Population Boom Requires Greater Power Generation

An urban development expansion project has commenced in Saudi Arabia in an effort to alleviate the country’s housing shortage problem. Because of the growth in housing and population, the power generation capacity is anticipated to increase to 60 gigawatts by 2023. Therefore, a long-term plan to expand power generation facilities throughout Saudi Arabia has been developed.

The Shuqaiq Steam Power Plant was constructed about 135 kilometers north of Jizan in southwestern Saudi Arabia along the Red Sea as part of this planned power generation expansion. The power plant is a heavy oil-fired thermal power plant that produces 600 megawatts of electricity across four fuel boilers. The Shuqaiq Steam Power Plant, which has a capacity of 2,640 megawatts, was constructed under the long-term plan of the Saudi Electricity Company (SEC).

An initial accurate 2D district design analysis was performed based on a formula in Microsoft Excel. However, the analysis of the pipe network was imprecise and needed to be reanalyzed. As a result, applications were needed to support the creation of a pipe network with node elevations as well as to support the analysis of the one-dimensional unsteady flow model. The SEC contracted Hyundai Heavy Industries Co. Ltd. to design the flat surface and vertical section according to the results of drainage analyses. Hyundai Heavy Industries, a leader in the heavy industries sector, is headquartered in South Korea. The organization has divisions in shipbuilding, special and naval ships, offshore and engineering, industrial plant and engineering, and engine and machinery divisions. The civil engineering department of Hyundai’s offshore and engineering division handled this project.

Revamping the Storm Drainage Network

The storm drainage basin area of the power plant is 140 hectares and comprises a tank, power block, building, and petroleum hydrocarbon (PHC) areas. The storm drainage network also includes 960 nodes and 28 kilometers of pipe links. Hyundai Heavy Industries oversaw all aspects of the power plant’s erection, including design, materials manufacturing, construction, and test operations.

Hyundai leveraged the geographic information system (GIS) data by converting the 2D design data into analytical data for the drainage network design and analysis in CivilStorm and StormCAD. OpenRoads made the construction of a 3D pipe network conceivable. The team then quickly created and submitted the revised design and the approval documents to the client. When the organization received approval for construction they built the infrastructure.

Revising the Initial 2D Design

The initial design of the storm drainage basin area was done using the 2D method, with the design analysis conducted with Microsoft Excel. This method of analyzing the large-scale area of the pipe network was vastly inaccurate and needed to be revised. Therefore, specific software was necessary to support the evaluation of the one-dimensional unsteady flow model as well as to design the drainage system.

The initial 2D design was top-quality, but there is a margin of error when manually inputting 1,000 nodes into a spreadsheet. Therefore, the 2D plan was revised and input into a GIS. Then, the project team reconstructed the network using StormCAD and CivilStorm where the pipe network construction and analysis of the 960 nodes was completed in 10 hours. The optimization of the drainage system was completed through design adjustments. Then, the new design was altered to reflect all supplementary changes and profiles were printed out from the applications.

All GIS data retained compatibility with the data within StormCAD as the application can be integrated with and work from within MicroStation®. Consequently, updating the GIS for changes as well as the 2D drawing output did not require any extra work, which saved time and reduced the likelihood of human errors. Converting the 2D plane data to GIS was completed through MicroStation, StormCAD, and MicroStation SDK to develop an add-in program that converts text on a flat surface to GIS properties. This automated data acquisition.
Designers and on-site construction staff worked together and shared designs via StormCAD, which was used along with MicroStation for collaboration. The data results were exported to Excel before being submitted to the client.

**Project Submitted Ahead of Schedule**

Stormwater analysis applications, such as StormCAD and CivilStorm, are now recommended by SEC, in particular for their trace analysis capabilities. Within StormCAD and CivilStorm, tracing analysis enabled the distribution of the runoff from the watershed to the appropriate pipes so that pipes could be designed with the proper diameter large enough so that overflowing is limited, which will reduce environmental impact.

Using GIS in coordination with these stormwater applications means that continuity between GIS and design data will remain.

Working with Bentley applications enabled the project team to quickly work and meet the client-approved deadline. Updating the GIS with the optimized drainage design of StormCAD took one team member one and a half days to complete. The swiftness and easy-to-use software reduced manpower costs and eliminated human error. Additionally, drafting approval documents was shortened by one day and processed without any errors through the drainage network mapping and profile extraction capability in the stormwater products. This capability enhanced design quality and reduced working hours and product drafting time.

*CivilStorm and StormCAD were used to analyze and design the drainage network.*