GHD

Customer Success Story

Autodesk® Revit® Structure

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—Paul Hellawell
Senior Modeler
GHD

A bridge to BIM.

GHD uses Autodesk Revit Structure for improved efficiency and coordination.

Palm Jebel Ali.

The Firm

GHD is an international professional services company serving clients in the global market sectors of architecture and building, infrastructure, urban development, water, transportation, mining and industry, defense, and the environment. The firm's staff of more than 6,000 operate from offices throughout Australia, New Zealand, Asia, the Middle East, the Americas, and Europe.

GHD delivers innovative solutions by combining technical skill and experience with an understanding of its clients' objectives and aspirations. The firm is committed to managing the social, economic and environmental impacts of its operations and assisting its clients to manage theirs—and recognizes innovation as the key to realizing this objective. In keeping with its commitment to innovation, GHD began using building information modeling (BIM).

"It was clear to us that BIM was poised to be a major innovation in our industry," explains Paul Hellawell, senior modeler, at GHD. "We saw its potential to assist in raising the standard of our deliverables and to help with reducing our documentation. By moving to BIM, we could gain a competitive advantage ahead of the crowd." In 2007, GHD began implementing Autodesk® Revit® Structure. The Revit platform is Autodesk's purpose-built solution for BIM. Applications such as Autodesk® Revit® Architecture software, Autodesk® Revit® Structure software, and Autodesk® Revit® MEP software built on the Revit platform are complete, discipline-specific building design and documentation systems supporting all phases of design and construction documentation. The firm currently has more than 100 users of Revit Architecture, 30 users of Revit MEP, and 60 users of Revit Structure—and expects those numbers to grow exponentially as people see the results of the firm's initial BIM-based projects.

The Bridge to Palm Jebel Ali

One of GHD's recently completed Revit Structure projects is a large bridge structure for Palm Jebel Ali off the coast of Dubai in the United Arab Emirates. GHD worked closely with its client, Nakheel, one of the largest real estate developers in Dubai, to complete the design for the structure. Palm Jebel Ali comprises several islands—the Trunk, the Spine, the Fronds (16), four Crescents, and the Crown—assembled in the shape of a palm tree, all linked by bridges.

Palm Jebel Ali is the second palm-shaped island built by Nakheel and stands as one of the largest land reclamation projects in the world; the first, Palm Jumeirah, is now home to more than 10,000 residents.

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More Than a Bridge
The Southern Utility Plot Support Structure (SUPSS) is a bridge structure that will also hold a large quantity of the utilities, pump stations, and glass-reinforced plastic (GRP) water tanks required to supply the Spine and the Fronds of Palm Jebel Ali with potable water, irrigation water, firewater, and sewerage pumping facilities.

The structure is an extension of the main Spine bridge abutment, with an additional seven spans of superstructure crossing over the utility plot. When complete, the bridge structure will be approximately 50 meters wide and 150 meters long, and will carry six traffic lanes, two bus lanes, and two pedestrian paths.

Project Challenge

GHD chose to use Revit Structure on this project based on the complexity of the coordination requirements. The area of work was predefined with connecting roads on each side of the bridge and a 10-lane highway over the top. The project required a certain amount of water storage below the bridge as well as provide the required space for the pumping stations and the support structure for the highway above. When it is built, the SUPSS will include one of the largest groups of GRP tanks in the world.

Model-Based Design
These tight space constraints necessitated a model-based design workflow that would enable careful coordination between the designs of the bridge and connecting road structures, as well as between the bridge's support structure, the pumping station pipes, and the storages tanks. "We started by obtaining the survey data of the existing surface terrain and imported those triangulations to create a topological surface in Revit Structure," explains Hellawell. "Next we imported the road design centerlines and strings—as these were our design constraints." All of this information was imported using 3D DWG files provided by the project's civil engineers.

Design Feedback
Then GHD created Revit Structure mass elements to represent the stored water. As the amount of stored water was so large, it had to be split over multiple tanks. The whole design was a balancing act between structure clearances and storage volume. The Revit Structure massing tools provided the team with a way to model the tanks with different shapes and sizes—as well as different quantities to see if they were achieving the necessary water volumes. The team also created a schedule of the water volumes.

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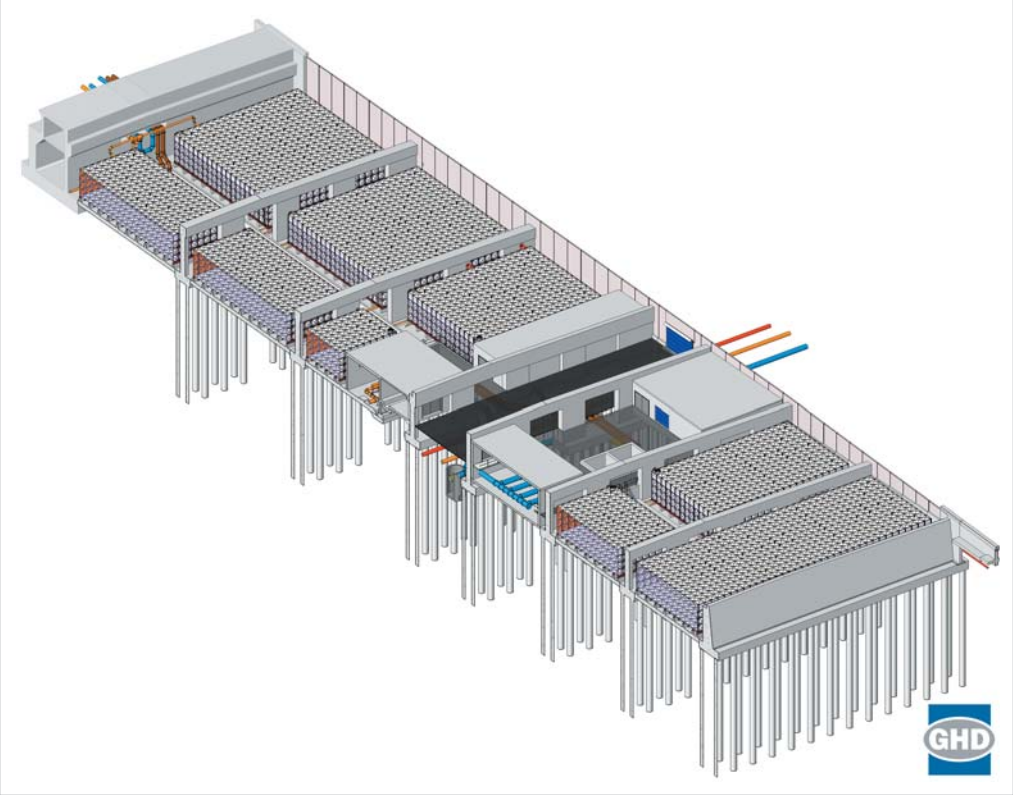
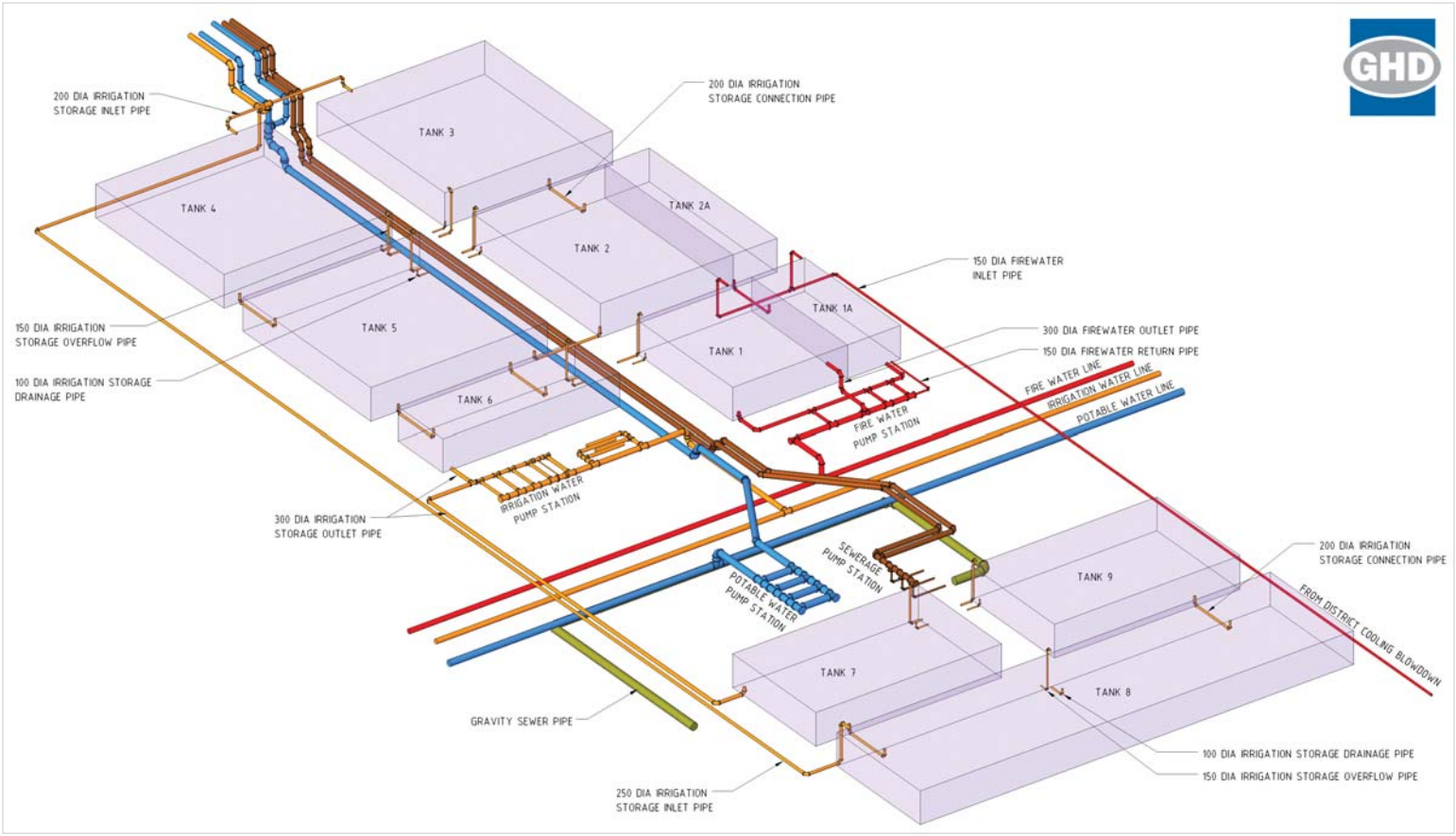
The team then started to design the structures around those masses. Due to the parametric nature of the Revit Structure modeling environment, as the structure changed or moved, so did the shape and size of the storage masses and the volume schedule. "This real-time design feedback was invaluable," says Hellawell. "As we moved the structures around to optimize the design, we knew exactly how much water there was in each tank and the clearance distances around them."

Clash Detection
Once the structure was designed and the masses that represented the water were fixed, GHD coordinated its design with the tank supplier, who provided 3D DWG files of the water tanks to GHD. The design team simply imported the tanks into their model and used Revit Structure to recheck all the clearances around the tanks, based on the actual tank designs.



Schematic site reticulation.



Sectional view under bridge deck.

"Using Revit Structure software, we were able to identify clashes and areas of congestion that we could resolve early in the process," says Hellawell. GHD's modeling team re-created the piping layouts in 3D using Revit MEP from existing 2D designs. "Because the piping was so complex, we decided to model the design in Revit MEP so we could perform clash detections," explains Hellawell.

Improved Coordination

During the design phase, the structure needed to be modified. Initially the SUPSS had seven massive concrete supports, including one at one end of the bridge that was adjacent to the support of the main bridge. Connecting that end of the SUPSS directly to the main bridge abutment would eliminate the need for the seventh support and its associated costs.

The design modification meant the team needed to change the remaining support beams, the tanks, the bridge deck, and all the related drawings. The parametric connection between the Revit Structure model and drawings allowed the GHD designers to quickly incorporate the design changes in the model, and all the affected documentation updated automatically. "By using Autodesk Revit Structure, we were significantly more efficient than our traditional drafting-based approach," says Hellawell. "By incorporating a BIM approach, we know that there will be greater efficiencies obtained in the construction process, which will be a direct benefit to the client."

Estimating Quantities and Cost

"Another great feature of Revit Structure on this project was using it for estimating," says Hellawell.

Revit Structure offers a full set of parametric structural design components such as beams, precast concrete elements, concrete rebars, and so on. The parametric definitions allow quick revisions to existing object types, and in addition, new objects can be graphically created and stored as families to be reused in other projects. GHD took advantage of this feature by creating many of its own families of bridge elements: families for beams, decks, barriers, and so on. When appropriate, the elements had a built-in reinforcing bar—enabling GHD to automatically calculate the rebar quantities as well as concrete volumes. "At the press of a button, we could produce accurate material quantity takeouts." Hellawell notes.

The Solution

Following the success of this Palm Jebel Ali project, GHD is expanding its use of Revit Structure for bridge projects. "For quite a while we have wanted to design bridges in 3D, but coordinating our design with the topography was always an issue," says Hellawell.

Now they import digital surface models of the existing terrain and the civil engineer's road design, as well as the centerline of the road going over the bridge, right into the Revit Structure design environment. The bridge design is better coordinated with the road design, and the bridge's documentation set is more consistent and coordinated with the design.

GHD even uses Revit Structure to check clearances under their bridge by modeling a mass that represents the envelope of traffic traveling under the bridge and performing clash detection between the bridge and the traffic envelope. Once a bridge design is finished, the GHD team can then export their Revit Structure model to 2D and 3D DWG files and send their design back to the civil engineer—improving collaboration and coordination with the extended design team.

Instant Visualization

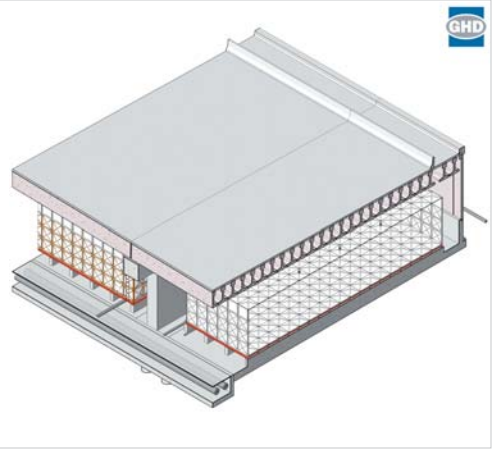
GHD has also come to appreciate the instant design visualization capabilities of Revit Structure. Anytime a change is made to the model, the software automatically updates every related view: the standard plans, sections, and elevations used for documentation as well as 3D views. These live 3D views give the GHD designers a better view of their emerging design—to try out different design concepts and guide their design decisions. For photo-realistic images, GHD also relies on the internal rendering engine included in Revit Structure.

"The design visualizations of our bridges have been a big hit with urban designers and local authorities," says Hellawell. "It's a very effective way to communicate the overall design."

Competitive Advantage

The visualizations also help to give GHD a competitive advantage. "We have been approached by people who have seen images and are interested in our '3D bridges,'" reports Hellawell.

"Revit Structure has assisted in improving our design coordination, our efficiency, and the quality of our documentation," states Hellawell. "It gives us more freedom to try out different concepts early in the design process and assists in improving our flexibility with design modifications design changes."



Section view through bridge deck.

To learn more about Revit Structure, visit www.autodesk.com/revitstructure.

Palm Jebel Ali, aerial view.

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