperability across all project phases.
- The Common Data Environment (CDE) platform was developed to meet the requirements of collaboration, while ensuring that BIM data can be transferred from one project phase to the next.

Highlights

- The ISO 19650 was adopted throughout the whole process of design and delivery.
- A common data environment (CDE) for design and delivery was developed. IFC files were used for information exchange. The CDE supports the collaboration among different domains.
- The transition of project collaboration was possible from file-level to data-level.
- Based on this project, the data requirements, use cases, IDM, and UML of railway were standardized.
- Multi-domains BIM design of alignment, track, subgrade, bridge, tunnel, telecom, signalling, etc.. were achieved.
- The use of an electronic sand table played an important role and developed "BIM- supported decision-making".
- The technology has enable rapid BIM modeling.
- Use of openBIM has accelerated and simplified the simulation of railway gauge clearance checking, signal visibility checking, video overlay, crowd evacuation in the station.

openBIM Solutions Used

IFC 2x3, ISO 19650, bSDD

Software Used

ProjectWise, AutoCAD, BIMRDS, IFC Rail Reviewer, OpenRailDesigner, Autodesk Revit, MicroStation, CityMaker

Result

openBIM was used during this project to help project managers with data integration, data analysis, and decision support by providing a better understanding of the project status. The openBIM standard has enabled cross-team and cross-regional collaboration, reducing barriers to communication and coordination.

This project is a successful application of ISO 19650 and openBIM solutions and will provide a case study for future project digitisation during the construction of intercity railways, subways, light rails, and other rail transit infrastructure in China.

By using this openBIM design and design review platform, the efficiency of modeling and quantity takeoff is more than 30% higher than that of traditional design, and the project was delivered on time and under budget. Based on the BCF standard, collision detection is carried out during the design process, saving cost and delay later in the project.

The use of BIM+GIS technology has helped to develop and build an electronic sand table platform that integrates geographical information, regional geology, fault zones, bad geology, traffic networks, environmental protection information, and BIM data of the whole project. This has helped the construction team to visualize, assess, and improve different design schemes and allowed the comparison of ideas to improve and accelerate decision-making during the railway engineering.

Data sharing among different stakeholders has been improved by the openBIM technology since each stakeholder can import and export BIM data in a standard format to share the information. When the design phase completes, the design models and drawings are automatically published by the CDE platform and available for use in the construction phase in multiple file formats.

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FINALIST

openBIM application for Model-based design of railway from Nykirke to Barkåker

Systra, Norway

Project Overview

The project was led by Systra for client Bane NOR, which is in charge of operations, maintenance, and construction of railways throughout Norway. It embeds the use of openBIM technology into the design and construction of a new 13.6 km double-track railway line between the towns of Nykirke and Barkåker, south of Oslo.

The work included the design and construction of several key structures, including two rock tunnels, two cut-and-cover tunnels, a new rail station, two rail bridges, and a pedestrian footbridge.

In addition to the rail infrastructure, the project also required the construction of 40 new permanent roads and 30 temporary roads.

Other design elements of the project included several temporary structures such as sheet pilings, tieback anchors, and other deep soil mixing ground improvement work, as well as new concrete bridges, retaining walls, and steel structures.

Alongside the structural and civil design work, the project also included architectural design and landscaping work, as well as hydraulics and mechanical, electrical, and plumbing in the station and other buildings.

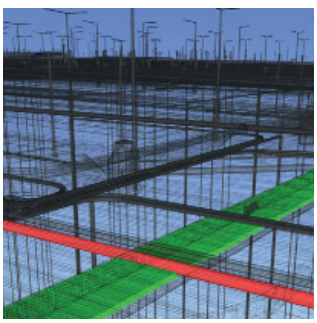
openBIM and IFC file formats ensured data accessibility and increased design and construction efficiency by improving collaboration and communication between different disciplines and reducing the time taken for checking data and detecting and avoiding design clashes.

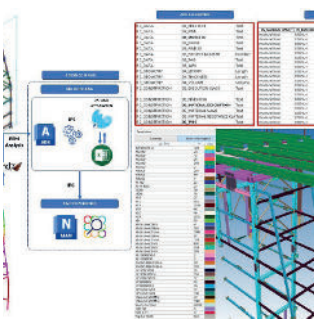
Core Objectives

- Use openBIM models to represent a comprehensive and accessible single source of truth across the entire project.
- To embrace drawing-less design and build – all project information should be stored, transferred and issued as 3D model data.
- To enable data accessibility across all software such as Revit, Civil 3D, Navisworks, Novapoint etc. as well as in open file formats like IFC
- To ensure a robust structure and validated quality of information in all BIM models.

openBIM Solutions Used

IFC 2x3





Category of Design for Infrastructure

Highlights

- OpenBIM Standard Ecosystem map created a clear information flow across 200 BIM models and between the design construction and operation teams.
- Drawing-less design and build was embraced to smooth information flow.
- Infrastructure element were mapped to IfcBuilding standards to create a comprehensive and accessible single source of data truth.
- A Maturity Matrix Index was used to clarify the level of development of the objects inside the models.
- The BIM models became the basis for data exchange, quantity take-off, project review and coordination with the client and stakeholders.
- Early error and clash detection was made made possible, saving on-site problems and reducing cost and delay.

Software Used

Autodesk Revit, Autodesk Civil 3D, Autodesk Navisworks, Bentley Systems Microstation, Trimble Novapoint, SierraSoft Roads, BIMcollab

Result

The project's openBIM Standard Ecosystem map set out a very clear and robust information flow to ensure that data was gathered, validated, and passed effectively between the design, client, and contracting teams throughout the design and build process. It was then made available for use during the operation and maintenance phase of the project.

Some 220 individual BIM models were created across the project disciplines. To ensure that each represented a comprehensive and accessible single source of truth, a dedicated set of parameters was included in all discipline models with direct links to 2D documentation such as specialist reports, 2D drawings, Excel files, and any other document that may have been needed by the contractor and client.

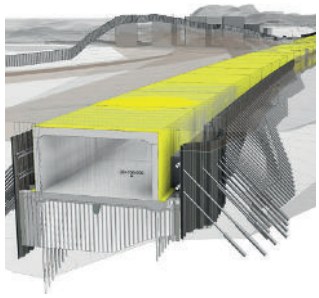
As accessibility of data across multiple software packages was very important to the project team throughout the openBIM implementation, IFC standards were used to map all infrastructure elements. Standard property sets were used to organize and define each model object so that the same property sets could be found in every discipline model, increasing information accessibility.

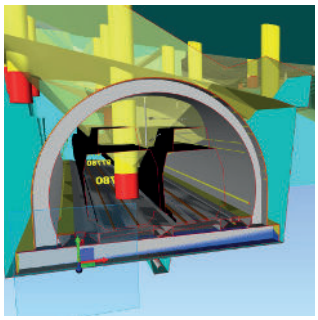
A Maturity Matrix Index was established to clarify the level of development of the objects inside each of the models. This ensured a step beyond the Level of Detail (LOD) specification, giving a more robust structure to the quality of information.

With all information being in a standardized format, the models became the basis for all information exchange on the project and for quantity take-off. The use of Navisworks Search Rules together with user-defined Quick Properties allows the extraction of quantities information.

Project review and coordination was also made easily possible with BIMcollab ZOOM tools which allowed rapid quality checks on model data, easy color-coded visualization of parameter values, analysis of multiple models, and easy sectioning and measuring tools.

Clash detection was also simplified through internal review.





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WINNER

Rail Tunnel: Mehrspur Zurich - Winterthur

ILF Zurich, Switzerland

Project Overview

This new 10 km long railway tunnel project used openBIM to ensure efficient and effective information exchange between the client, SBB, and IG Brütt+, the design and construction joint venture made up of five main design and delivery partners.

The Brüttener Tunnel sits at the heart of a new twin-track rail route between Zürich, the biggest city in Switzerland, and Winterthur. To increase capacity from the current 670 trains per day to the forecasted 900 trains per day, an additional double track is needed via the Brüttener Tunnel.

The tunnel is designed in a Y-shape with three portals and an underground junction. It consists of two single-track tubes with an outer diameter of approximately 10 m. The tubes are connected with 20 underground cross passages, which are needed for tunnel safety.

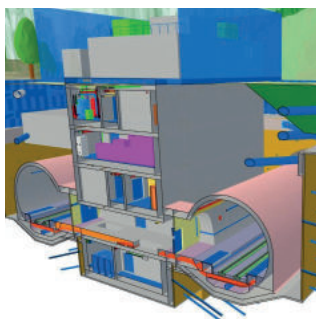
The decision to embrace the use of openBIM on this project began during the conceptual design phase, which started in 2017. SBB and the joint venture IG Brütt+ started working together and both committed to implementing so-called "big openBIM" as a pilot project within SBB.

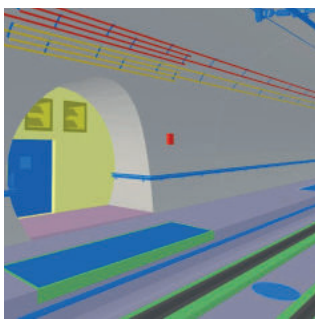
The phrase "big openBIM" refers to the fact that this project involved many disciplines, making it crucial to create an information management system that worked for all.

A test openBIM model was created during the design for one of the 20 cross passages. Once this demonstrated the benefits, the entire tunnel project was modeled and served as a pilot project of big openBIM in SBB.

Core Objectives

- To convince non "BIM" users of value of BIM models.
- To avoid "parallel planning", and design in 3D.
- To enable the complete project to be viewed at once for coordination purposes.
- To manage data with simplicity, clear structure and user-friendliness.
- For modelling and model structure to be filterable and "future proof".
- To take practical steps to make the model easy to navigate and to understand.





Highlights

- The use of openBIM improved coordination between disciplines and helped to solve and reduce conflicts.
- Stakeholder visualization were key to helping the team understand the design and to provide a framework for negotiation.
- The model enable automated determination of quantities, saving time and boosting accuracy.
- The openBIM process promoted a more stable design in which there were fewer changes required during construction.
- The team benefitted from more efficient work preparation and greater collaboration with contractors.
- The use of a Common Data Environment provided a single source of truth for the project, reducing error, design clashes and the need for rework.

openBIM Solutions Used

IFC 2x3, IFC 4, BCF, .cvs, .json

Software Used

Autodesk Revit, Autodesk Civil 3D, Dynamo, Catenda CDE, Vectorworks, Nova, Vrex, Autodesk, Navisworks, Solibri, BIMvision, SimleBIM, Python

Result

This pilot project for the use of openBIM for the creation of a 3-dimensional model as the single source of information has demonstrated how the technology and process can create great value throughout SBB's design process. The Brüttener Tunnel project has paved the way for the use of openBIM during construction and, most importantly, during the operations and maintenance of the new railway line.

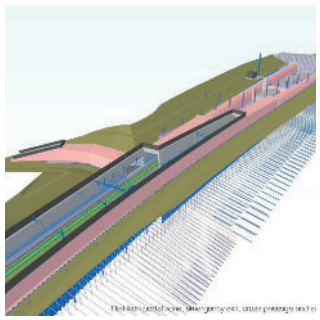
Catenda was used as the project's central Common Data Environment (CDE) platform, creating the so-called "single source of truth." For many disciplines, it was one of the first major BIM projects they had been involved in, so it was critical to ensure that all tools were as simple to use as possible.

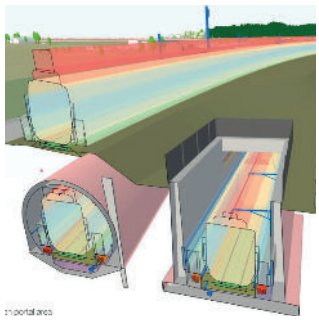
The main use case during the first five years of the project has been design coordination, with information and data exchange managed using BIM Collaboration Format. This helped to bring together and provide effective information exchange between 16 specialist planning disciplines, with 26 different use cases and 12 different software tools.

Having established the 3D design model, the openBIM process was continued during the project's permit application design phase. Having a "single source of truth" enabled 2D drawings to be quickly and accurately created for Swiss Authority approval, while the 3D model and visualization tools helped local stakeholders and communities to really understand the project and its impact.

For the project team, the openBIM model's intuitive structure has enabled information to be shared with non-expert users, who were able to use the model with little specialized training. As such, the model has been used as an authoritative source of information in the design process, in meetings, and in reports – not least because it is compatible with SBB's existing asset database.

As the project moves towards the construction phase in 2025, the model has also been central to creating tender documents, with automated quantity take-offs and a more coordinated and stable model, which should lead to fewer changes during construction.





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WINNER

Multi-domain openBIM Digital Engineering Certification and Handover for JiuQuan-Ejina Railway

China Railway First Survey and Design Institute Group Co./ China Academy of Railway Sciences Corp., China

Project Overview

The new JiuQuan-Ejina Railway is part of China's Belt and Road Initiative and is situated in the China-Mongolia economic corridor in northern China. The project saw the delivery of a 244 km stretch of new track costing 4.4 billion CNY (US$620 million) and taking 30 months to complete as the so-called "Green Ribbon in the Desert."

Handover of the new asset to the operator, the Gansu Jiu'e Railway Co., was a critical phase of the project. For the first time, digital assets validation and certification have been carried out in railway communication, signal, electric power, catenary, and other fields, collectively referred to as the "Four Electric" in China.

Core Objectives

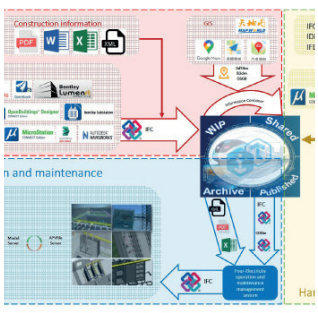
- To ensure that all data is standardized, integrated, accurate and accessible.
- To establish digital assets validation and certification system based on openBIM to enable the complete railway to be handed over into operation.
- To digitise a series of standards such as IFC, IDM, EBS, etc according to the digital validation method.
- To establish the railway BIM model validation technology based on IFC.
- To develop openBIM validation software and support automatic validation of .ifc format model and information.
- To enable digital assets handover and application based on COBie standard and with the use of virtual reality (VR) and augmented reality AR technology.

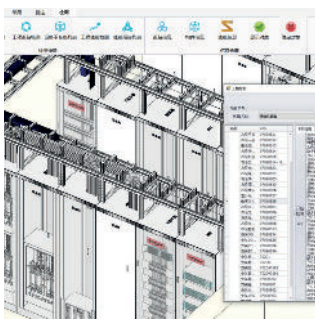
openBIM Solutions Used

IFC, IDM, ISO 1965, IFD, Cobie

Software Used

Autodesk Revit, Bentley Systems Microstation, Bentley Systems Substation, Bentley Systems OpenBuildings Designer, Bentley Systems Raceway and Cable Management, Bentley Systems Microstation, Autodesk 3DS Max, Unity, Onesight, Microsoft Office





Highlights

- The validation process helps to make better decisions across the overall project life cycle.
- The cost and time of file transmission is reduced by 50% and has saved more than 1 million CNY (US$140,000) in travel expenses.
- The project has saved more than 5.5 million CNY (US$775,000) and improved work efficiency by more than 20%.
- The investment for the construction unit was reduced by around 3,625,600 CNY (US$500,000), and the project cycle was shortened by 52 working days.
- Through the application of openBIM, any digital engineering problems during construction period are highlighted and the drawings amended. This provides an effective guarantee for construction delivery.
- Digital engineering validation and certification enables all parties involved in the construction to communicate more effectively and provides a guarantee for construction delivery and intelligent operation and maintenance.
- Digital engineering solves the difficulty of high work intensity of operation and maintenance personnel and so avoids any potential impact on the normal operation of trains.
- Digital engineering improves the design quality, provides basic information for construction and operation and maintenance, and ensures the integrity and correctness of data information transmission.

Result

The project ensured that as-built delivered assets were submitted to meet the information model-based operation and maintenance requirements of the railway. This provided a non-destructive delivery of information, and the openBIM concept and capability increased the accessibility of data and productivity of each participant in the data validation and certification process. The quality control certification has been approved by the Chinese government.

The project was carried out in accordance with ISO 19650, a multi-process BIM information management mechanism, and CDE covering construction, handover, and operation and maintenance were established.

A set of openBIM-based project digital asset quality certification/review processes was established, supporting the automatic detection of openBIM models.

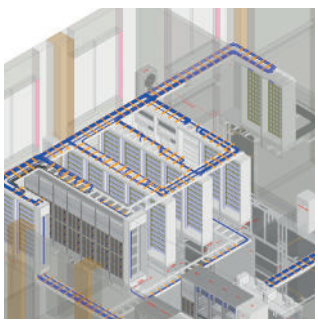
All participants took part in the consistency review of graphic models and physical models to ensure that the information model delivered at different stages meets FM requirements.

To meet the needs of the handover process, a common data environment (CDE) was created to reflect the processes of information gathering and validation. The published data used by the operation and maintenance teams therefore drew on raw work-in-progress construction and inspection data, which is then shared and validated while cross-referencing to the overarching railway Four-Electricity operation and maintenance data. Only once validated is the data published as validated data in the CDE.

This data was delivered to the operation and maintenance platform based on open format, which facilitates the operation and maintenance management of a series of sustainable projects.

To access this verified data, visual operation and maintenance was enabled. Based on COBie standards, the asset data was imported to meet the requirements of workers and enabled both static data and dynamic data visualization of digital assets, allowing hidden engineering to also be validated.

This improved operation and maintenance efficiency by more than 10%, on-site validation efficiency by more than 30%, improve validation quality by more than 10%, and reduced investment by more than 20%.



buildingSMART International

FINALIST

New digital solution through IFC to automatize the handover to O&M

Enel Green Power, Italy

Project Overview

Enel Green Power operates renewable energy plants globally and is actively helping nations to drive their move towards electrification and sustainable energy. At the heart of its strategy is putting people and the environment first when developing new power resources. As such, it is constantly pushing technological boundaries and increasing stakeholder awareness in a bid to maximize outcomes and value for communities.

This project consists of a new digital solution to improve and optimize the process of handover of new generation assets to the operator to boost the efficiency of the operation and maintenance phase of the asset lifecycle.

The new Integrated User Platform (IUP) is a new IT infrastructure that supports and integrates the data transfer process, based on the BIM methodology and, especially, on the interoperability of tools thanks to the use of the open format IFC.

The project has been carried out with industrial software company Aveva and assists project management by making collaboration and communication between the project design, delivery, and operation stakeholders more efficient and effective, boosting the quality of the handover process.

Currently, the IUP is operational on 20 energy generation projects in five different countries. Some 160,000 objects are now managed on the system.

Project Overview

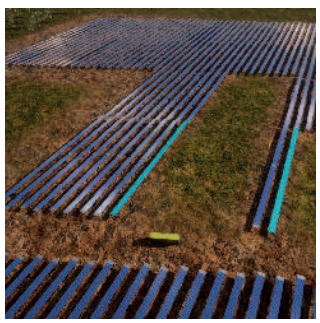
- Data can be made available to the various systems automatically, ensuring content consistency and facilitating handover to O&M activities.
- Automatic definition and creation of a hierarchical structure (FLOC) which represents the plant organized according to the O&M standard.
- Open format ensures standardization of information modeling and communication.

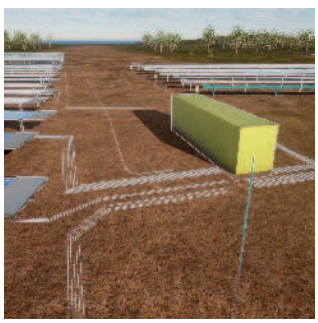
openBIM Solutions Used

IFC 2x3, IFC 4, BCF, .cvs, .json

Software Used

OpenText, SAP ERP, SAP AIN





Highlights

- Process optimisation - boosts the efficienvy of the handover process.
- Security & quality - enables control and validation of data on ip, liability, risks, and contracts and the authenticity of users.
- Data governance - definition of new parameters to insert within the models all the data necessary for the development and maintenance of the project.
- Collaboration - development of a unique source for all phases in the Enel process, accessible by different stakeholders.
- Economic optimization - has saved Euros600k to date.
- Reduction time - reduce the process time about 90% and mitigate the risk of a possible human error.

Result

The Integrated User Platform (IUP) solution collects information from various digital systems used during the development and construction of new plants into a single digital platform and makes it available to the operation and maintenance teams.

The goal is to facilitate the real-time exchange of data and information between working teams and make the collaboration between colleagues involved in renewable plant construction projects more effective.

The system uses IFC2X3 and IFC4 standards for interoperability and BCF standards for collaboration. Data is automatically drawn from the as-built BIM model and uses automatic definition of objects and the creation of a hierarchical structure to help manage the assets.

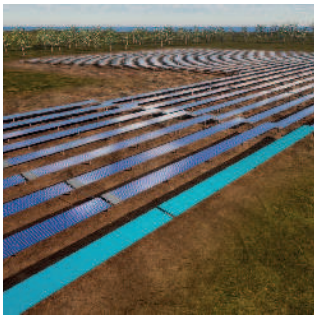
The IUP has a knowledge-sharing component focused on information on individual business projects. This includes a general overview of project progress, the KPIs of safety, quality, and sustainability, the status of contracts and payments, as well as aspects linked to operations & maintenance.

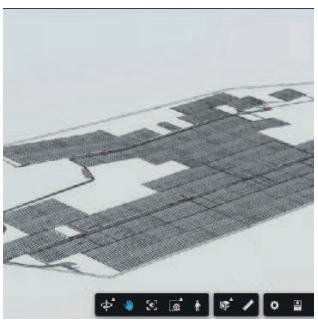
This also includes data on the country or geographical area where the project is located, with updates in real-time on political situations, any ongoing emergencies, and weather forecasts to assist the operation and maintenance of the assets.

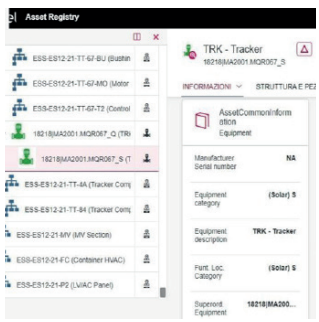
openBIM is more than a technology; it's a philosophy that empowers collaboration and innovation in the construction industry. By fostering interoperability and shared data, openBIM enables better communication among diverse stakeholders, leading to enhanced project efficiency, reduced human errors, and cost savings. In Enel Green Power it is the bridge that connects ideas, disciplines, and expertise, ultimately revolutionizing construction thanks to data exchange.

> "Our journey with buildingSMART International's Awards Program has not only amplified our expertise but also unlocked unparalleled collaboration and innovation. OpenBIM is bridging innovation and construction, one collaboration at a time, by fostering data-driven harmony and ingenious solutions among diverse stakeholders. This participation fuels our commitment to a smarter and interconnected future."

Lucrezia Bartoli, BIM Expert, Enel Green







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FINALIST

BRISE-Vienna

Research Unit Digital Building Processes, TU Wien, Austria

Project Overview

The City of Vienna is working with several industry partners to digitalize the building permit process from application to approval. The key objective is to improve the efficiency of the process and thus reduce the time taken to issue a permit.

The BRISE process—Building Regulations Information for Submission Envolvement—will enable applicants to benefit from a faster, simpler approval process while also providing immediate feedback from a preliminary assessment. This should provide a more robust and transparent basis for planning and allow any corrections or adjustments to be made in good time.

The use of openBIM technology helps to avoid any potential restrictions in the approval process caused by a developer's choice of authoring software. It also ensures the longevity and security of data stored by the city authority.

Digitization should enable a more efficient exchange and sharing of data, thereby improving collaboration and integration across the development process and encouraging the use of openBIM throughout the lifecycle of a structure.

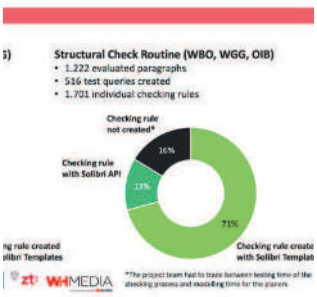
Additionally, the use of virtual 3D models of each proposed development will give members of the public a clearer view of the impact of that project before construction work commences, encouraging feedback and design improvement.

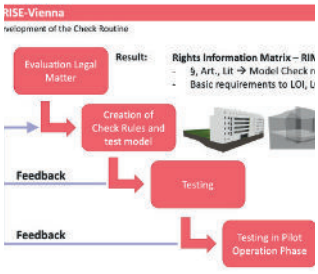
Core Objectives

- To accelerate the building permitting process across the City of Vienna from application to approval.
- To rethink and simplify the applications process placing open, digital technology at the heart of the process.
- To improve the feedback to applicants to encourage better design.
- To make the planning process more robust and transparent.
- To provide the community with more information about potential developments and opportunity to comment.

openBIM Solutions Used

IFC





Highlights

- BRISE has enabled the building permit process to be accelerated by up to 50% in future.
- The openBIM format enables applicants to avoid any potential restrictions or difficulties in the approval process caused by their choice of authoring software.
- openBIM ensures compatibility across different software products and the longevity and security of data.
- For applicants, this open approach provides flexibility.
- The openBIM method enables more efficient exchange and sharing of data and so improves collaboration and integration.
- For building authorities, openBIM ensures that data remains accessible for years, regardless of software changes.
- By allowing openBIM submissions in the approval stage, building authorities are able to encourage the use of openBIM throughout the lifecycle of a structure.

Software Used

Autodesk Revit, Allplan, ArchiCAD

Result

The BRISE project utilises and integrate state-of-the-art technologies such openBIM, Artificial Intelligence and Augmented Reality to transform and digitise the entire City of Vienna buildings approval process.

The system is tailored to meet the needs of individual users ensuring that the system is useful and of real value to developers, home owners and to the affected communities .

The checking process brings together and checks digital model data for the application:

- The Building Application Model (BAM) contains the Building Elements, Building Applicant Objects, Building Volumes and surroundings .
- The Reference Model is drived from a verified survey plan of the area.
- The Service Information Model (SIM) contains all service information and uses Artificial Intelligence tools to analyse and retrieve information from a range of local services so as to understand any potential impacts or clashes from the new development.

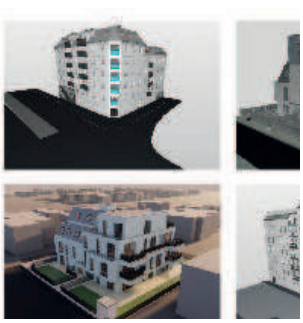
These three models and then brought together to create the Building Authority Checking Model which is used as the basis for application checks based on building laws and structural regulations for the City of Vienna.

This work includes three types of checking routines built into the system:

- Type 1 - automatic checking rule – such as for natural lighting.
- Type 2 - partial automatic checking rule – such as for escape route planning.
- Type 3 - assisting checking rule – such as for statics and load-bearing elements.

A pilot phase has been implemented on 24 real projects including residential buildings, dormitories, barracks buildings and office buildings while also using a range of different software such as Allplan, ArchiCAD and Revit. Testing has been carried out during this pilot to evaluate the checking rules and documentation and demonstrated up to 50% reduction in time to approval.

The BRISE project provides a living lab for the further development of digital administrative processes should now allow cities across Europe to learn from the experience gathered in Vienna, and serve as a blueprint for replication and transfer to other scenarios and dimensions.



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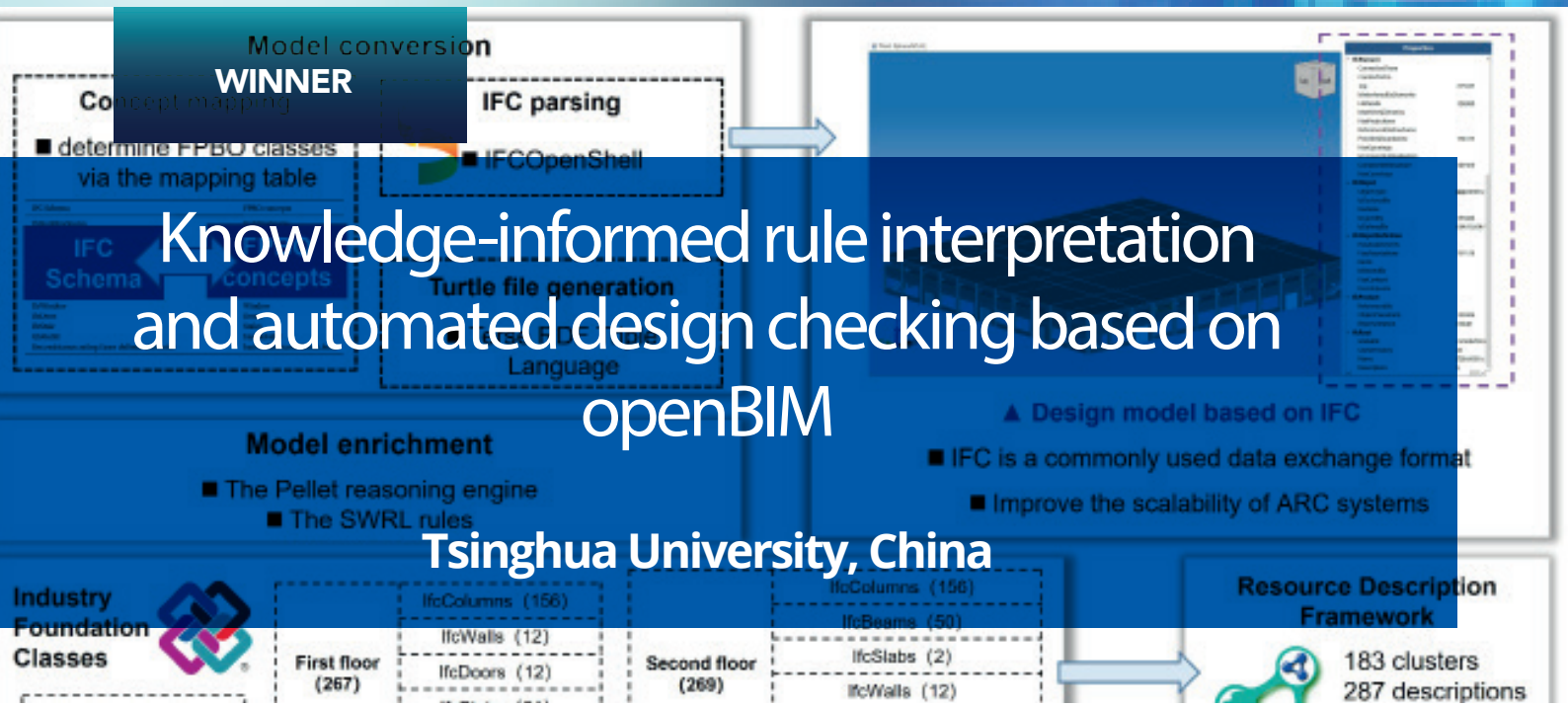


Knowledge-informed rule interpretation and automated design checking based on openBIM

Tsinghua University, China

Project Overview

Design checking is key to controlling design quality and has a significant impact on the efficiency of the construction process. However, there are many problems with current manual checking methods, such as data subjectivity, low efficiency, and the likelihood of errors.

This research project proposes a new approach that automates the design rule interpretation and design checking process based on a knowledge-informed process. This integrates semantic modeling and natural language processing and, when compared to manual methods, is five times faster in rule interpretation and 40 times faster in design checking.

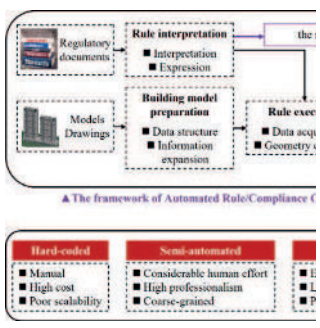
Automated rule checking is an essential procedure to improve design quality in the construction industry. Given that the current pass rate for preliminary checking of construction drawing design documents is only around 40%, automation also offers benefits in improving the industry's efficiency.

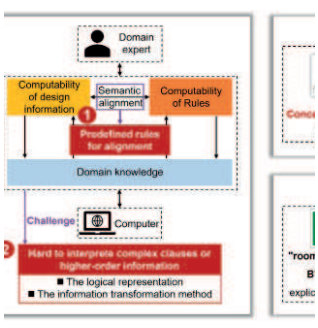
This solution is built on openBIM and other open and free tools to improve its feasibility and scalability and provides over 95% accuracy for interpreting simple and complex clauses, outperforming the current state-of-the-art methods.

The most vital and complex stage of automated rule and compliance checking is rule interpretation. Complex and multi-source data sources, accurate semantic alignment, and interpretation of complex clauses are all urgent challenges that need to be addressed.

Core Objectives

- To develop a new approach that automates design checking by integrating domain knowledge.
- To develop an open, free and powerful solution for automated design checking.
- To use knowledge-informed rule interpretation and automated design checking framework based on openBIM that:
- automates the alignment of regulations concepts with those in ontology.
- generates complex rules with implicit information.
- improves the ability to interprete complex rules.





Highlights

- The project proposes a knowledge-informed rule interpretation and rule checking approach to design checking.
- The solution is built on openBIM and other open and free tools to improve its feasibility and scalability.
- The tool boasts 95%+ accuracy for interpreting simple and complex clauses, which outperforms the state-of-the-art methods
- Compared to manual methods, this automated process is five time fasters in rule interpretation and 40 times faster in design checking.

openBIM Solutions Used

IFC

Software Used

Autodesk Revit, Allplan, ArchiCAD, GraphDB, Blender

Result

The use of openBIM and IFC supports seamless collaboration between all project participants, breaking data silos and solving the problem of unified data format interaction. It also allows the new automated design checking system to be supported by a wide range of BIM software, thus improving the scalability of the automated system.

The new automated checking system consists of four stages:

- Ontology-based knowledge modeling,
- Model preparation with semantic enrichment,
- Enhanced rule interpretation, and
- Checking execution.

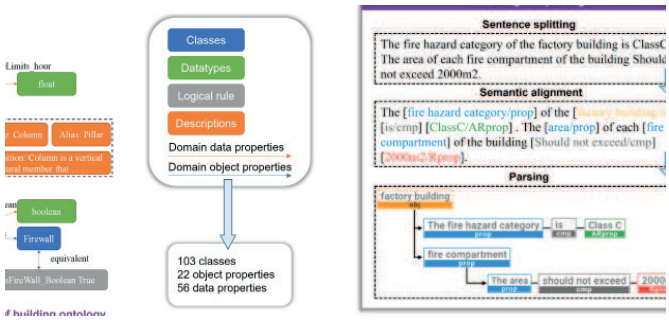
Automated compliance checking is performed through a reasoning engine, GraphDB. Additionally, visualization of results can be carried out using Blender.

The prototype tools of the proposed framework and datasets developed in this work can be obtained from open source, which will also enable the development of the automated rule compliance. The proposed semantic similarity and conflict resolution algorithm achieves the best accuracy of 90.1%.

The challenge for the project now is to gain knowledge around how computer software solutions can better understand complex clauses and align the concepts with design models. Although many efforts have been made for automated rule interpretation, there are still some research gaps. The challenges of complex clauses and semantic alignment still need to be addressed urgently. For example, understanding how to make regulations and BIM models "speak the same language" and how to implement implicit information processing.

> "Our project aims to develop a new approach to automated compliance checking (ACC) of building design by integrating semantic modelling and natural language processing, etc. It is important to represent and process the design information in a uniform and semantic-rich format. However, there are too many design applications with various data formats, and it is hard to get connected with most of them. While openBIM introduces IFC, an open and neutral data format, that is supported by most of BIM applications. Thus, data interoperability among different systems become much easier, and system scalability is easily achieved. With the help of openBIM solution, the efficiency of our ACC solution is expected to be improved by tens of times."

Keyin Chen, Graduate, Tsinghua University



buildingSMART International

FINALIST

openBIM-based Design Optimization and Prefabrication Automation of Steel Reinforcement

Hong Kong University of Science and Technology and National University of Singapore, Hong Kong, China

Project Overview

This research projects sets out to create a new openBIM-based approach to enable the automated clash-free design optimisation and prefabrication of steel rebar in reinforced concrete building structures.

Reinforced concrete structure is currently the most used structural form, but the design and fabrication of steel reinforcements is still a manual or semi-automated task.

The project identified that an integrated digital workflow is needed to support the automated design and fabrication for rebars. The use of openBIM is also key to improving interoperability, reliability, efficiency and collaboration of the digital workflow, however, existing openBIM process could not satisfy automated rebar design and fabrication.

The use of digital design solutions underpins the growing academic and industry interests on offsite construction and Hong Kong's policy to support offsite prefabrication / prefabricated steel reinforcement components.

The project is based on a 6-story sport center with more than 80 columns, more than 360 beams and numerous building joints. This project aims to show that automation is possible for a number of tasks normally conducted manually or semi-automatically in practice such as:

- rebar design optimization,
- clash-free rebar model generation, &
- prefabrication (BVBS code, bar bending schedule & drawings),

The aim is to enhance productivity, effectiveness, quality control, and reduce wastage on site and to design, prepare andpass rebar models directly to contractors and factories for prefabrication.

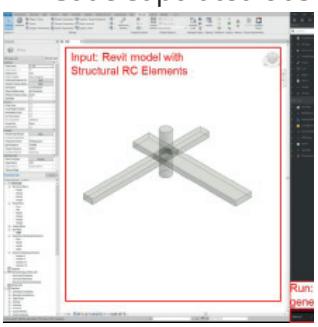
openBIM Solutions Used

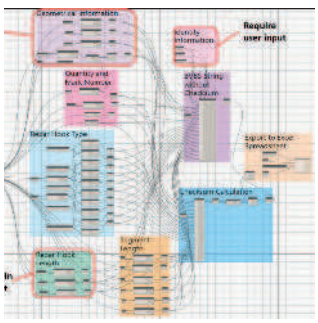
IFC, IDM, MDV

Core Objectives

To automate the clash-free design optimization of rebar using;

- IFC-based information passing (IFC: Industry Foundation Class).
- Optimization algorithm with artificial intelligence (AI).
- Code-stipulated clash resolution with AI.





To automate the prefabrication activities of rebar using:

- Information requirement based on Information Delivery Manual (IDM).
- Development of Model View Definition (MVD).
- Extension of IFC data model.
- IFC-BVBS integration (BVBS: BundesVereinigung der Bausoftware, fabrication machine codes).

Highlights

- Integrated workflow based on IFC to enhance interoperability provides a smooth information exchange between software and plugins using IFC-based approach. This creates accurate, reliable and automated results.
- BIM-based design approach integrates optimisation algorithm and AI techniques and Integrates graph neural networks and genetic algorithms to support clash-free design optimization. The result saves material, contributes to sustainability and improves on site constructability.
- The openBIM workflow based on IDM, MVD and IFC support rebar fabrication. Plugins are developed for automatic generation of rebar drawing, bar bending schedule and BVBS code to improving the efficiency of rebar prefabrication and avoid errors.
- Extended IFC is used to meet the information exchange requirements of BVBS. This add attributes and entities for missing information and represent the product, resource, and work control in automatic prefabrication of rebar.

Software Used

Autodesk Revit, BVBS: BundesVereinigung der Bausoftware

Result

The project has created an integrated workflow based on IFC for rebar design optimization. This enhances the interoperability between BIM software, structural analysis software, and optimization plugins for rebar design, supporting the use of BIM-based optimization algorithms and clash-free design.

The digital workflow is based on IDM, MVD, and extended IFC to support rebar fabrication:

- IDM: Identify information requirements that derive the process map of rebar fabrication.
- MVD: Implementable data for software applications.
- Extended IFC schema: Add attributes and entities for missing information.
- IFC-BVBS integration: Meets the information exchange requirements of BVBS machine code.

The project has been implemented in three distinct phases:

1. Automatic Steel Reinforcement Design Optimization: The openBIM-based steel reinforcement design approach uses the architectural BIM model for structural analysis and element connectivity analysis through a developed plugin and graph neural network (GNN) to improve the computational efficiency of design optimization.
2. Automatic Generation of Steel Reinforcement Model: A plugin is developed based on IFC to realize the automatic generation of steel reinforcement models for most components. This enables openBIM-based parametric and automatic clash avoidance.
3. Automatic Steel Reinforcement Prefabrication: The use of openBIM-BVBS integration with data standards for steel fabrication and the extension of the IFC schema supports rebar representation and prefabrication. The systems allow the automatic generation of bar bending schedules and drawings from openBIM models.

The research project has identified several future directions, including advancing the workflow to more structural component types and enriching the existing IFC standard. The development of an automatic checking module is also being considered to check code compliance requirements for steel reinforcement design, along with work to enrich the use cases for the proposed steel reinforcement design and fabrication workflow.

buildingSMART International

WINNER

BIM4EarlyLCA: Automated LCA for design decision support in early design stages using openBIM and NLP-based semantic model healing

Technical University of Munich, Germany

Project Overview

This project develops a method to enable the partial or fully automated calculation of the embodied carbon across the full life cycle assessment (LCA) of built environment projects and assets using open BIM, IFC-format tools.

The use of openBIM data formats such as IFC and BCF is key to opening up the data and enabling more and different stakeholders, such as building owners or real estate developers, to participate in the element- and material-related decision-making process.

The ability to analyze multiple elements of the building or asset BIM model is key to supporting design decision processes in the critical early design phases of projects.

The reality is that for the LCA of embedded carbon, the early and detailed design stages are at odds with each other through the BIM modeling and design process.

In the early design stage, a top-down approach is taken, starting with a focus on the overall needs of the new building and assembling the design to meet these needs, with the consequent carbon implications.

However, this reverses in the detailed design stage where a bottom-up approach is embraced, looking at the carbon impact of each element that then goes into the creation of the overall project or building.

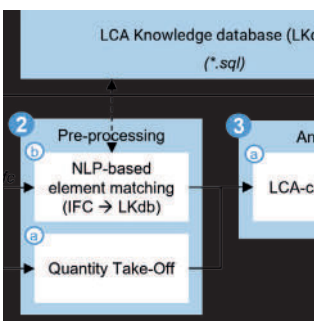
This mismatch means that the original LCA modeling for the building will inevitably not match the designed modeling, leading to the misalignment of intended LCA embedded carbon with the actual delivered impact.

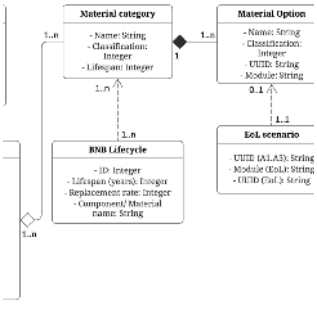
Core Objectives

- To automate calculation of the embodied carbon across the full LCA.
- To better align the early design stage carbon aspirations with the detailed design outcomes.
- To simplify the model interrogation and data analysis process making it accessible to non-technical users.
- To supports design decision-making across a wider range of stakeholders.

openBIM Solutions Used

IFC, BCF





Highlights

- openBIM models (IFC) with little exchange requirements (base quantities, classification, materials) enable the calculation of LCA in early designs stages.
- Natural Language Processing (NLP) enables automated element matching for early design semantic model healing for estimating embodied GHG emissions (LCA).
- openBIM workflow using IFC & BCF supports design-decision making and enables more stakeholders, such as building owners or project developers (non-LCA experts).

Software Used

MySQL, Python, Bert, IFC openshell, Autodesk Revit

Result

The project enables automated calculation of the embodied emissions across the LCA to support design decision processes in early design phases. The use of openBIM models (IFC), which have few exchange requirements such as base quantities, classification, materials, etc., enables the calculation of LCA in early design stages where there is often a large amount of missing information.

In this early design phase, the reality of uncertain information is handled by using ranges of design options in a specially developed LCA knowledge database, which also includes missing material layers of conventional elements for semantic model healing.

The development and use of NLP enables automated element matching in the BIM model to assist with this missing information in the early design and supports semantic model healing to estimate the embodied GHG emissions across the LCA.

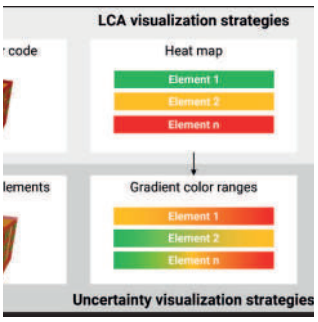
The openBIM workflow using IFC & BCF is key to opening up the process to non-technical users and so supports design-decision making and enables more stakeholders, including non-LCA experts such as building owners and project developers, to more effectively engage with the design process.

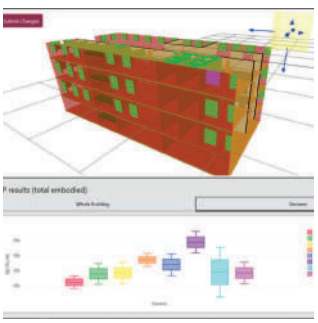
Design decisions are communicated back to the BIM modeler without any data losses, by extending the BCF schema.

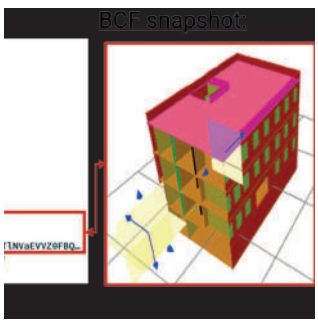
> "openBIM data formats, especially IFC or BCF, enable different stakeholders, such as building owners or real estate developers, to participate in the element- and material-related decision-making process. For estimating the carbon footprints in early design stages we use Natural Language Processing (NLP) to automatically enrich current IFC elements and materials with the datasets for life cycle assessments (LCA). To communicate the design decisions back to the BIM modeler without any data losses, we extended the BCF schema and forward also LCA-related information."

> "The openBIM Awards program of buildingSMART International also gives students and young researchers a great opportunity to highlight their research in the field of openBIM. Furthermore, presenting their projects at an international Summit is an outstanding platform to network and share ideas. Highlighting sustainability as an important priority in the evaluation process shows the current necessity of openBIM approaches to solve current global challenges. "

Kasimir Forth Chair of Computational Modeling and Simulation · TUM School of Engineering and Design







buildingSMART International

FINALIST

Methodology for life cycle assessment in infrastructure construction based on BIM models and the visual presentation of results in a digital environment

AFRY Deutschland Gmbh, Germany

Project Overview

This research projects considers a new approach to the identification and visualisation of carbon emissions across the lifecycle of built environment assets.

BIMetrix is a new openBIM based process which an analyses digital project information in the design, delivery and operation phases to create true lifecycle assessment of both operational and embedded carbon.

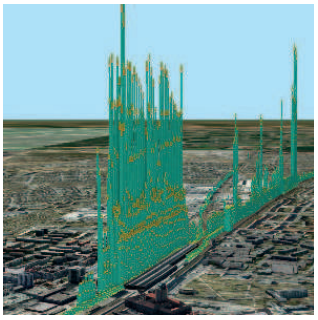
CO2 emissions in the construction sector are responsible for around 38% of the global total. This number is falling but to date the focus has been on reducing the operational carbon emissions. Success in this reduction means that returns are diminishing and means that work to reduce embedded carbon is now a priority.

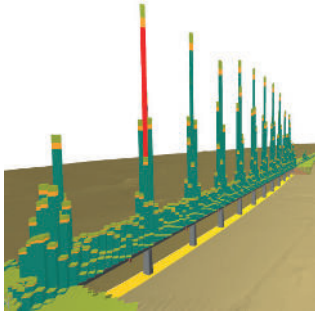
Early life cycle assessment provides the greatest potential for CO2 savings - 80% of the carbon reduction potential is set between case study planning and early design and detailed design phases.

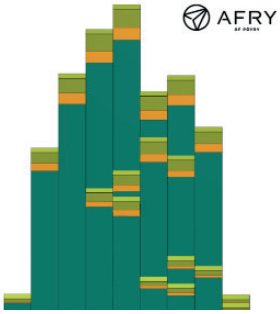
Lifecycle assessment is key to identifying and reducing this embedded carbon. This process has already started to move from the classic manual LCA to a new world of BIM-based LCA. However, this project takes a step further to move to openBIM based LCA - increasing amounts of automation and applicability to larger projects.

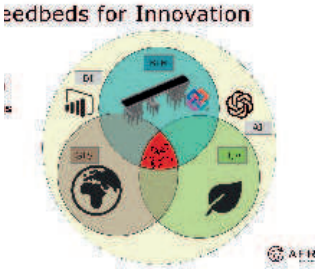
Core objectives

- To help to identify and reduce the amount of embedded carbon in built environment assets.
- To automate the Life Cycle Assessment process.
- To embrace openBIM IFC-based tools.
- To create an early applicable.
- To create an intuitive visualisation to assist interpretation of the results.









Highlights

- Allows the environmental impacts of projects to be visualised.
- Can be applied to all areas of the construction industry and integrates ideally with openBIM workflows.
- Provides the ability to precisely see local differences within a project allows specific optimization potential to be accurately identified.
- Suitable for projects of any scale and links BIM-GIS with LCA data.
- BIMetrix has not only been applied theoretically, large companies have already recognized its potential.
- Automation and the use of IFC standards means that the BIMetrix method is applicable to all project stages, all project sizes, all Structures and all software vendors.

openBIM SolutionsUsed

IFC

Software Used

ArcGIS

Result

The BIMetrix tool uses semantic and geometric processing of data supported by Artificial Intelligence (AI) to analyze BIM models and Geographic Information System (GIS) data, carry out automated Life Cycle Assessment (LCA), and calculate the carbon impact, followed by visualization of the results.

Semantic processing includes the extraction of information from BIM models and mapping that data to an "ecodatabase" to establish the carbon impact of elements.

Geometric processing is able to map the embedded carbon back into the model and provide a relatable visualization of the calculation.

The tool takes raw data from pre-quality checked IFC openBIM models, which is then fed into the BIMetrix tool to output the LCA calculation of the embedded carbon across the asset model.

Development to date has been based on real project examples.

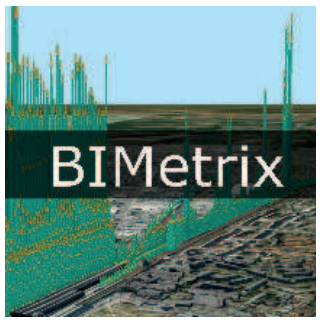
Work so far has included the automatic processing of several hundred different BIM models and demonstrated that processing time is reduced by about 85%.

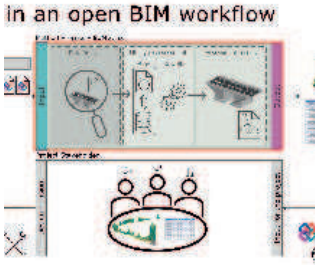
By embracing the openBIM approach, the method is independent of any authoring software. However, the quality of the life cycle assessment is dependent on the quality of the IFC models and EPD datasets.

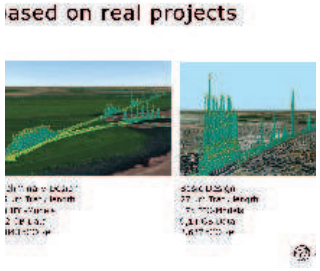
Next steps for the project include the creation of generic EPD datasets, work to improve the AI-based mapping and connection of further international eco-databases, and improvement in the optimization functions.

It is hoped that the systems will eventually be able to automatically generate ECO-certificates to demonstrate performance across the lifecycle.

> "Our BIM-based LCA method consistently relies on the IFC standard. It is essential for the planning process; it overcomes software boundaries. With IFC files as a basis, the LCA method becomes universally and flexibly applicable. You can't optimize what you can't see. Focusing on sustainability is our duty to the earth and future generations."
>
> Felix Hermann, BIM Engineer AFRY







buildingSMART International

SPECIAL MENTION

Neural Search for openBIM

Ecole de technologie superieure, Canada

Project Overview

This research project creates a new search tool to simplify and speed up the current process of extract actionable information from increasingly complex BIM models. By using natural language-based search queries, the tool bridges the gap between technical and non-technical users, thereby democratising the accessibility and usability of BIM through the use of open standards.

The motivation for the work was the realisation that construction professionals are facing an information retrieval bottleneck, slowing down their use of data and introducing delays in the design and checking process.

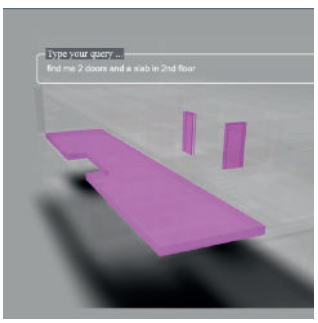
This situation is only set to become worse as the use of digital twins increases and as clients demand data-rich digital models. The rapid tech growth and openBIM maturity is also fuelling data complexity and while IFC solves interoperability, data complexity remains a challenge.

In the current use of BIM models, complex queries are needed to interrogate and check project data but the use of text-based search is rarely used. As such the current practice is not intuitive or satisfying. Existing search methods are mostly lexical in nature and lack of attention to practicality.

The Neural Search project solves these problems by providing a tool which allows users to simply ask a natural language-based question of the model - such as "find me 2 doors and a slab on the second floor" - enabling the tool to quickly retrieve the desire elements and data for even the non-technical the user.

Core Objectives

- To assist professionals facing an information retrieval bottleneck.
- To bridge the gap between technical and non-technical users, and democratise the accessibility and usability of BIM.
- To prepare for a future of digital twins and data complexity.
- To meet the need of clients increasingly asking for data-rich digital models.
- To respond to data complexity fuelled by rapid tech growth and openBIM maturity.



- To use IFC as a future proofed solid technological backbone.

Highlights

- The use of openBIM and machine understanding of domain-specific language provides enhanced user experience for both technical and non-technical users.
- The tool enables cross-disciplinary collaboration.
- The use of natural language-based queries closes the technical skills gap in the use of BIM.
- The work demonstrates that size and complexity of language models does not guarantee the accuracy of the query result – instead greater focus on dataset creation is needed to ensure this accuracy is delivered.

openBIM Solutions Used

IFC

Result

The search tool uses a natural language interface to enable users to interrogate the BIM model. The search uses three distinct processes to understand this query:

- The Intent Classifier to understand the user intent.
- The Syntax Parser – to understand word dependencies.
- The Semantic Parser – to understand the extracted entities.

The Query Generation process then aligns this request to the model data through the Query Builder and Query Executor which then leads to the generation of a search result.

The query response is based on semantic matching, using embeddings as opposed to synonyms and contextual embedding learning as opposed to static embeddings

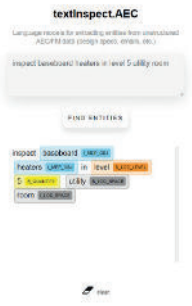
The work has also looked at ways in which the technology can assist in model interrogation beyond simple search and to bridge domain-specific technical language with digital representations of the built asset data.

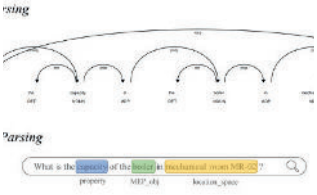
It is also looking at more intuitive or conversational interfaces to apply to BIM software, in augmented and virtual reality applications and in robotics.

Other areas such as Automated workflows for use in compliance checking, project estimation and change management are being investigated.

> "In essence, this research provides evidence on the creation of a system proficient in decoding natural language-based queries. By doing so, it bridges the gap between technical and non-technical users, thereby democratizing the accessibility and usability of BIM through open standards, IFC in particular. This innovative approach extends the potential reach of BIM tools beyond their traditional user base of highly skilled technical users, inviting a broader range of stakeholders to engage with, contribute to, and benefit from these powerful resources."

Mehrzad Shahin-Moghadam, PhD candidate at École de technologie supérieure





buildingSMART International

WINNER

CBIMS: an openBIM+ Solution for Customizable BIM Checking based on buildingSMART & China National Standards

Tsinghua University, China

Project Overview

CBIMS is a new customizable BIM checking tool designed to leverage the power of openBIM and harmonize with the Chinese national standards.

The BIM research team of Tsinghua University Software School proposed the new standards framework based on international standards and China's conditions. The team also developed relevant standard support tools for the standard application.

Previously, closed-source data formats provided by modeling software were mostly used as the local model submission format, resulting in data isolation which made it very difficult to reuse the model when there was subsequent demand for model-based approval and management.

The establishment of local standards makes it a necessary requirement that all the software entering the Shenzhen market support IFC4. This solution achieves both the integration of standard software and the flexible separation of standards and software, allowing the development of more standards while using the same software for compilation and checking without new development.

The project framework is divided into four parts to form an end-to-end framework that ensures the openBIM application in China:

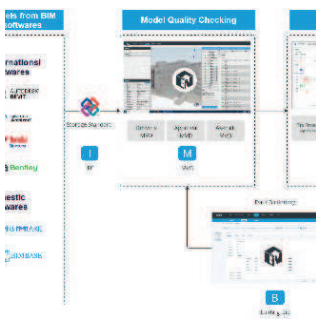
- IFC models exported from BIM software;
- model quality checking;
- building code checking;
- and CIM application, which forms a digital twin city.

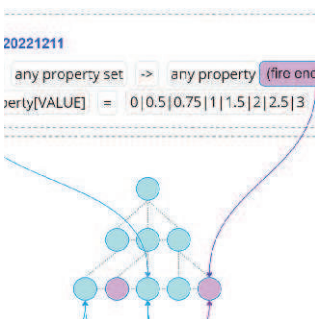
Core Objectives

While BIM checking is promoted frequently in China, it's use and application is still very fragmented with each individual city promoting their own file formats creating information silos. The result is that the format, terminology used in models, modeling requirements, and the building codes are all different. The objective of this project was to create a single openBIM checking tool that harmonises standards and building codes across China.

openBIM Solutions Used

IFC, BCF, MVD





Highlights

There are a number of key outcomes from the project:

- It is the first time that openBIM and China National Standards have been combined.
- The first time that Chinese BIM software vendors have competed and cooperated on the same platform.
- The first time that openBIM has been implemented in Chinese megacity, Shenzhen.
- The first time that openBIM has been used as the foundation of CIM. The openBIM process promoted a more stable design in which there were fewer changes required during construction.
- To date some 4121 high quality models from 172 projects in Shenzhen have been delivered using this solution.

Software Used

Net, Python, C++

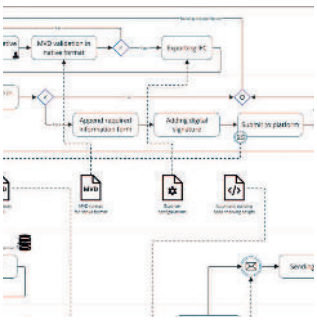
Result

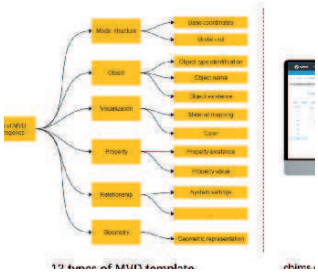
CBMSA is the first openBIM solution to be applied in a megacity. It provides a replicable reusable framework that enables multiple domestic and international software companies to uniformly export IFC for construction permissions, allowing them to cooperate and compete on a fair and neutral platform.

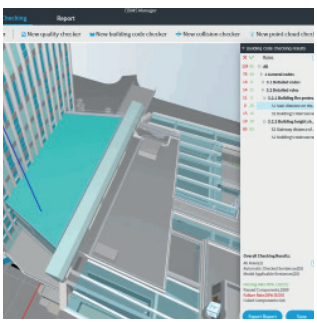
To date, 6362 high quality IFC models from 219 projects in Shenzhen have been delivered using this solution. Additionally, there have been 14220 high quality IFC models from 741 existing building projects delivered. This include many projects without existing CAD drawings, whose IFC models are created from point clouds.

The project, CBIMS, can be explained in five parts:

- C: China. There are thousands of building codes from hundreds of Chinese cities with a population of more than one million and a multitude of software solutions emerging. By adopting OpenBIM technologies and China national standards, CBIMS is the unified BIM checking framework that links these cities, software and building codes.
- B: Building dict. By adopting existing national standards' terms and adding extended terms, building dict is the tool that maps terminologies of models to those of building codes.
- I: IFC. In China very few people use IFC, especially in large cities and at scale. Although IFC comes with many advantages, its neutrality, openness and precision, is considered a challenge due to the potential perceived loss of information in IFC export, the lack of visualization, and a relatively large file size. This solution overcomes these fears.
- M: MVD. The team adopted buildingSMART's MVD technology to define the model quality requirements. Common MVD rules are categorized as 12 templates, such as model structure, object, visualization, property, relationship, and geometry. A faster algorithm boosts the checking speed by about 10 times,
- S: SNL. In terms of building code checking, this solution puts forward SNL technology based on GB/T Three Six Four Five Six (36456), a China National Standard led by our team.







buildingSMART International

SPECIAL MENTION

usBIM.geotwin (GIS Digital Twin) - A world of construction - a single digital twin

ACCA Software, Italy

Project Overview

usBIM.geotwin is a new software solution designed to integrate GIS data with openBIM IFC models to help create and manage the Geospatial Digital Twins which create the backbone for Building Information Modelling (BIM) projects.

The software creates a dynamic connection between ACCA's usBIM platform and the Esri® ArcGIS® technology. This forms an intelligent integration between openBIM and GIS.

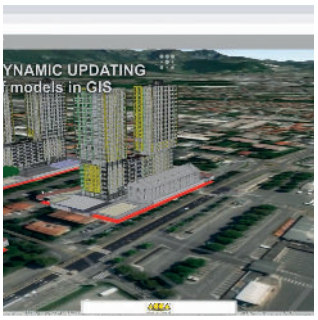
GIS provides the vital context required for the analysis, simulation and optimisation of infrastructure design solutions. The solution enables an interconnection between the BIM model and the GIS for any type of geospatial query.

This makes it possible to create Geospatial Digital Twins for the smart cities of the future. These digital models interact at a territorial level and connect the project information which is updated in real time as it is gathered and produced by technicians, construction companies and maintenance workers.

The result has taken forward the use of digitisation and geospatial management of buildings and infrastructures, easing the complexity and the management of continuously updating project data.

Core Objectives

- To view, analyse and manage all construction data around the world in a single Digital Twin.
- To exploit and utilise the combined power of IFC openBIM and GIS.
- To streamline project management and ensure secure sharing at any scale.
- To enable access to all information seamlessly, ensuring real-time updates at every stage of the project lifecycle.



Highlights

- openBIM and GIS data is brought together and seamlessly integrated in a single working environment.
- Enable the manage large-scale projects with unlimited data capacity.
- Allows the use of open formats and full GDPR compliance on data protection and security.
- Provides dynamic data management and updating at every stage of the life cycle.

openBIM Solutions Used

IFC

Software Used

Acca usBIM, Esri ArcGIS

Result

The new software solution has enabled the introduction and use of 100% openBIM for IFC models (up to version 4.3) on a variety of application including Buildings & Infrastructures, Asset Management, Asset Operations, Facilities Management and in the use of the IoT (Internet of Things) applications.

One of the main limitations of the technologies currently adopted for the digitisation of construction is the static integration of data between BIM and GIS systems. This leads to numerous limitations in the management of digital twins.

Using the usBIM.geotwin the limits of managing digital twins are removed as the technology is based on a dynamic, two-way integration between the openBIM® and GIS systems.

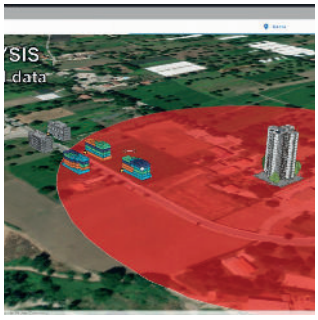
The usBIM.geotwin solution dynamically integrates openBIM® models and processes with maps, scenes and GIS functions to build and manage Digital Twin Geospatial without dimensional limitations. While each platform manages its own data, the user only works on one interface.

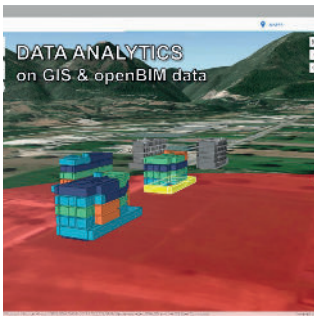
This enables real-time examination of the interactions between project elements and their environment and simplifies the assessment of the impact of design decisions on surrounding areas.

"usBIM.geotwin is an innovative and cutting-edge solution to create and manage Geospatial Digital Twins of BIM projects by integrating GIS data with openBIM IFC models. The dynamic connection between ACCA usBIM platform and Esri® ArcGIS® technology creates intelligent integration between openBIM and GIS. A new paradigm for the digitization and geospatial management of buildings and infrastructures with no limits on the complexity, number and continuous updating of the data.

Participating in the bSI Awards is a stimulating experience! It stimulates the creativity of our company and makes us grow year after year, thanks to the exciting international competition with the best companies in the openBIM sector. It is not just a competition, but a networking opportunity that stimulates knowledge on topics that our company considers fundamental for its own development and for that of the entire AEC sector. Winning is hard, because the participants are many and all very professional, but it allows to bring ideas and technologies to the attention of many operators in the AEC world and opens up new opportunities."

Michelangelo Cianciulli, openBIM and IFC expert ACCA





buildingSMART International

SPECIAL MENTION

openBIM Checker - A hassle-free IDS-based solution enabling robust quality check on the LOIN and consistency of openBIM

Wings & Associates Consulting Engineers Ltd. Hong Kong, China

Project Overview

This Building Information Modelling (BIM) compliance checking and validation software tool is built using the openBIM approach, emphasizing open data exchange and collaboration between stakeholders in the construction industry.

The solution is IDS-based and provides a robust quality check on the Level of Information Need (LOIN) and consistency of openBIM data across all stakeholders from design, construction, handover to facility management.

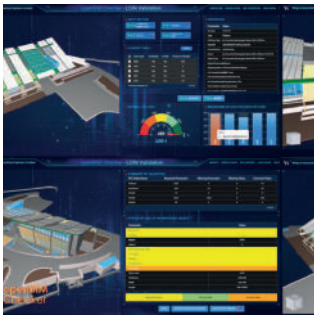
It has been customized specifically for the Hong Kong market, including BIM requirements of CIC, Public Works Departments, and potentially for Buildings Department approval process for private sectors. The software includes an easy to use, intuitive interface to reduce barriers to entry and increases accessibility and so provides a low-cost alternative to traditional software solutions.

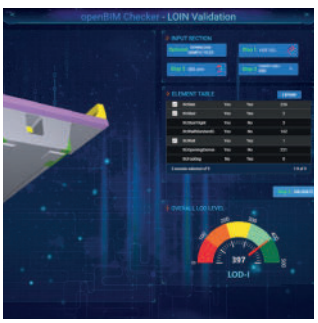
As an open-source solution, it can be integrated with other codes for unlimited potential for expansion. The software promotes more efficient workflows and facilitates data communication, making it easier to comply with QA requirements and providing a soft landing on the QA process.

The IDS-based checking tools help to ensures consistency and accuracy across the entire project.

Core Objectives

- The openBIM Checker validates data across the whole asset lifecycle - in the design and statutory submissions phase of projects and the construction and handover phases.
- The easy model view & selection tool establishes the model categorisation for geometrical & non-geometrical data.
- In the design phase, the checking tool checks the geometrical & non-geometrical design data against the model data.





Highlights

- Localized solution - customized for Hong Kong market.
- Easy-to-use - intuitive interface.
- Cost-effective - provides a low-cost alternative to traditional software solutions.
- Potential for expansion - open-source solution.
- Facilitates collaboration - promotes more efficient workflows and facilitates data communication.
- IDS-based checking tools - ensures consistency and accuracy.

openBIM Solutions Used

IFC, BCF, IDS

Software Used

Autodesk Revit, ARCHICAD, Tekla Structures

Result

A number of key outcomes are noted across the various phases of project delivery, handover and operation:

Model Inspector: This uses tailor-made icons to select common structure elements and is able to search BIM elements quickly and identify elements with industry terminology. Data can then be filtered with a single-click button to improve workflow and save time.

Data Verification: this automatically cross-checks design drawing consistency with BIM models by loading and compare design data from both sources. It is able to identify discrepant data instantly with a single click and so improve BIM model accuracy and consistency.

IDS Converter: Automates the creation of Information Delivery Specification (IDS) file by converting the Excel templates file. This generate IDS file according to Exchange Information Requirements (EIR) of each project phase and IFC BIM model from Project Information Model (PIM) following client's Asset Information Requirements (AIR. The system is flexible to generate IDS files for different project stages through a set of validation conditions, able to export IDS according to IFC Entities and CAT Codes and use CAT codes for primary categorization.

Level of Information Need (LOIN) Validation: Able to visualize, analyze and report the compliance level of the LOD-I for relevant model components in relation to IFC Entities and CAT Codes reducing time spent by 90%. Aligns with LOIN framework specified in the HK CIC BIM Standards General and output BCF files with validation issues to enhance collaboration.

openBIM checker is now being offered as a free trial on all Government Departments and Companies in Hong Kong

> "Participating in this Awards Program for openBIM Checker has been incredibly rewarding. The program's recognition of its innovation and impact significantly enhanced its credibility within the construction industry, promoting wider awareness of the transformative power of openBIM. Valuable networking opportunities facilitated knowledge exchange and potential collaborations, driving the adoption of openBIM practices and fostering industry-wide growth. The program's extensive exposure showcased openBIM Checker to a diverse audience, generating substantial stakeholder interest and amplifying awareness of its benefits.

York Tang, R&D Manager, Wings & Associates Consulting Engineers Limited