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>
> —Raymond Kahl
>   Managing Principal
>   Urban Design Group

Better designs. Smarter operations.

BIM improves the design, construction, and operation of a new cinematic arts educational complex.

Project under construction. Photography courtesy of the University of Southern California.

The Project
In 2009, the School of Cinematic Arts at the University of Southern California (USC) marked its 80th anniversary with the dedication of a new multibuilding complex. The $165 million facility is adjacent to the school's current location on the USC University Park Campus in Los Angeles.

The main building is a four-story, 137,000-square-foot facility housing classrooms, production labs, and administrative offices, as well as a 200-seat theater, an exhibition hall, and a café situated off a central courtyard. Completed in 2010, the second phase of the project provides another 63,000 square feet of educational and production space in four buildings.

The USC School of Cinematic Arts was the first university in the United States to offer a Bachelor of Arts degree in film and is now the top-ranked film, television, and interactive media school in the country.

The new complex underscores the school's continued pursuit of innovation and growth. While providing much needed space for expansion, the project itself is groundbreaking. The primary donor of the facility—Lucasfilm Foundation—specified the use of a building information modeling (BIM) process for design, construction, and lifecycle management of the buildings. In addition, the school stipulated that the buildings be designed and constructed to maximize longevity and performance.

The Team
The university's project architect was Urban Design Group (UDG), a full-service design firm specializing in commercial and institutional buildings. The project architect coordinated the programming, design, and construction through the university's Capital Construction and Development, and Facilities Management Services departments. The contractor was Hathaway Dinwiddie, a prominent builder in California. The team also included construction management and cost estimating company TBD Consultants; mechanical, electrical, and plumbing (MEP) engineering firm IBE Consulting Engineers; structural engineering firm Gregory P. Luth and Associates (GPLA); KPFF Consulting Engineers, who provided civil engineering services; and BIM facilitator View By View.

The project team relied on core Autodesk BIM solutions, including Autodesk® Revit® Architecture software, Autodesk® Revit® MEP software, Autodesk® Revit® Structure software, and AutoCAD® Civil 3D® software, along with Autodesk® Navisworks® Manage software, and Autodesk® 3ds Max® Design software, to help deliver the project under budget and ahead of schedule.

Autodesk®

Decisions were made in hours instead of days, helping minimize disruptions to the construction schedule.

Project Challenge

With its existing instructional complex at 120 percent capacity and some buildings in urgent need of renovation, USC School of Cinematic Arts launched its building campaign in 2005. After much investigation, the school had already concluded that major renovations were too costly due to the age and code compliance of some of its buildings. In addition, new construction would enable the school to set new standards for its facilities. The school directed the project team to deliver a high-performance complex that reflects the school's legacy and has a 100-year lifespan.

"We were tasked with designing buildings that were energy efficient, earthquake resilient, and with highly flexible interiors that could accommodate the school's needs for a century to come," explains Raymond Kahl, managing principal at UDG. "In addition, the project donor—perceiving the advantages of BIM for lifecycle management—specifically requested that the designers, engineers, construction contractors, and facility managers all use BIM."

The Solution

Driven by the owner's commitment to BIM, the design teams, the fabricators, the BIM facilitator, and the contractor used BIM processes and software solutions for the design and construction of the complex. Throughout the project, View By View used Navisworks Manage to help aggregate disparate design and fabrication models into a single master model for cross-disciplinary collaboration, coordination, and clash detection.

The team repurposed its BIM-based design models for energy and structural analysis, design and construction visualization, specification, material and cost estimating, fabrication, and ultimately as a platform for ongoing facility operation and maintenance. "The collaboration on this project extended beyond building delivery into lifecycle management," says Kahl. "USC proactively worked with the design team to make sure that the information needed for operations and maintenance was embedded in our models."

Create Virtual Designs

Although this complex is new, its location is next door to the school's existing facilities. "Given this urban campus setting, we had to make sure the buildings were scaled to fit comfortably in the confined footprint and complemented the other university buildings," says Cliff Bourland, UDG project manager.

To honor the school's legacy, UDG used Autodesk BIM solutions to help design buildings that played well with the architectural vernacular that was popular at the school's founding in 1929. "To help visualize how our emerging designs fit on the site and meshed with the neighboring buildings—and to better communicate those designs to USC—the team used Revit Architecture and 3ds Max Design to assist in the creation of model-based visualizations and animations," says Bourland.

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>
> —France Israel
>   President
>   View By View

BIM for Infrastructure

The site's existing infrastructure and utilities also posed a challenge. To coordinate the connections to the new building, KPFF used AutoCAD Civil 3D, Autodesk's BIM solution for civil engineering, to help create an as-built infrastructure model of the existing site, which also included a vulnerable 75-year-old stormwater canal.

The project team then used Navisworks Manage to better coordinate their architectural, structural, and MEP designs with the existing and emerging infrastructure models, helping to maintain continued utility service to the rest of the campus and minimize construction delays.

Maximize Longevity

The facility's structural engineering design reflects the school's goal of a 100-year life span. The design features replaceable connectors that isolate and redirect the damaging effects of an earthquake, protecting the building's inhabitants and structure. The design results in a minimal number of interior structural columns, which helped UDG build flexibility into the buildings' interiors.

"During preliminary design, we relied on Revit Architecture to more quickly lay out, visualize, and study various interior options based on spatial 'building blocks' that could be more easily reconfigured to better meet the unforeseen needs of the school in the future," says Kahl. "Once the space planning was complete, the design team transitioned its conceptual models to detailed design and documentation."
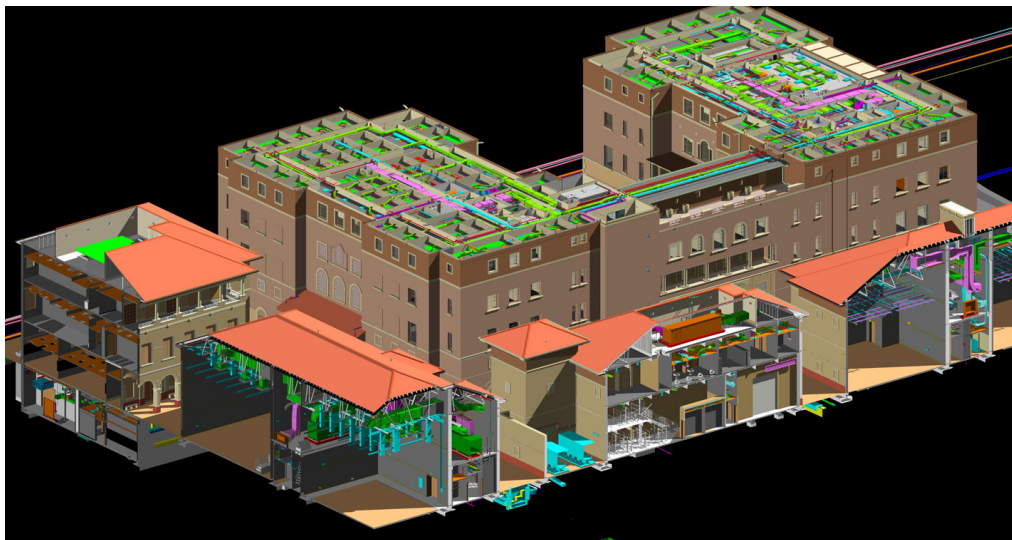
Building cutaway, including all MEP systems. Image courtesy of View By View.

Coordinate Designs

"Throughout the design and construction process, Autodesk BIM solutions were absolutely essential for collaboration and coordination," says France Israel, president of View By View. GPLA imported its design to Revit Structure for tighter design coordination with UDG's Revit Architecture and IBE's Revit MEP models. "Then during our weekly design reviews, the project team used Navisworks to merge and visualize cross-discipline design and fabrication models, helping to guide design decisions and quickly resolve design conflicts that might have become costly field changes," adds Israel.

Optimize Performance

To meet the school's requirements for high-performance, the project team designed the new complex to LEED Silver™ standards. Early in the design process UDG and IBE collaborated on materials, systems, and strategies to maximize building performance. "Instead of spending time re-creating models for analyses, we used the intelligent information in our Revit-based design models to conduct daylighting and whole-building energy analyses," explains Kahl. "As a result, we developed building designs that took better advantage of sunlight, wind direction, and temperatures, as well as building systems that delivered optimal energy performance."

Streamline Construction

During construction, the team continued to rely on Autodesk BIM solutions for visualization, coordination, and planning. "The Revit family of products and Navisworks software products enabled a digital RFI
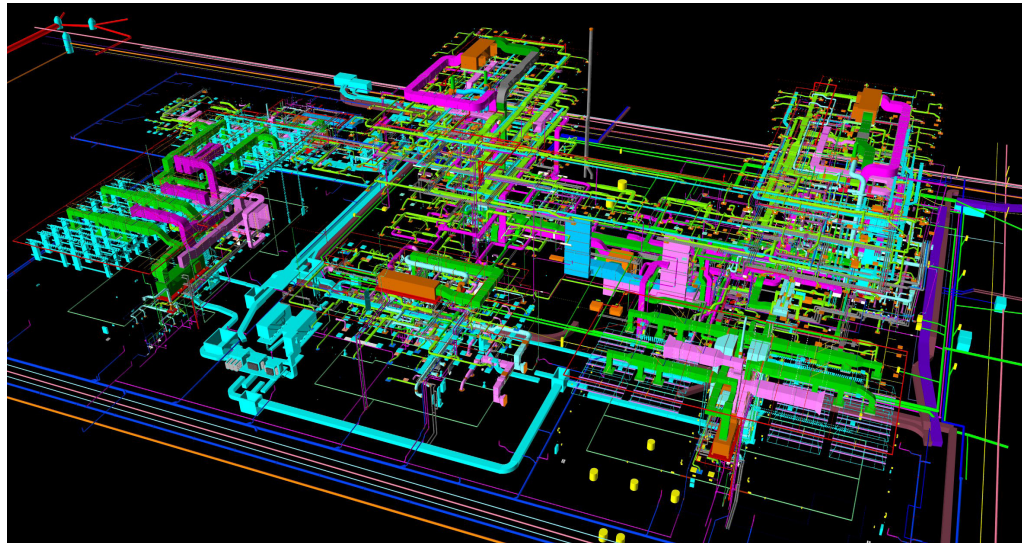
MEP design model preloaded with maintenance data. Image courtesy of View By View.

process," says Israel. "Decisions were made in hours instead of days, helping to minimize disruptions to the construction schedule, minimize the number of RFIs, and expedite the RFI response time."

The construction trades also used BIM, referencing Revit and Navisworks models from computers in construction trailers. In the later stages of construction, workers even accessed the Navisworks models on-site from handheld tablet PCs.

Extend BIM to Lifecycle Management

With design and construction complete, USC is now extending BIM to lifecycle management by linking the data-rich design models of the new buildings to its existing operations and maintenance (O&M) software platform. The new School of Cinematic Arts complex is the first time the building systems in any of USC's buildings were designed using Revit MEP, so this is the university's first opportunity to finally use BIM for "smart" building operations and live maintenance monitoring.

"The 3D models of the complex's main buildings—the first phase of the project—were great for design, construction, and coordination, but unfortunately they did not contain the data that USC needed for facility management," says Israel. During the second phase, USC worked with the project team, the installation contractors, and the commissioning agent to incorporate as-built facility data into the Revit models. Data included equipment numbers,

electrical capacities, fan speeds, and hyperlinks to warranties and operation manuals. "A lot of the added data had been locked away in hardcopy documentation and drawings," says Bourland. "By digitizing this data and making it more readily available to facility managers, USC can leverage the information inherent in BIM to help make dramatic improvements to its overall response and repair time."

The next step was to create a custom software solution and user interface that links the Revit models and data to USC's O&M platform, giving it a more accurate and interactive visual capability. The custom solution, which uses software from EcoDomus, Inc., enables USC to compare "as operated" data received from building sensors and meters to BIM-based "as built" data and improve performance using "as maintained" data from USC's maintenance management software. The implementation also features role-based access to the O&M platform, using four USC facility "personas" to deliver functions, data, and hyperlinks pertinent to that role. "Now USC can access a single solution to find data and documents, get live performance information, and also see 3D graphics of system components, presented in the context of the building as a whole," says Mitch Boryslawski, co-founder EcoDomus, Inc.
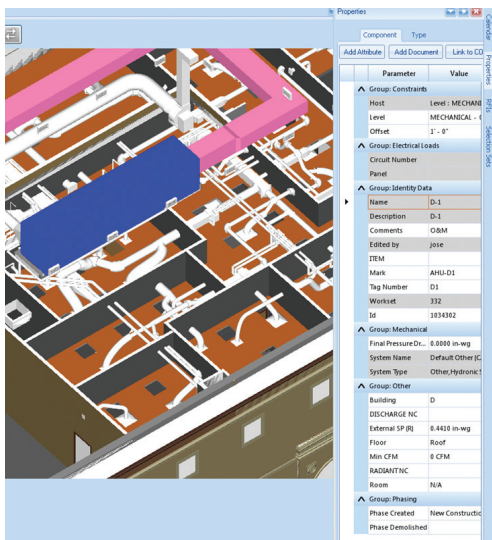
USC uses BIM for "smart" building operations. Image courtesy of EcoDomus.

BIM provides a strategic opportunity for improved facility management.

BIM-Enable Operations

USC's efforts represent a proof of concept for extending BIM to operations. The first stage is complete, with several staff using the integrated solution for their day-to-day work. In the coming months and years, USC has aggressive plans for BIM-enabled operations. USC's current implementation has proven that it can successfully transition data and models from design and construction to operations. Now it's time to measure the ROI, and put plans in place to make the process repeatable and affordable.

Expedite Close-Out

"During design, construction, and commissioning, most of the information USC ultimately needs for its operations has been already captured, usually in a digital format," says Bourland. "BIM processes keep that information digital so it can be harvested for ongoing facilities management. But this means USC has to require a standard data format such as COBie for as-built deliverables; a format it can use to streamline data integration with its O&M platform and start reaping the benefits of BIM at occupancy." In anticipation, USC is now leveraging their experiences on this project to establish BIM standards for operations and to expedite the close-out process.

The Results

USC wanted a facility that reflected the school's history, reputation, and vision. The project team delivered on that—and a lot more. The architectural theme of the new School of Cinematic Arts complex is a scaled-down motion picture studio, reminiscent of the early days of filmmaking. But the complex is actually bursting with state-of-the-art technology, innovative design features, advanced building systems, and operational strategies that will serve it well for 100 years.

"The use of BIM processes and solutions on this project has led to integrated planning and delivery, cohesive teamwork, expedited project schedules, and fiscal control," says Kahl. The first phase of the project was two months ahead of construction schedule and 2 percent under budget. The second phase of the project came in three months ahead of schedule and 10 percent under budget.

The complex features eco-friendly materials and building systems. The buildings' radiant heating and cooling systems are the largest of its type in Los Angeles, and USC expects the complex to achieve a 30-percent greater reduction in energy use than required by California's strict energy codes.

And perhaps the most lasting benefit is the prospect of using BIM for building lifecycle management. "The use of BIM resulted in data-rich as-built models that contain a wealth of information for smarter building operations," says Boryslawski. "BIM has given USC a strategic opportunity to help improve facility management."

For more information about Autodesk BIM solutions, visit **www.autodesk.com/bim**.

Street view of building complex. Photography courtesy of the University of Southern California.

School of Cinematic Art classroom. Photography courtesy of the University of Southern California.

The use of BIM resulted in data-rich, as-built models that contain a wealth of information for smarter building operations. BIM has given USC a strategic opportunity to help improve facility management.

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