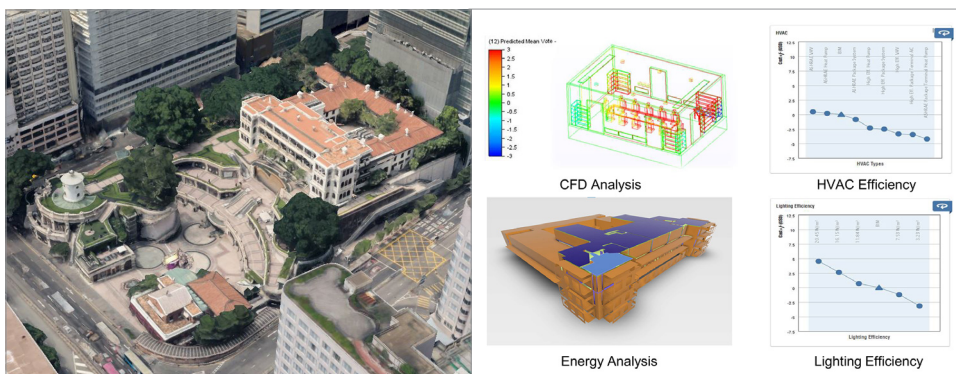# Enhancement of HVAC systems for Improved IAQ and Occupant Thermal Comfort using BIM-Supported Computational Approach

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PROJECT NAME

Enhancement of HVAC systems for Improved Indoor Air Quality and Occupant Thermal Comfort using BIM-Supported Computational Approach

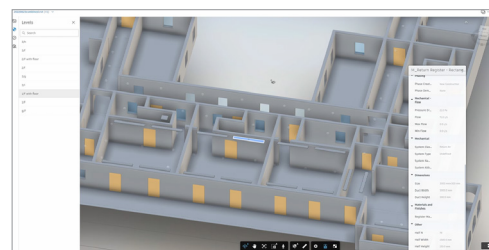PROJECT LOCATION

FWD HOUSE 1881, Tsim Sha Tsui, Hong Kong

TYPE

Heritage Building

AUTODESK PRODUCTS USED

Autodesk® AutoCAD®
Autodesk® BIM 360®
Autodesk® CFD
Autodesk Construction Cloud®
Autodesk® Insight™
Autodesk® Revit®

Aerial view of FWD HOUSE 1881 Heritage
Image Courtesy of The Hong Kong University of Science and Technology

CFD Analysis / HVAC Efficiency / Energy Analysis / Lighting Efficiency
CFD and Autodesk Insight for HVAC system operation and occupant comfort
Image Courtesy of The Hong Kong University of Science and Technology
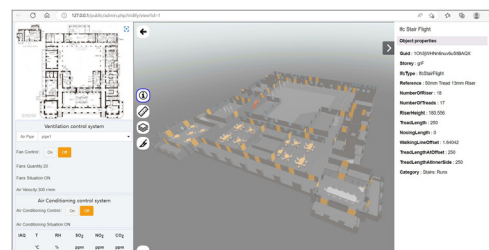
Project Background

FWD HOUSE 1881, regenerated from the former Hong Kong Marine Police Headquarters, is a declared monument serving as a cultural and commercial landmark in the heart of Tsim Sha Tsui. The building is exposed to salinity and moisture from the ocean and air pollutants emitted from nearby roadside traffic. Due to unsatisfactory air quality, oxidation signs, wood discoloration and aging marks are observed there. This commercial heritage building has a complex building layout and space offering hotel, office and fine dining services.

Project Challenges and Solutions

Firstly, Standardized BIM procedures cannot be applied directly to heritage buildings because of their non-homogeneous features and complex morphology. Historic buildings are characterized by the lack of clear traceable construction records such as drawings and construction processes because heritage buildings go through different usages and eras against the changes and advancements in technologies and regulations over multiple time periods. An approach was proposed to address the lack of information by integrating documents, information and graphics into an Heritage Building Information Modeling (HBIM) model for heritage building preservation. Secondly, the lack of the functionality of BIM to support heritage building preservation and an HBIM modelling approach for supporting Computational Fluid Dynamics (CFD) simulation of heritage buildings need to be addressed. This project proposed HBIM approach supports CFD simulations with a refined HBIM modeling method. Based on the proposed digital modeling process, HBIM geometric model is simplified strategically to reduce computational cost while retaining sufficient accuracy for CFD simulations.

Autodesk BIM 360 supports cross disciplinary and regional team collaboration
Image Courtesy of The Hong Kong University of Science and Technology

A digital twin of FWD HOUSE 1881 Heritage
Image Courtesy of The Hong Kong University of Science and Technology

How does BIM help for your project?

To enhance HVAC systems for improving indoor air quality and occupant thermal comfort, BIM integration with Geographic Information System (GIS), Virtual Reality (VR), Internet of Things (IoT), CFD simulation, EnergyPlus and Autodesk Insight builds a digital twin of FWD HOUSE 1881 for environment management and heritage building preservation improvement. Autodesk BIM 360 and Autodesk Construction Cloud support interdisciplinary and cross regional team collaboration. The fusion of IoT and BIM visualizes environmental data at different locations of heritage building. Integrated BIM and GIS supports CFD simulation of the surrounding fluids of heritage buildings. BIM-based CFD simulation analyzes the effect of the ancient HVAC equipment under different condition setting and layout on the environment to improve building heritage protection and personnel health. Combining BIM with EnergyPlus and Autodesk Insight for energy simulations achieve accuracy improvement for saving energy and carbon emissions, and support carbon neutrality and sustainable operation.

AUTODESK