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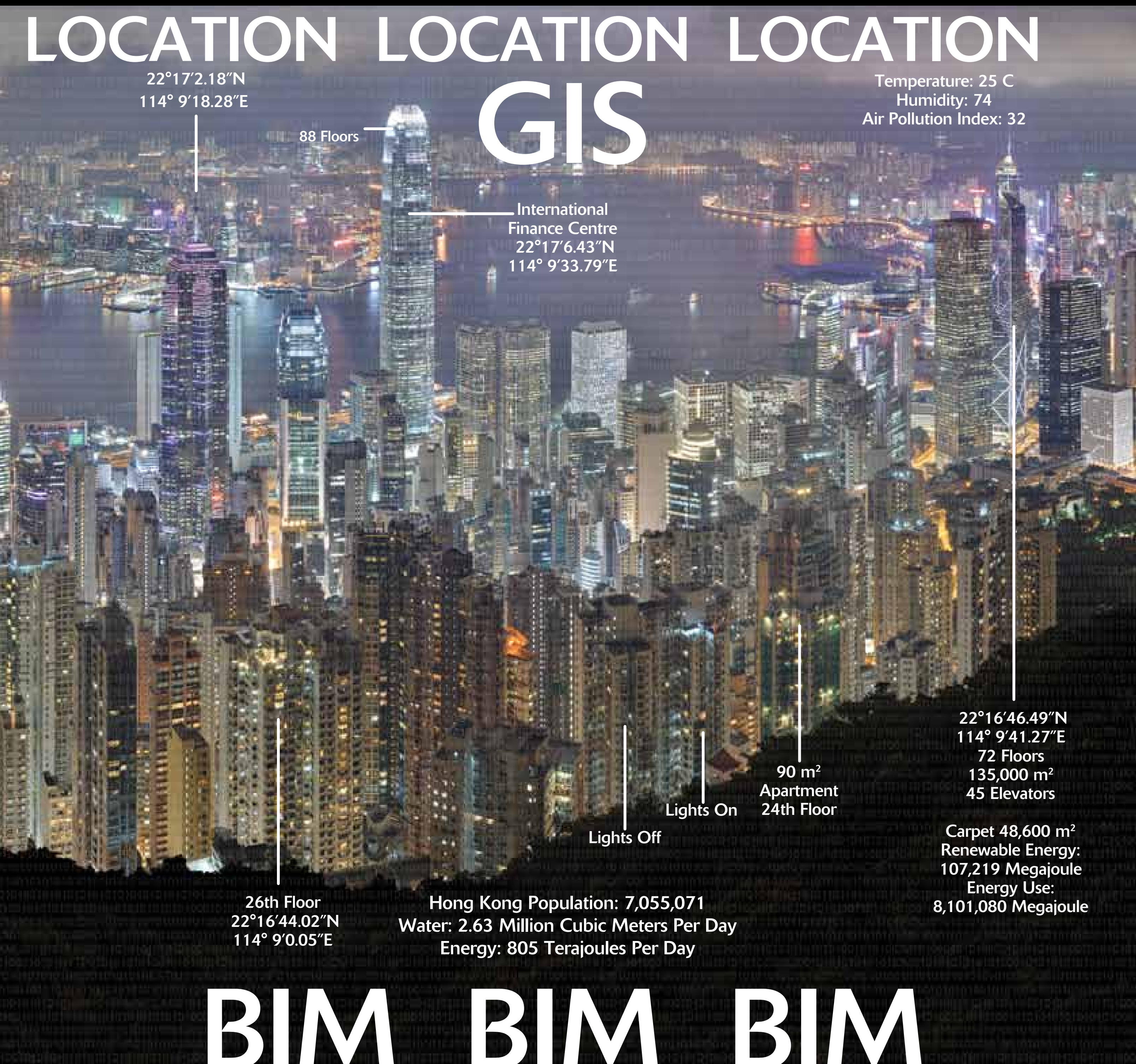

Photo of Hong Kong from Victoria Peak: Samuel C. Louie | 392M | 22°16′42.08″N | 114° 8′47.86″E

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Convergence Yields Smarter Facilities: *Practical Applications for Building Planners and Operators*

By John Young

THE SPRING 2010 ISSUE OF *JBIM* PROVIDED A NUMBER OF interesting articles focused on building information modeling (BIM) and facility management (FM) applications. One of these articles, written by Kurt Maldovan and Tammy McCuen, LEED AP, discussed the increasing request for better support of the planning and operations portion of the facility lifecycle. This is a trend that people in the geographic information system (GIS) industry believe is quickly driving an anticipated and necessary nexus between BIM data and GIS technologies.

The BIM Use Categories and Frequency Used Table 1 in the BIM Best Practices article from that issue (available for download at www.buildingsmartalliance.org) actually demonstrates why BIM-GIS interoperability is increasingly desired by facility owners and operators. Most categories listed in the table with a Frequency of Category Use value of 5 or smaller describe analyses that are native to GIS. The contents of this table are derived from a set of presentations delivered at the buildingSMARTalliance (bSa) International Conference in December 2009.

Why do facilities owners and operators wish to incorporate GIS? Arguably, it is because they face increasing pressures to make their buildings "smarter." Operating and maintaining buildings for longer periods of time requires retrofitting existing buildings or designing and constructing new buildings to be sustainable for optimal occupancy and use. Owners and operators also find they must comply with a host of compliancy issues such as those represented in Federal Executive Orders 13327, 13423 and 13514. Regardless of the driver, facility operators are increasingly using GIS to achieve their smart building goals.

What is a smart building? It's a building that is managed with data and information systems capable of supporting building planners and operators with faster, more accurate decision-making applications—applications that deliver authoritative analysis, visualization and reporting. The National Institute of Building Sciences and bSa recognize the trend toward smarter buildings and have proactively supported a BIM-GIS interoperability best practices study, for which the results are presented in this edition of *JBIM*.

GIS EXTENDS BIM AND FM

Smarter buildings and facilities—those that are safe, secure, energy-efficient and optimally operated and utilized—will result from the convergence and interoperability of GIS, BIM models and specific FM technologies like enterprise asset management (EAM), building automation systems (BAS), computerized maintenance management systems (CMMS), computer-aided facility management (CAFM) and integrated workspace management systems (IWMS).

The implicit structure and organization of BIM objects and their attributions, coupled with the ability to store BIM object attributes in a relational database, provide helpful technical integration points with GIS. GIS natively stores data in a geospatial or location-based relational database management system. When BIM models and GIS are integrated, this opens up a suite of new analysis options for facility owners and operators. It also allows the results of these analyses to be reported and visualized at all geographic scales or levels of detail.

At the National Aeronautics and Space Administration's (NASA) Langley Research Center's New Town project in Hampton, Virginia, building designers are working with GIS and facility managers to develop an interoperable system of BIM, GIS and EAM technologies to benefit the facility owner/operator. System interoperability alone will save substantial time and lower the cost typically required to locate, convert and/or translate data into one authoritative information source. Once interoperable, NASA facility managers will recognize improved space and asset management analysis, visualization and reporting capabilities at all levels of geography.

Another sustainable, green project is being developed from the ground up in Abu Dhabi, UAE. Masdar City uses a combination of BIM and GIS technologies to plan and design buildings and supporting infrastructure. After construction, GIS will continue to be used by integrating it with CMMS. This integration will make facilities maintenance easier, as well as enable the tracking of resource use and reuse and the overall carbon balance of the operational city.

IMPROVED BUILDING AND ASSET ANALYSIS

ESRI's ArcGIS system includes out-of-the-box proximity analysis tools such as a 2D or 3D buffer or the Find Nearest tool, which can quickly aid a planner or building operator. The tools

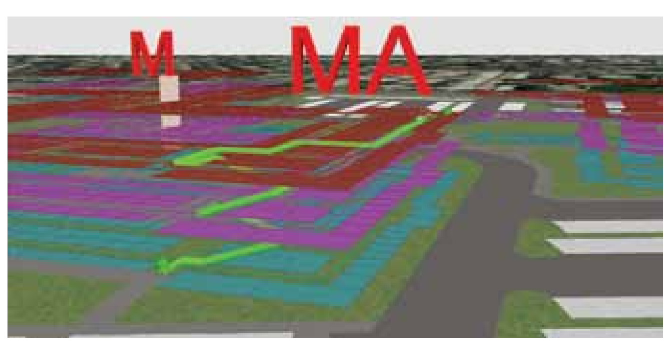

Figure 1. Building interior transportation network analyses results depicted for "Best Route" tools. The M and MA are names of different wings of the building.

can assist in determining where best to locate, or not locate, a particular exhibit or store materials. For example, if a museum or historical building has rooms, spaces or antiquities that are sensitive to vibration, the proximity of a nearby subway system could have an impact on specific sections of the building. The same type of scenario can be assumed for proximity to above-ground sounds and vibrations, such as street noise.

Proximity analysis is standard practice for emergency managers and those performing continuity of operations analyses for building and infrastructure assets. The U.S. State Department's Office of Emergency Management is one example of where there are plans to integrate building and facility data into emergency management situational awareness map viewers. This integration will provide timely, accurate, map-based emergency assessment and response decision support.

Practitioners can also model building interior networks. Network analysis tools can be used to determine the best route from one location to another either inside or outside the building and all points between **(FIGURE 1)**.

Network obstacles or time-of-travel constraints can also be modeled and used in best-path analyses. This is particularly helpful for safety and security planning and compliance. City College of San Francisco (CCSF) is taking advantage of similar capabilities for both Americans with Disabilities Act (ADA) compliance and crime mapping. The CCSF project shows collaboration between the Facilities Management and Buildings and Grounds departments to create a mutually beneficial GIS data repository and decision support application interface. Networks and supporting analyses can also easily be set up and established for building interior systems like HVAC water, telecom and electric systems.

Other proximity and topologic analyses useful to planners include determining the impact of building shadows or window glare on adjacent buildings and city streets **(FIGURE 2)**. GIS analyses can also be used inside buildings to calculate visibility and sunlight volume for use in threat/vulnerability and energy analyses **(FIGURE 3, FIGURE 4)**.

Energy or "green" building analyses are increasingly being performed using GIS by organizations such as National Institutes of Health in Bethesda, Maryland, and the New York City Department of Health and Mental Hygiene, to quantify indoor environmental quality and energy metrics. These attributes are analyzed and mapped in two, three and four dimensions, room by room, floor by floor and building by building, to help quantify the impact of implementing ENERGY STAR products and/or following sustainable LEED practices. The U.S. Green Building Council recognizes the value of GIS technology to capture and analyze proposed building locations and building sustainability

Figure 2. Shadow and glare analysis showing impact of proposed building on adjacent buildings. Yellow dots = windows receive sunlight; blue dots = windows in shade; red dots = windows receive sun light as well as glare.

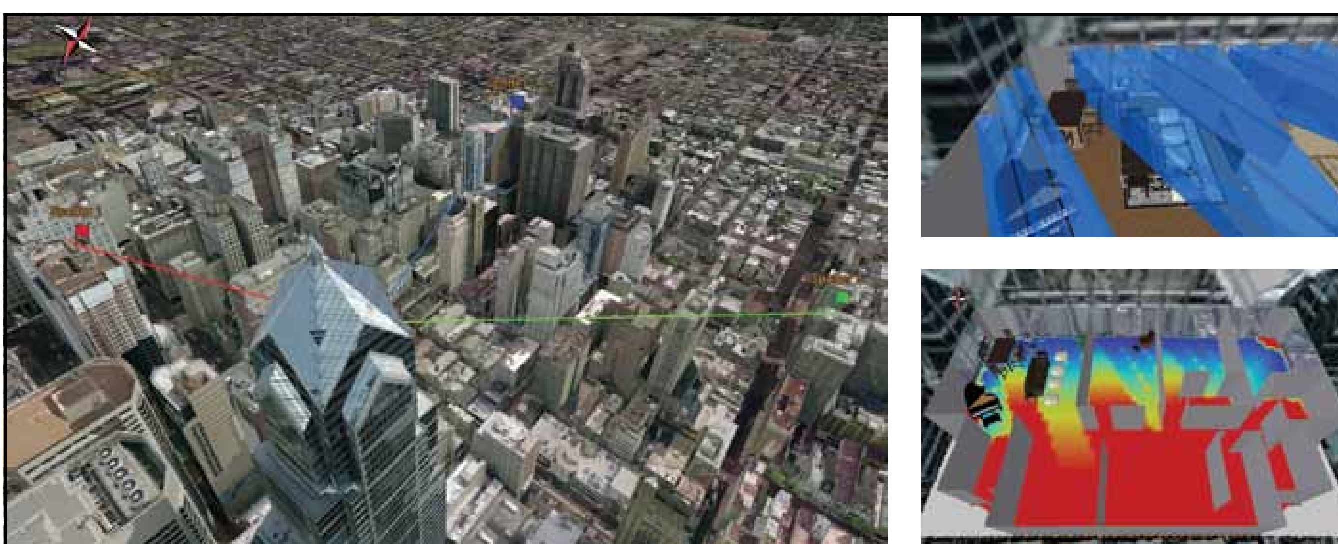

Figure 3. Building interior visibility volumes and heat maps calculated for three spotter positions.

performance and is working to geospatially enable a variety of LEED rating system analytic tools and reporting capabilities.

OUT-OF-THE-BOX TECHNOLOGY FOR BUILDING OPERATORS AND MANAGERS

There are many GIS analysis capabilities that FM operators can use right out of the box, without customization. The ability to store and read BIM data natively is one. The ArcGIS 3D viewing applications ArcGlobe and ArcScene can directly read and view BIM Industry Foundation Class (IFC) objects **(FIGURE 5)**. Using the ArcGIS Data Interoperability extension, users can perform extract, translate and load (ETL) routines that provide direct mapping of BIM objects to GIS database objects, which provides direct import and export of BIMs into and back out of GIS databases.

Building interior space data models (BISDM) developed for GIS databases and true 3D object support in GIS, like ESRI's ArcGIS with the 3D Analyst extension, coupled with the ability to publish and serve GIS data, maps and analytic services via a services-oriented architecture (SOA), make using GIS capabilities a reality for BIM practitioners. To take advantage of GIS web services, users can adopt BIM software applications and data products that support SOA-based web services and commonly used SOA protocols and application programming interfaces (APIs) such as Simple Object Access Protocol (SOAP) and Representational State Transfer (REST). Further extending options for interoperability and ease of deployment, ESRI's ArcGIS platform can also reside in a public or private cloud environment like Amazon's Elastic Compute Cloud. ESRI's geodatabases and BISDM's support building design and classification specifications, organizations and standards like the Building Owners and Managers Association (BOMA), the Facilities Inventory and Classification Manual (FICM), Open Standards Consortium for Real Estate (OSCRE), the OmniClass Construction Classification System (OmniClass) and the Construction Operations Building information exchange (COBie).

VALUE AND RETURN ON INVESTMENT

Smarter facilities will result from the convergence of BIM, GIS and additional FM system technologies mentioned above. These tools and technologies will help primary facility stakeholders and users improve decision-making capabilities, the time it takes to make these decisions and the reliability of the results. These benefits will translate into recognizable and, in many cases, dramatic increases in cost efficiencies, reduction of risk and increased facility sustainability and longevity. For more information and to read about the user example, visit www.esri.com/fm. ■

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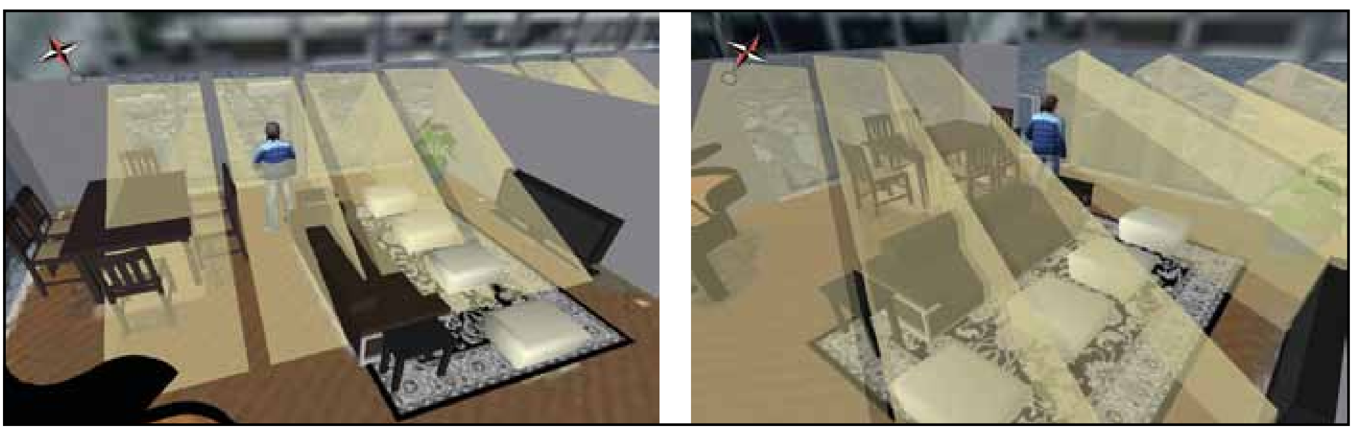

Figure 4. Building interior sun volumes calculated at different times of day.

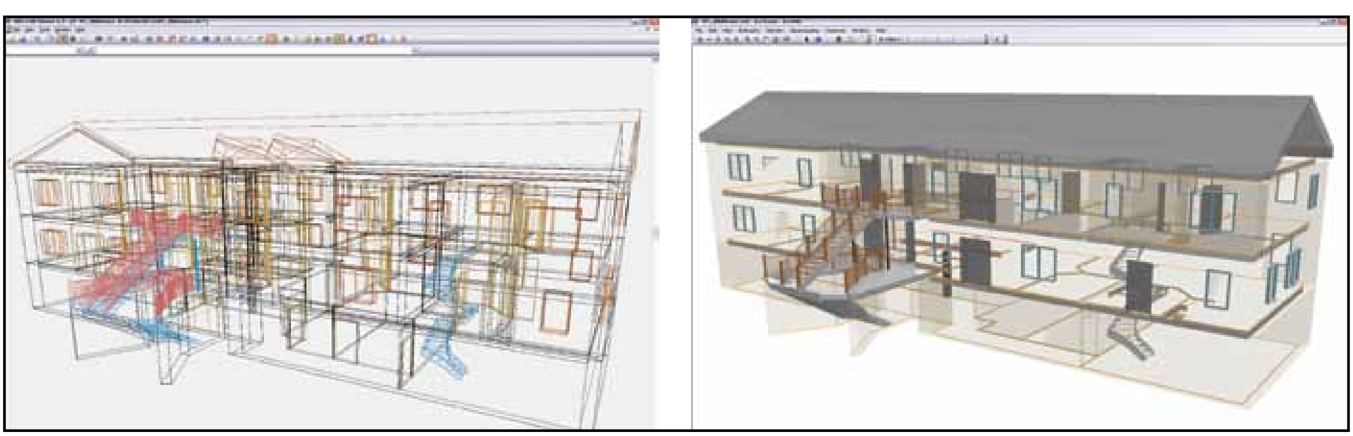

Figure 5. BIM IFC file shown as wireframe in IFC viewer and in ESRI's ArcScene application.