

Utilizing a BIM model from design to quantity survey for construction projects

TODA CORPORATION

“TODA BUILDING Aoyama” completed in Aoyama, Tokyo in March, 2011, received an ‘S rank’, the highest rank possible in “CASBEE” (Comprehensive Assessment System for Built Environment Efficiency). Toda Corporation has been utilizing GRAPHISOFT’s ArchiCAD BIM software for design and construction of building projects according to the given circumstances, applying BIM models throughout the workflow of the design stage to production design and also in the construction phase. We interviewed the designers of the Architectural Design Division at the Toda Corporation.



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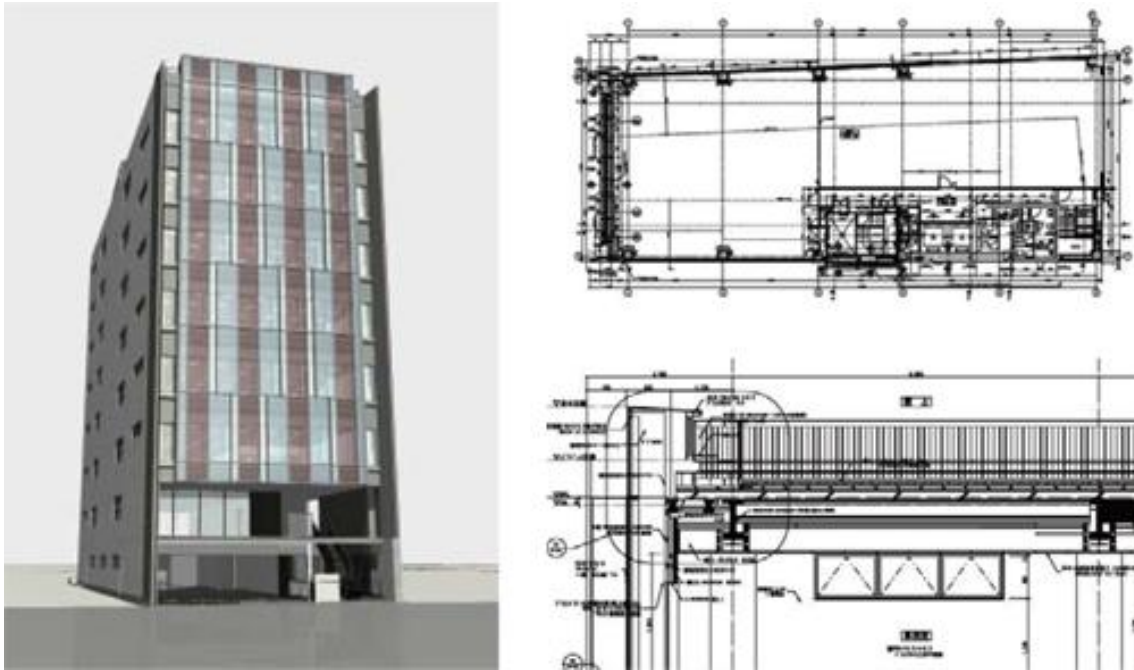
Challenges of generating documents from a BIM model

Toda Corporation’s Architectural Design Department (Planning) implemented ArchiCAD in 2008. It was mainly the young staff that utilized the program in the practice, and in 2009, we were already using ArchiCAD for project planning for design competitions. In 2010, we started generating full-fledged building drawings from the BIM model, and the first project was the “Toda Building Aoyama”.

“The task of this project was to generate all the documents from the BIM model, which we used to produce using 2D CAD. In addition, using a feature of BIM, we verified the effectiveness of producing bills of quantity and quantity takeoff from the BIM model,” explains Mr. Gomadou, who is responsible for the Architectural Design Department (Planning) of the Architectural Design Division. Generating documents from the BIM model is one of the hurdles of BIM implementation. I believe in the future, standardizing BIM documentation will be necessary in general, but the present situation is that we are adjusting to the existing specification of our firm’s documentation. Therefore, we need to create detailed customization.

For instance, when we generate a drawing from the BIM model, depending on how you set the thickness and line types of the outlines, shaded lines, and dimension lines, the look and the emphasis of the drawing becomes totally different. “First, we were using ArchiCAD default settings, but soon we started customizing the lines so that the look of drawings were closer to our firm’s standard,” explains Takashi Kitagawa of the Architectural Design Division’s Technology Department. We input the material and finishing information so that we could extract the bills of quantity and finish schedule, as they are needed. Our goal was to reduce the workload by extracting information, which used to be inserted one by one to create the lists or tables, directly

from the BIM model. “In order to automatically generate bills of quantity and finish schedule, it is important that the attributes are inserted to each element of the model,” Mr. Gomadou said.



Standard floor plan and detailed section drawing generated from BIM model

Reviewing element fittings and the construction process with the digital mock-up

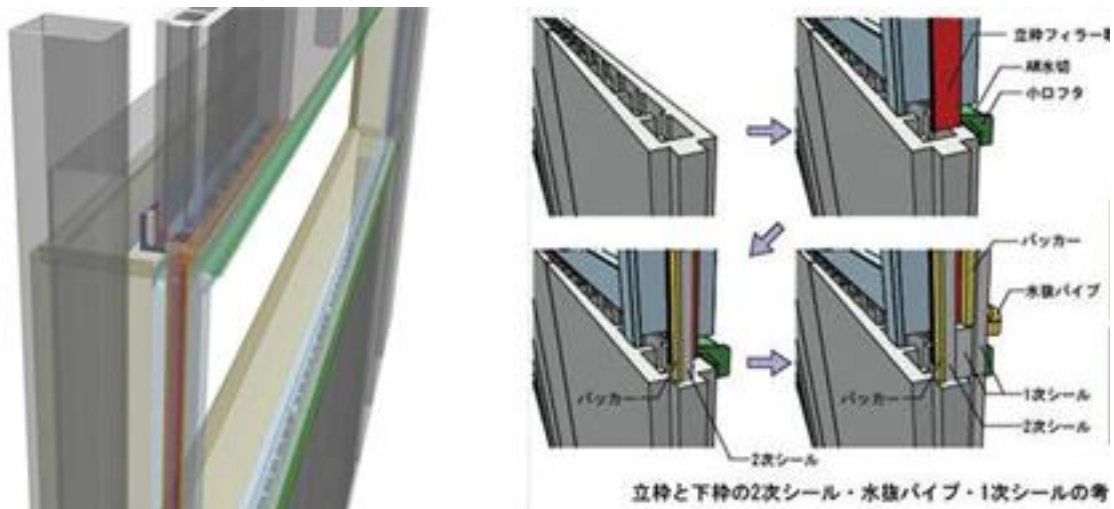
The BIM model was also useful to plan the construction process, effectively using the narrow space of the building site surrounded by other buildings. We represented the makeshift construction plans, which led from the underground to the ground level, in a 3D model. This helped us to check the connection area of the building’s peripheral areas and the bracing walls, and also to check for interferences on the gantry for the heavy equipment’s entry and building frame, planning the transfer of heavy machinery, and checking the scaffolding sizes. At the construction site, we analyzed the fitting and the joint measurement of the exterior walls within the structural parts. For example, we visualized an extruded cement slab and coping/sash double-glazing to check how they settle in place and reviewed the construction process in chronological order.

The error in the total quantity calculation became less than 1%

Furthermore, when we calculated the building frame’s concrete quantity of the foundation and slab of each floor from the BIM model, the discrepancy from the quantity survey was as low as 1%, and there was about a 5% difference from the placement quantity at the construction site.

Utilizing walk-throughs for marketing

One of the advantages of using ArchiCAD was that we could utilize the walk-through for marketing activities when approaching potential tenants. The add-on VBE (Virtual Building Explorer) converts data for those computers without an ArchiCAD installation to be able to open the file and to view the building using a walk-through feature. “Even before the building was completed, we brought the BIM model to the potential tenants and let them operate the viewing themselves so that they could feel the space of the building. This kind of game-like presentation was really effective,” says Mr. Gomadou. Using these steps, “Toda Building Aoyama” started the construction in June 2010 and completed the building in March 2010.



Left: Digital mockup of an opening, Right: Chronologically ordered construction process

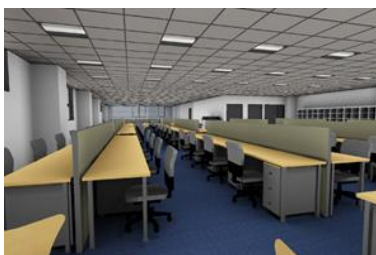
Preparing the basis for applying BIM in actual projects

In the firm, about 30, mainly younger members of the staff use ArchiCAD. "Since the design team led this project using BIM, we now can say that the level of the design documents we produce from BIM is close to the level of what we would use for real building projects. From now on, we would like to enhance our BIM usage on both quality and quantity, collaborating with other departments of the firm," says Mr. Kitagawa. Also, in marketing we are considering using BIM as an approximate estimation tool for business planning and as a connection between sales and design. Within design, we intend to strengthen the simulation using BIM models including architecture, structure, MEP and production design. And for quantity surveys, in addition to bills of quantity, which we confirmed the accuracy of this time, we are planning to produce finishing quantity calculations as well as establishing the method of model making for quantity surveys.

As for construction, we plan to apply BIM for earthwork, makeshift planning, management of concrete placement, analyzing of building methods of pre-cast parts and steel frames, and also for management of finishing stages, as a means to improving the productivity and the quality of the construction. Furthermore, the facility management after the completion of the building is something we would like to work on. We are also now thinking of collaborating with other firms who would do detailed design of steel frame parts and MEP parts from our complete BIM model, including design, structure and MEP. The possible scenario would be that, for steel frame parts design, we would convert the BIM model designed in ArchiCAD to IFC format, which the collaborating firm could take over to their structural design software compatible to BIM. Then they could design each steel frame part as well as welded and bolted joints.



Combination of MEP model and frame/structure model



Walk-through using VBE



BIM model visualizing the construction and the site photo

Similarly, it is also possible to have design done on water pipes and ventilation ducts with MEP software without conflicting with architectural parts and structural elements if we provide subcontractors with IFC data from the BIM model. By using the common communication format of the BIM model, known as IFC, we can make use of the “OPEN BIM” concept promoted by GRAPHISOFT, which links field-specific software from different disciplines. Toda Corporation plans to proactively utilize BIM throughout the workflow of the architectural production processes, namely: marketing, design, quantity survey, production design, construction and even the facility management after completion of a building, based on the concept of OPEN BIM, using ArchiCAD as a foundation tool to connect with various software for exchanging model data.

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