Jan De Nul Uses Bentley Civil Software to Obtain Accurate Cost Estimates to Win Panama Canal Expansion Dredging Contracts and Deliver Ahead of Schedule

3D Models Yield Accurate Material Volumes for Dredging Contracts

Project Summary

Organization:
Jan De Nul Group

Location:
Panama City to Colon, Panama

Project Objective:

- Double the Panama Canal's capacity through the construction of a third set of locks.
- Allow the transit of Panamax ships that are 25 percent longer and 50 percent wider.
- Achieve a 12 percent internal rate of return on investment for Panamanians.

Products used:
Bentley MXROAD
gINT

Fast Facts

- Jan De Nul won major excavation and dredging contracts at the Pacific and Atlantic entrances and locks, as well as Gatun Lake.
- Bentley MXROAD and gINT were used to calculate accurate material volumes and cost estimates to achieve the winning lowest bids.
- Volumes calculated by zone enabled Jan De Nul to optimize deployment of vessels, trucks, and equipment.
- The 3D models provided real-world coordinates for machine guidance at construction sites.

ROI

- The Panama Canal Authority reached a construction a milestone in October 2011 with the flooding of the first section of Pacific lock lanes.
- Excavation works close to the Centenario Bridge were executed by Jan De Nul 4.5 months ahead of schedule.

Achievable Estimates Win Multiple Contracts

Jan De Nul Group, one of the world's largest dredging contractors and a leading civil and environmental engineering company, is engaged in several major projects on the USD 5.5 billion Panama Canal Expansion Program. The program will add a third set of locks to double the capacity of the canal and allow the transit of vessels with up to three times the cargo. To move the millions of cubic meters of materials required for the expansion, Jan De Nul created achievable cost estimates for each project site using Bentley MXROAD and gINT. Three-dimensional models of the dredging sites enabled the contractor to accurately calculate material volumes, and execute the most efficient excavation and dredging works. This enabled them to not only submit winning bids for seven projects in the Panama Canal Expansion Program, but to complete the works four and a half months ahead of schedule.

Calculating Millions of Cubic Meters

Initiated by a national referendum in 2006, the Panama Canal Expansion Program is scheduled for completion by 2015, roughly 100 years after the canal first opened. The program consists of construction of two new sets of locks—one on the Pacific and one on the Atlantic side of the canal. Each lock will have three chambers, and each chamber will have three water reutilization basins. The program also entails the widening and deepening of existing navigational channels in Gatun Lake, and the deepening of Culebra Cut. Four dry excavations projects will be executed to open a new access channel connecting the Pacific locks and the Culebra Cut.

The expansion will allow the canal to accommodate vessels up to 49 meters wide and 366 meters long, compared to the current size of 32.2-by-294.1 meters. The so-called "new Panamax" ships will carry two to three times the cargo. At the same time, the locks' water-saving pools and basins will use 7 percent less water per transit than existing locks—achieving a significant environmental goal for the Authority.

Jan De Nul is part of the consortium Grupo Unidos por el Canal, SA (GUPC), contracted in 2009 to design and construct the USD 3.2 billion Third Set of Locks, which is the main project in the canal expansion program. GUPC is led by Sacyr Vallehermoso of Spain, with Impregilo of Italy, Jan De Nul of Belgium, and Constructura Urbana SA of Panama. Providing support to GUPC for design is the joint venture CICP Consultores Internacionales LLC, led by Colorado-based MWH Global in partnership with California-based TetraTech and Iv-Infra of the Netherlands.

The expansion program involves removing millions of tons of wet and dry materials from the project sites. Contracts for the excavation and dredging works were awarded to companies with the lowest bids. The largest of the projects awarded to Jan De Nul were the USD 54 million dredging of 5 million cubic meters of rock from the Pacific Entrance North Access Channel (PENAC); and the USD 89 million dredging of 15 million cubic meters of material from the Atlantic Entrance.

Jan De Nul is engaged in dredging 20 million cubic meters of rock from the Pacific north access channel and the Atlantic entrance.

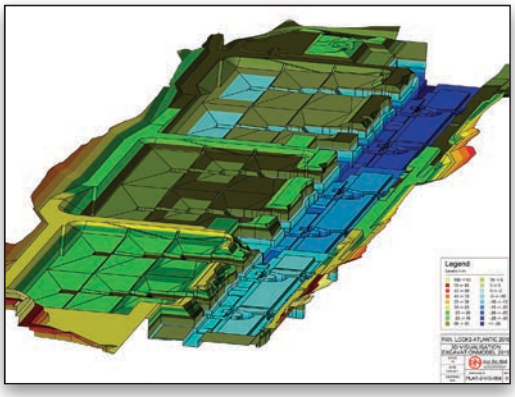
Jan De Nul applied a relatively simple formula for estimating the costs of these dredging projects based on the volume of each type of material to be removed, whether the material was above or below the sea surface (dry or wet), and the method and price for removing each type of material. The contractor relied upon accurate information about the types and volumes of materials at the project sites in order to calculate achievable cost estimates.

"We designed multi-strata 3D layers in MXROAD, using data from hundreds of boreholes from gINT along with seismic data. We could then accurately calculate volumes for all materials, which will need to be extracted, and be confident that our results are correct."

– Bob Van der Burght, Head Designer, Jan De Nul Group

Modeling Multi-layer Materials

Geological explorations revealed more than 10 types of materials requiring different removal methods at the dredging sites. Jan De Nul used Bentley gINT for reliable geotechnical and geoenvironmental data management and reporting. The software allowed the contractor to gather, manage, present, and report on subsurface data for multi-strata soil layers with efficiency and accuracy. Data for hundreds of boreholes was then exported from gINT for use in MXROAD.



Jan De Nul used gINT to store and analyze geological data and then used MXROAD to build 3D models of the material profiles.

To calculate accurate volumes, Jan De Nul used borehole data from gINT, along with seismic and survey data to build 3D models of each project using Bentley MXROAD. The modeling software provided a proven, powerful, and concise method of creating 3D surfaces for volume and quantity extractions. Volumes were calculated from channel sections or linear triangulations. Calculations for multiple intermediate layers were more complex, since the sum of the different soil volumes had to be the same as the total volume already calculated.

At the site of the Pacific works, for example, the survey for the locks was delivered as contour lines in a CAD file. Geologic information from data for 370 boreholes stored in gINT revealed a complex soil profile with different hard basalt layers. Jan De Nul imported the CAD file and gINT borehole data into Bentley MXROAD and fully designed the theoretic earthworks model of the locks and water-saving basins. The team built 26 models of soil layers, then checked for mistakes by making profiles of the models. The resulting cross-profile of the locks and water-saving basins combined the topographic model, the theoretic design model, and the ground models for sands, silts, clay, basalt, and sandstone.

Using gINT borehole data and 3D models from MXROAD, Jan De Nul split the material volumes into contractual boundaries, calculating pricing based on how many cubic meters of soft materials had to be dredged by a hopper dredger, for example; and how many cubic meters of hard materials like sandstone, basalt, and siltstone had to be dredged by a cutter section dredger or be blasted and dredged. Volumes of dredged material for disposal also had to be calculated according to disposal method.

Executing Theoretical Models Onsite

Despite the staggering volumes, accurate calculations by material type made possible by the use of gINT and MXROAD enabled Jan De Nul to submit winning bids for several projects in the Panama Canal Expansion Program. In addition to the two largest contracts at the canal entrances, Jan De Nul executed works at the Atlantic and Pacific locks requiring 40 million cubic meters of dry earthmoving, 20 million cubic meters of dry backfilling, and 10 million cubic meters of dry dredging. Other project awards included the Gatun Lake dredging and Pacific Access Channel Phase 4 (PAC-4) excavation.

Jan de Nul's work began in September 2008 at the Pacific Entrance. Once the construction phases started in each location, the team supported the projects by producing Google Earth overlays for logistics planning such as checking shipping routes and sailing distances for dredging vessels. The team also delivered 2D models with volume checks and balances. The Bentley MXROAD models were directly imported into the software for GPS guidance of the machines used for leveling, excavating, and dredging works. The theoretical 3D designs were imported without data loss, enabling the machine operators to use real-world coordinates for these highly accurate large-scale projects.

On October 19, 2011, a milestone in the construction of the new locks was reached when the Panama Canal Authority flooded the first section of the newly excavated lock lanes on the Pacific side. The excavation works close to the Centenario Bridge were executed by Jan De Nul 4.5 months ahead of schedule.

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