COMPANY

Kitasato University Hospital

LOCATION

Sagamihara, Japan

SOFTWARE

Autodesk® Revit®
Autodesk® Navisworks® Manage
AutoCAD®
Autodesk® 3ds Max®

Reaching consensus with BIM

Integrated project team collaborates on a complex Japanese hospital using Autodesk BIM solutions

BIM gave us an intuitive understanding of the design. By virtually navigating through these models, we could 'see' how our staff and patients will move around the hospital, enabling a close collaboration with the design team to develop a facility that will meet our needs for decades to come.

—**Akitaka Shibuya**
Vice Director
Kitasato University Hospital

Exterior panoramic perspective drawing of Kitasato University Hospital New Hospital Project. Image courtesy of Kitasato University Hospital.

The project

Kitasato University is one of Japan's top universities for life sciences and medical sciences, supported by undergraduate and graduate programs, research institutes, and affiliated hospitals. Its Sagamihara campus, (located in Japan's Kanagawa Prefecture) is already home to two of its four hospitals, including the Kitasato University Hospital. The university is currently building a new 14-story hospital on this campus, right next door to the existing Kitasato University Hospital. When completed, the new state-of-the-art hospital will replace much of the existing facility, which was built more than 40 years ago.

The 92,700 square-meter facility will have 757 new beds and will feature a seismically isolated structure of reinforced concrete and steel-reinforced concrete construction. The building's lead designer, Nikken Sekkei Ltd., was selected in July 2009. The construction companies, led by Takenaka Corporation, were selected at the end of 2010. Construction began in September 2011 and is expected to be completed by the end of December 2013.

The challenge

"To remain an advanced medical environment for decades, the facility had to be designed for long life and flexibility," explains Makoto Fujiki, assistant director of the design department at Nikken Sekkei. Therefore, the team used a core and shell design. Elevators, piping, ductwork, and other elements that link the building vertically were placed in the central core and the peripheral shell. Concentrating these elements within the core and shell results in large open areas that can be flexibly partitioned as needed, but it also increases the congestion of building systems in those core and shell areas—necessitating careful project coordination.

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Use BIM to integrate project teams and build consensus

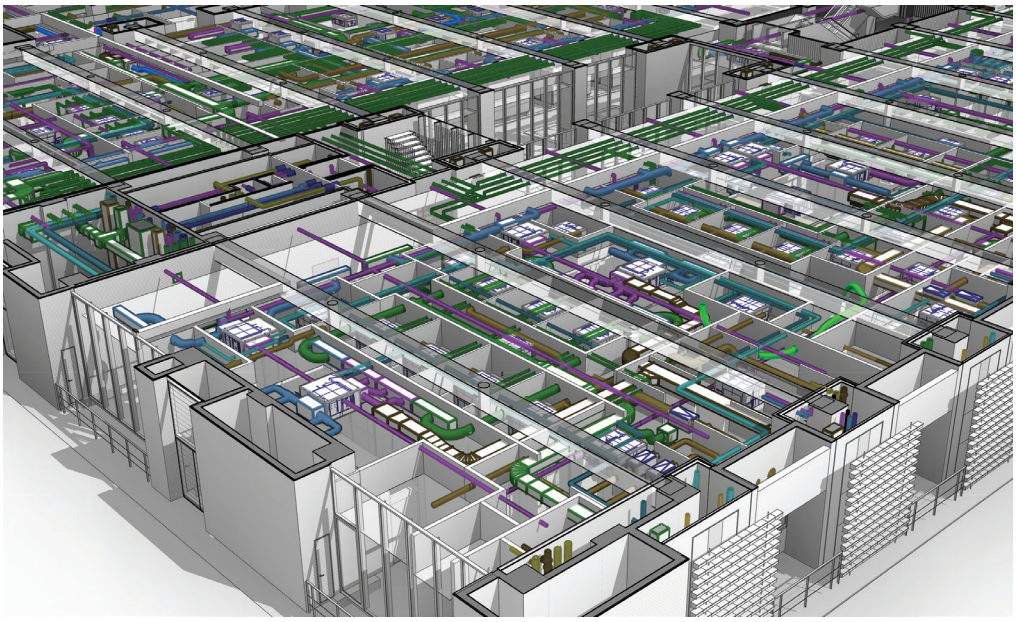

Image courtesy of Kitasato University Hospital.

More challenges

To help ensure that its needs were met, Kitasato University Hospital was closely involved in the design process. But to enable a dynamic interchange between owner and designer, the university staff would require a thorough understanding of the design. "Beyond knowing how it would look, we needed to understand how it would function," says Akitaka Shibuya, vice director of Kitasato University Hospital and assistant director of the university's new hospital project division. "We need to know whether it will perform satisfactorily as a medical facility." This level of understanding would be difficult to ascertain from traditional 2D orthogonal drawings, particularly for people without an architectural or engineering background.

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>
> **—Eiichi Hosoda**
> Work Site Manager
> Takenaka Corporation

The solution

Throughout the design and construction process, the project team used Building Information Modeling (BIM) solutions from Autodesk, including Autodesk® Revit® for 3D architectural design and project visualization, Autodesk® Navisworks® Manage for whole project visualization and coordination, AutoCAD for project documentation, and Autodesk® 3ds Max® for advanced 3D rendering and animation.

"Some people said it was foolish to use BIM for such a large-scale hospital," says Fujiki. "But I thought that—because of the large scale and complex nature of the building—accurate and efficient design would not be possible *without* the use of BIM." Intelligent 3D design models enabled the team to identify and resolve coordination issues early in the design process, helping to avoid costly rework and delays during construction.

In addition, building models played a vital role in the communication between the design team and the owner. "BIM gave us an intuitive understanding of the design," says Shibuya. "By virtually navigating through these models, we could 'see' how our staff and patients will move around the hospital, enabling a close collaboration with the design team to develop a facility that will meet our needs for decades to come."

Nikken Sekkei relied on Revit for its building design. "This was my first time using BIM software," says Fujiki. "We conducted a comparison study of multiple tools and selected Revit for its ease of use, robust functionality, tight integration with AutoCAD, and data compatibility with related building design software."

During detailed design, the team expanded to include structural and building systems engineers, as well as design consultants, construction personnel, and fabricators. Their 3D models, along with the Revit model, were combined in Navisworks Manage for coordination and review of the integrated project.

Exceed client needs

Nikken Sekkei developed its initial design using Revit software. The resulting Revit model was instrumental for communicating its design to the university and gathering feedback from hospital staff to refine the conceptual design. "Is there enough space to transfer a patient from a wheelchair to the bed?" "How much of the hospital room can a nurse see when walking down the hall?" "What's the level of natural daylight in this room?" A virtual 3D model helped that staff visually understand, and even walk through, the proposed space to answer questions like these and evaluate the performance of the design as it relates to medical care activities and suggest improvements. "Using the Revit model, each hospital department could provide important input on the design," reports Fujiki. "The end result was a better functioning hospital for our client."

The design team also used analysis features of Revit to study and optimize space utilization in the facility. "For example, within the Revit virtual environment, we examined the effect of sunlight, shadows, and artificial light," says Shibuya. " "Based on the results, we moved individual hospital rooms to locations with the most exposure to natural light, and relegated staff meeting rooms to darker areas in the building."

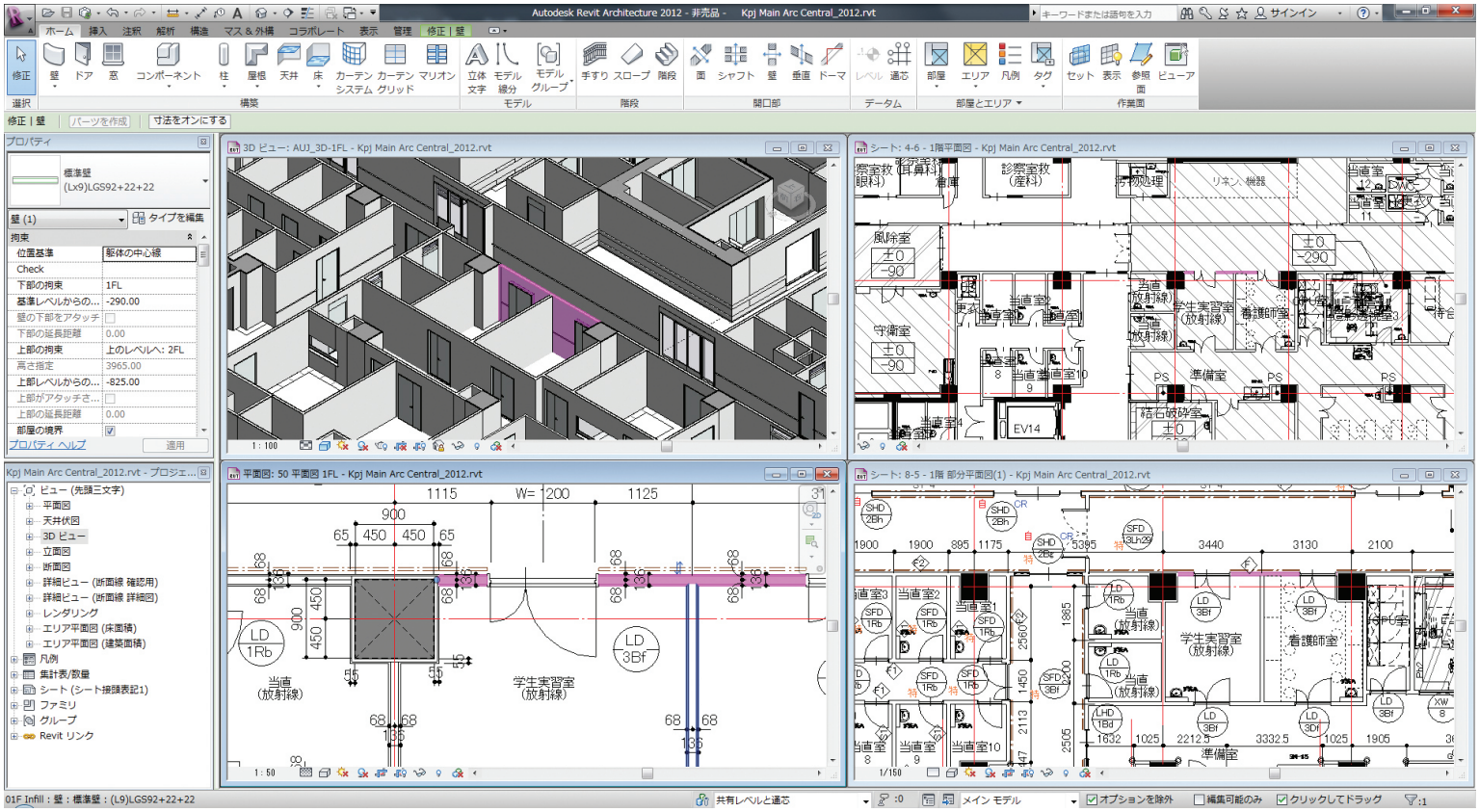

Image courtesy of Kitasato University Hospital.

Integrate the project *and* project team

During detailed design, Autodesk BIM software enabled cross-discipline design and project coordination, as well as collaboration between the design team and the construction companies. Unlike conventional building projects, the owner awarded contracts for project construction before detailed design began so that the construction companies—Takenaka Corporation, Kinden Corporation, and Toyo Netsu Kogyo Corporation (Tonets)—could work together with the designers much earlier in the design process for better decision making and improved quality. "The decision to use BIM for detailed design of this hospital was unusual for construction projects in this area and was thought to be 'adventurous' by some," recalls Genichi Mori, a design section manager in Takenaka's product division who was in charge of detailed design on this project. "But having been involved in other BIM projects, I knew BIM would provide major advantages on this project—which it did."

This extended project team used Navisworks Manage to integrate the models of the major building disciplines early in the design process to gain a clearer understanding of whole project. For example, Kinden and Tonets (who were responsible for the project's building systems) were able to use the Navisworks model to study the piping arrangements in context of architectural and structural elements for improved collaboration.

The team also used Navisworks Manage to perform formal clash detection. "For a building with such complex functions as this hospital, there is normally a great deal of rework that needs to be done during construction," says Fujiki. "But on this project, Autodesk BIM software helped us identify and solve coordination issues during the design process. This helped reduce the amount of expensive rework during construction—improving construction efficiency and quality, which ultimately benefits our client."

Increase efficiency of drawing production

"This was a large scale project and, on average, 16 to 20 A1 size drawings were needed for each floor of the 14-story building," explains Eiichi Hosoda, Takenaka's work site manager for the project. "This large quantity of drawings had to be prepared quickly to meet a demanding work schedule and keep up with progress on the site."

AutoCAD is one of the most commonly used applications in the building industry and the companies involved in this project had an abundance of AutoCAD-trained personnel. The interoperability between the Revit platform and AutoCAD enabled the organizations to take advantage of existing CAD drafting staff for efficient documentation, enabling the teams to meet their drawing production deadlines.

Extend BIM to construction

3D models were used throughout the entire construction process to communicate the design to both owner and construction staff. Most aspects of the design were completed in the detailed design stage, but some of the owner's design decisions occurred after construction had begun, such as the selection of interior color and finish materials. Although physical samples and mockups played a large part in these selections, designers also imported Revit models into Autodesk 3ds Max to produce photorealistic images that conveyed design choices for hospital interiors in an easily understandable form.

3D models were an essential tool for construction personnel as well, helping them decipher the layout or routing of complicated building elements, which can be difficult to ascertain from traditional 2D drawing views. For example, a rooftop heliport necessitated a complex series of roof elevations that required lightning rods. The complicated layout of the roofs made it difficult to understand (from the construction drawings) the routing of the ground cables for the lightning rods. Construction personnel could zoom into the pertinent areas of the 3D Navisworks model to see exactly where the ground cables were supposed to go.

The project team also used Navisworks to evaluate construction logistics. For example, models of several large construction cranes were added to the Navisworks model to study crane placement. The crane arm was rotated to check the range of the crane and identify placements that involve the least amount of rotation.

"The value of the Revit and Navisworks models increased as construction complexity increased," reflects Hosoda. "Autodesk BIM solutions provided a more thorough grasp of the whole building and had a major impact on the understanding of the workers at the site."

Future prospects for BIM

With construction of the hospital nearing completion, Kitasato Hospital personnel are already looking forward to the use of BIM for facility management, operations, and maintenance. "At the outset of this project, the use of BIM for handover and lifecycle management was an important consideration," says Shibuya. "A precise, intelligent 3D model of the as-built hospital from the rooftop to the basement will be a valuable asset for our ongoing maintenance and management."

The result

By relying on BIM processes and Autodesk BIM solutions to facilitate 3D modeling and close collaboration amongst the extended project team, the design of the hospital was completed in just six months. Construction of the new hospital is on track for completion at the end of 2013. "This project represented our first full-fledged use of BIM and Autodesk BIM solutions," says Fujiki. "The results were epoch—a resounding success."

"Even in the midst of a constantly-advancing field of medicine, BIM has given us the confidence that this project will result in a state-of-the-art medical care facility that provides us flexibility for years to come," says Shibuya. When asked whether he would recommend the use of BIM to those who are planning hospital construction of their own, Shibuya's immediate response was, "Without a doubt, yes. It has completely exceeded my expectations."

For more information, visit
www.autodesk.com/BIM

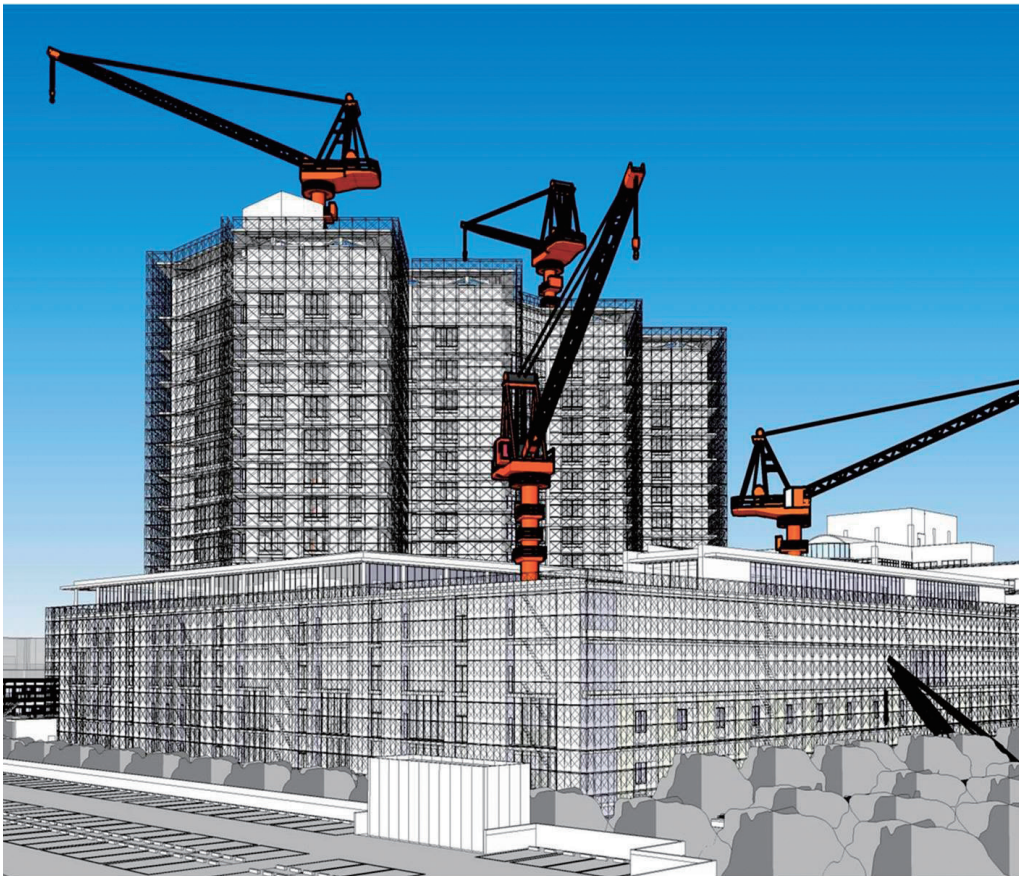

Image courtesy of Kitasato University Hospital.

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> — **Makoto Fujik**
> Assistant Director, Design Department
> Nikken Sekkei Ltd.

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