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Sustaining Infrastructure

Henning Larsen Architects Design 'Green' Skyscrapers for Riyadh Financial District

BIM-Enabled Design Achieved Goals of LEED-Certified Master Plan for Sustainable City Center

Project Summary

Organization
Henning Larsen Architects

Solution
Buildings

Location
Riyadh, Saudi Arabia

Project Objectives

- Provide sustainable city center for growing workforce in financial sector
- Create LEED-certified master plan for King Abdullah Financial District
- Design three signature, mixed-use buildings under design-build contract

Products Used
Bentley Architecture, Bentley Navigator, MicroStation, GenerativeComponents

Fast Facts

- Designing Crystal Towers involved more than 200 professionals from multiple disciplines in five countries.
- BIM-enabled design allowed for optimized objects and easy checking of building quality, cost, and materials.
- Software interoperability allowed team to share files among multiple firms.
- Bentley software for 3D design aided communication, collaboration and on-time delivery.

ROI

- Time savings were achieved by using 3D BIM models to aid in decision-making processes.
- Integrated 3D design enabled the team to quickly and effectively achieve sustainability goals.
- Optimal green design concepts yielded "Class A" architecture.

Architects Adhere to Aggressive Timeline

On a teardrop-shaped plot just north of Riyadh, Saudi Arabia, the King Abdullah Financial District is developing into a world-class business center for banks, financial institutions, and professional services. Denmark's Henning Larsen Architects finalized a LEED-certified master plan for the 1.6 million-square-meter plot, and then came on board as project architect for three of the signature buildings. From creating preliminary sketches through detailed design, the project team used MicroStation, GenerativeComponents, and Bentley Architecture to quickly and effectively achieve its goals for a sustainable city center.

The massive project, which broke ground in 2008, will provide more than 3 million square meters of floor space in 40 green buildings, as well as entertainment, recreational, and cultural attractions. This $10 billion development was inspired by King Abdullah bin Abdulaziz al-Saud's vision for the Middle East's first global financial center. That vision is expected to be realized by 2012.

Henning Larsen won the international design competition for the project in 2006. "When we designed the master plan for King Abdullah Financial District, the vision was not to break any records in terms of height, size, and so on," said Birte Baek, CAD manager and 3D specialist for Henning Larsen Middle East. "Apart from creating state-of-the-art financial facilities, the vision was to create a public realm for people with a focus on the human scale and diversity, and on improving the environment from macro to micro level, both from a master plan point of view as well as for each individual building."

The three buildings designed by Henning Larsen—Crystal Towers, Villas in the Sky, and The Gem—are part of the four mixed-use parcels awarded to design-build contractor Saudi Binladin Group. Three other contractors are developing seven parcels in stage-one construction expected to be completed in 2011. Stage-two construction will see another 30 parcels under development with a 2012 deadline. This aggressive timeline will build out 70 percent of the district, according to Construction-WeekOnline.com.

If building a new business district in less than four years were not challenging enough, then adding a mandate for every building to be LEED-silver or LEED-gold certifiable would make this project noteworthy on a global scale. Indeed, the LEED-certified master plan will produce the first LEED-certified buildings in Riyadh.

As a result, sustainability has been part of the mindset from the earliest sketches. The design approach had to take into account the site constraints and possibilities, from the local environment and population density to building geometry and orientation.

To meet the fast-track schedule dictated by the completion deadlines, Henning Larsen used 3D design tools to communicate and collaborate with more than 200 professionals from multiple disciplines in the United Kingdom, United Arab Emirates, Saudi Arabia, Austria, and Denmark—just for the Crystal Towers project. Baek noted, "When we work on so tight a schedule as on these projects, in which the construction team builds on site in parallel with the design team, it's very important that we provide the right deliverable on time, and in the right quality, so that the build contractor gets the right information."

Green Requirements Attributed to Design Objects

Using Bentley Architecture, the project team had the opportunity to attribute sustainable requirements to building objects while maintaining high quality and consistency. For example, the Crystal Towers feature recessed, scaled, crystalline apertures that optimize views of the plaza and landscaping while shielding the interior from the intense sunlight. The building facades made of light stone cladding, in combination with lush vegetation and water features in the surrounding landscapes, lower ambient air temperature around the towers by six to eight degrees Celsius.

King Abdullah Financial District at Night

The 3D models and construction simulation help in working with contractors on site to evaluate the consequences of any changes.

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"What we really find unique in Bentley software is that, at any time, any design idea can find a tool that gives us a drawing and design opportunity," Baek said. "When using GenerativeComponents, we also have all parametric solutions optimized in our concept."

Working in the same model within Bentley software from concept to detail design, team members never had to model the same thing twice. They also had links forward and backward to other drawings and elements, as well as the ability to import and export data to share with firms working on other software systems. Throughout the whole process, building information modeling (BIM) allowed the project team to follow and check building quality, cost, and materials, in addition to optimizing the building objects.

Coordinating models using Bentley Navigator enabled cross-discipline checks and improved working relationships among disciplines. The ability to share both 3D models and 2D drawings with the owner and building contractor afforded the project team the opportunity to illustrate their designs and "tell the right story." This helped all parties to gain a better understanding of the buildings.

In the early stages, 3D models, renderings, and visualizations were key to communicating the master plan vision to all stakeholders. A presentation video with vivid interior close-ups and exterior flyovers was particularly effectively at displaying the richly detailed design concepts. "Flythroughs are a very good way to explore and communicate designs, especially in master planning, as it then takes you through the public realm at eye level," Baek said. "The detailed flythrough presents early design ideas that provide a better understanding of our vision and a clear understanding of the master plan's complexity."

Bentley software also assisted the project team in following the sustainability guidelines that Henning Larsen devised for the district as a whole. The architects are serving as consultants during construction to ensure the design schemes submitted by other builders conform with the world-class standards King Abdullah expects. The 3D models and construction simulation help in working with contractors on site to evaluate the consequences of any changes.

"MicroStation has been an invaluable tool and instrument for Henning Larsen Architects to manage and deliver the project on time," Baek said. "Across disciplines, different companies were working with different software. Bentley software gave us a high degree of certainty that we were delivering high-quality, coordinated project material. The combination of our considerable experience in the use of Bentley software and our knowledge of design checking assured precise delivery."

3D BIM Produces Time and Cost Savings

Using Bentley software for 3D modeling and analysis gave Henning Larsen the confidence that the team was "on the right track," according to Baek. "For our client, it's important to get a distinct and sustainable Class A architecture, which means a design that is not only thought of as a 'fantastic and amazing building,' but a concept that can communicate on all levels yet is durable and flexible for the future," she said.

Crystal Towers Interior

The $151 million Crystal Towers embody the architects' vision. The towers are centrally located between the Financial Plaza and a verdant pedestrian thoroughfare called the Wadi. Housing 93,000 square meters of prime office and retail space, the 18- and 25-story buildings are connected by a dramatic skywalk that not only welcomes through-traffic from the adjacent green spaces, but also provides shade for an outdoor meeting area. The towers themselves will shade much of the Wadi, where people may gather to socialize.

A large portion of the district features communal outdoor spaces, as well as a network of skywalks between buildings, allowing pedestrians to stroll from one end of the city to another without leaving the comfort of air-conditioning. Indoor spaces minimize solar heat gain in the desert climate. "Our projects are characterized by a high degree of social responsibility, not only in relation to materials and production, but also as regards good, social spaces encouraging intimacy and community," Baek said.

Design options for the sustainable buildings and spaces were complex and varied. Time savings were achieved whenever the 3D BIM models aided in the decision-making process. For example, choosing an energy-efficient façade system took less time with 3D BIM to illustrate the choices. The challenge was to limit the iterative process and retain the time-cost benefits of design optimization.

When the project is fully realized, the King Abdullah Financial District will set a new standard for sustainable urban development in cities around the world. As a vibrant city center with green buildings shading green spaces, the district will become an active hub of urban activity. It will not only be a place of commerce but also an entertainment destination and a desirable residential neighborhood. Apartments, shops, restaurants, sports facilities, hotels, and conference venues are expected to draw an international clientele. The district will employ a projected 50,000 people and house approximately 8,000 residents. A monorail connecting various areas of the district will provide public transportation throughout.

The financial district's predominantly green features will contribute to achieving the kingdom's overriding objective: To provide an attractive working environment for the growing workforce in the financial sector—which is the largest in the region, with the 11th largest stock exchange in the world and the largest banking sector in the Middle East. This ambitious undertaking may indeed fulfill King Abdullah's vision of transforming Saudi Arabia, already the world's oil capital, into the Middle East's financial capital.

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