

## COMPANY

**GS Engineering & Construction Co., Ltd**

## LOCATION

**GS Yeokjeon Tower 537 Namdaemun-ro 5-ga  
Jung-gu Seoul, Korea**

## SOFTWARE

**Autodesk® Building Design Suite  
Autodesk® BIM 360™ Glue**

# Parnas Tower extension project uses BIM and laser scanning techniques for collaborative construction

GS E&C constructs a luxurious hotel and office complex with the help of Autodesk BIM and cloud solutions.

GS Engineering & Construction Company brought in Autodesk BIM 360 Glue cloud-based collaboration software to make use of BIM-based output from our precon process at construction sites. In the past, we had only a few copies of 2D drawing on site, but we're now able to check integrated, BIM-based precon output at our sites, helping us avoid any problems in ongoing construction work.

—**Yeon-suk Jeong**  
Ph.D. / Senior Manager  
GS E&C



Aerial view of the Parnas Tower

## Project summary

Since 2010, GS Engineering & Construction (E&C) has been implementing Building Information Modeling (BIM) technology on its construction projects. For their recent large-scale Parnas Tower expansion project, they adopted Autodesk® ReCap™ software, which enabled them to create 3D models from laser scans as part of an integrated Autodesk workflow that helps support collaboration and a more efficient, streamlined construction process.

Parnas Tower, which is part of the Grand InterContinental Hotel Seoul in Samsung-dong in the heart of Seoul's central business district, is being extended as part of a complex of hotels and offices. Work began on the expansion project in March 2013 and is scheduled to be completed by July 2016. Twice the size of the existing hotel, the new Parnas Tower will have 38 floors above ground and eight floors underground, giving it a total floor area of 22m<sup>2</sup>. As part of this extension project, GS E&C will provide a total of 667 hotel rooms—138 rooms in Parnas Tower and

529 rooms in the Grand InterContinental Hotel Seoul.

The new Parnas Tower aims to become LEED (Leadership in Energy and Environmental Design) Gold certified and seeks to receive recognition for having the highest rate in eco-friendliness. In addition, the company plans to install solar panels and a ground-coupled heat pump system in the building, which will enable it to provide 7 percent of the expected energy consumption from renewable energy sources.

## Company

**GS E&C, one of the world's leading contractors**

Founded in 1969, GS E&C is one of the world's leading engineering & construction firms, utilizing its global workforce and technological prowess across the wide scope of its business, covering everything from construction and housing to civil projects to oil, gas, and petrochemical facilities.

Its advanced technological capabilities and wealth of experience enable GS E&C to

## GS E&C's BIM adoption phase



construct the best in high-tech buildings. World-class office buildings—such as the IFCS (International Financial Center Seoul) in Yeouido, the GS Tower, COEX Convention Center, ASEM Tower, and the LG Twin Tower—have become instant landmarks in downtown Seoul. GS E&C strives to continue that legacy, investing heavily in BIM and support solutions to help ensure its momentum for sustainable growth is maintained in the future. Its investments are already paying off in terms of international recognition, not least by winning the grand prize in the construction category at the 2012 BIM Awards from BuildingSMART Korea.

GS E&C began using BIM technology at its construction sites in 2010, when the international construction industry was just beginning to move from 2D based systems to 3D-based BIM systems. Reflecting this change, the Korean Public Procurement Service made it compulsory from 2012 to use BIM for public projects worth over \$50 million.

In fact, moving to a BIM process couldn't have come at a better time for the Korean construction industry, which, with high operating margins under threat from looming market conditions, was in need of a new business model that would not only increase construction productivity but also reduce costs to mitigate the higher levels of market risk.

In response to these conditions, GS E&C signed a memorandum of understanding (MoU) with DPR Construction, an American general contractor, and put in place a bilateral cooperation plan that would help GS E&C adopt and promote the wider use of BIM technology for building projects.

### GS E&C's strategies for BIM adoption phases

GS E&C seeks to go beyond the simple use of BIM by adopting a more efficient and streamlined process as part of an advanced construction management technique based on lean construction. In order to do so, GS E&C broke up its strategies into four distinct phases (outlined above). It is now working to secure the requisite technologies to enable it to move to the third phase.

### Challenge

For the Parnas project, GS E&C must handle building extension work, reconstruction, and new construction at a single site. The company is responsible for not only carrying out the construction work, but also for controlling costs through the management of design and engineering.

Their first challenge for building extension and reconstruction work was to create accurate floor plans that capture the as-built condition. Over the years, the building underwent several remodels that were not properly documented, and the building's floor plans were incompatible with the actual layout of the building. GS E&C also conducted a construction feasibility study to help them establish an effective, cost-effective collaboration system.

### Solution

#### BIM solution used in the Parnas Tower project

For this project, the team used Autodesk® Navisworks® Manage, Autodesk® AutoCAD® MEP, Autodesk® Revit® Architecture, and Autodesk Recap software—all found in Autodesk® Building Design Suite Ultimate edition.

GS E&C created an intelligent 3D model using Revit Architecture in the design phase, then integrated the model with Navisworks Manage to identify and coordinate clashes and interferences. Autodesk ReCap helped to capture accurate data from a laser scan of the building, and that data was uploaded to the cloud for analysis on-site with Autodesk® BIM 360™ Glue® cloud-based software.

"As the contractor does not make the design itself, it does not necessarily need to have all the various sorts of software available. What tends to happen is that it sticks with the software that's most widely used in the design field. Autodesk is perfect for this. It not only does what we initially set out to do, but it also strings the design phase together with the construction phase, which we're finding is a real plus for project work," said Yeon-suk Jeong, who is the senior manager at GS E&C.

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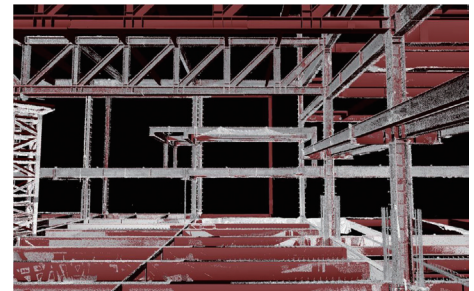


Image 1. 3D data from laser-scanning obtained using ReCap

## Benefit

### Autodesk ReCap supports laser scanning

The Parnas Tower project includes a combination of reconstruction and new construction work, which involves decisions regarding which parts of the building need to be demolished, which parts need to be maintained, and which parts are to be newly built. To solve the problem of discrepancies between the as-built drawings and the as-built condition of the building, GS E&C gathered 3D building data from a laser scan and checked location, distance, and length in order to avoid errors in design due to inconsistencies with the drawings.

Yet, when looking for a way to add laser scanning data to its workflow, GS E&C found itself running up against a brick wall, unable to adequately handle bulk point cloud data. The new, upgraded Autodesk Building Design Suite, which includes Autodesk ReCap software, offered a simple, yet highly effective solution.

When laser-scanned building data is transferred to and stored in Autodesk ReCap, a file is created that's half the size of the data, a tremendous savings. By loading this file into Navisworks Manage and adjusting the origin coordinates, it is possible to achieve pinpoint accuracy in comparing it with the BIM model. This result can then be used to inspect the quality of the construction work to prevent cost increases or delays brought on by construction errors. Moving to a BIM workflow also helps stakeholders make decisions more quickly as it equips them with a whole-project view. As the saying goes, one picture really is worth a thousand words.

The image 1 shows an example of comparison between 3D BIM model and laser scanned data of mega truss structures which were constructed on site. GS E&C found the mega truss structures were perfectly installed. Through the aggregation of scanned data and the BIM model used by the steel constructor, GS E&C was able to complete MEP systems in the mega truss structures with no interferences. They were the first firm in Korea to use laser scanning successfully in a construction project.

### BIM model integration and coordination with Navisworks

In the course of project implementation, GS E&C's construction partners hold coordination meetings twice a week with stakeholders to drive collaboration. At the meetings, the team uses Navisworks to combine BIM data into a single integrated model that all parties can access.

"When we used to think about Navisworks, it was only about automatic interference checks. What we realized is that we were just scratching the surface. With Navisworks and its 4D sequencing feature, we have been able to simulate detailed construction schedules and reduce construction risk. The strongest outcome has been that we have minimized the possibility of construction errors and improved the quality of construction work through a whole-project review integrating the scanned data with BIM data," said Jeong.

Moreover, the BIM model created through coordination meetings actually works to reduce the risk of reconstruction errors and mistakes, while improving the quality of the construction work by enabling the use at the construction site of 3D data, rather than 2D drawings.

### Design review and cost savings with BIM-based preconstruction

The image 2 is a 3D model of machine equipment and an electrical part with 8.5 million components involved. If 2D modeling had been used, hundreds, if not thousands, of 2D drawings would have been needed to represent them all.

The BIM process enables GS E&C to quickly generate digital representations of the design, review redundant details, remove errors, and effectively optimize the design as a whole.

The image 3 is a 3D model with the structure included. By examining construction feasibility—which includes interference between steel framework and equipment as well as joint connections between curtain walls and steel framework—before the construction work started, GS E&C was able to prevent potential reconstruction work or delays to the construction schedule.

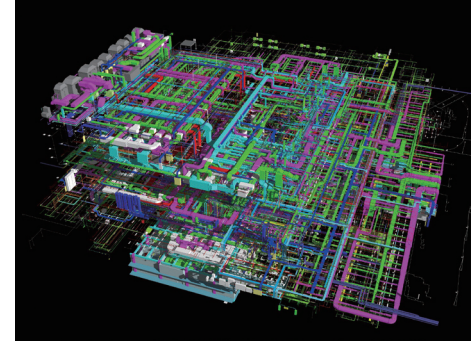


Image 2. BIM Model(only MEP)

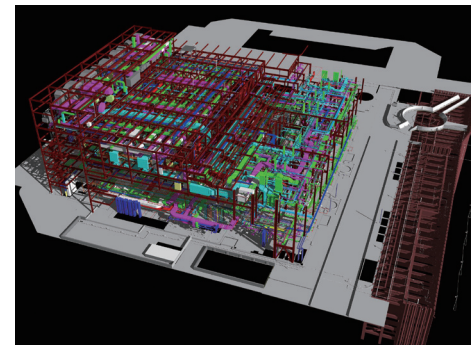


Image 3. BIM Model(structure including)



Image 4. Opinions exchanged with an on-site engineer using BIM 360 Glue

Moreover, the team improved usability for better maintenance going forward, which satisfied the owner. For example, it reviewed the path through which replacement parts are brought in, examining access holes in the electrical and stage installation.

For this BIM-based precon, GS E&C established a work process using 11 types of software and held coordination meetings twice a week, with intelligent 3D models created in each construction step. Through this, it identified tens of thousands of interferences in the early design phase, which it managed to slash by more than half, delivering 2D drawings to the construction site with most of the interferences already resolved.

Furthermore, BIM-based precon helped the company achieve cost reductions. GS E&C planned to build the country's largest banquet hall with mega-truss, electrical installation, and stage setting at the top, in the podium extended to the main building. However, extensive interference between all kinds of components on the ceiling, such as ducts and pipes—which were themselves the product of insufficiently high ceiling space in the pre-existing hotel—made it difficult to allocate even minimal amounts of working space. Plus, there seemed to be the risk that, even with construction completed, there wouldn't be enough space for maintenance work.

To solve such problems, GS E&C adjusted the size of framework structural members, adjusting the distance between trusses and reducing the weight of the steel framework through the optimization of mega-truss design. In addition, it reduced the number of temporary bents for the installation of the long-span truss, which helped cut the cost and shorten the critical path.

With the mega-truss steel frame changed, GS E&C identified the optimal path for the air-conditioning and smoke control duct, saving substantial costs. Phased optimization worked to effectively minimize the size of the space that needed to be managed after construction, shortening the catwalk path for the maintenance of stages and electrical installation by 48 percent, from 460 meters to 250 meters. This is an example of BIM-based lean construction that not

only reins in the construction schedule, but also saves on both labor expenses for installation and material costs.

### Whole-project review on-site using BIM 360 Glue

GS E&C brought in BIM 360 Glue to make use of BIM-based data from the precon process at the construction site. Since the Parnas Tower project involves maintaining some existing structures and reconstructing and building others, GS E&C used Glue to upload or download BIM data to and from the cloud server at the construction site. This helped them divide up the structural parts to be maintained from those that needed to be removed and/or reconstructed—a capability that was used on an ongoing basis, whenever the need arose.

Though BIM 360 Glue is now used for certain complex structured sections, GS E&C is engaged in work to establish a system that would see it make use of BIM 360 Glue across every construction process and section, testament to GS E&C's belief that BIM 360 Glue can deliver tangible results.

### Vision

GS E&C used the BIM process as part of a lean construction approach from the early design stage throughout the project to improve the quality of design and construction work and achieve the greatest owner satisfaction.

It plans to secure third-phase BIM technology and expand its use through the management of designs within an established budget for pre-production and modular construction. GS E&C aims to promote the wider use of BIM among all its partners, including owners, designers, contractors, and main partners.

Note: Precon stands for pre-construction. Precon is a process to create 3D data and a BIM model with all the elements involved in design coordination, process simulation, and on-site distribution management. Precon seeks to construct a building in virtual space prior to commencement of actual construction work.