

**NPDES UPDATE**

EPA strengthens program to protect U.S. waters

[» READ IT](#)

BLURRING CAD/GIS LINES

Better use of GIS helps engineers arrive at preferred project alternatives quicker

[» READ IT](#)

QUALITY EROSION CONTROL

QDOR program takes scientific approach to choosing best materials for the job.

[» READ IT](#)

SEARCH

GO



Click to get your **FREE 2010 CULTEC Stormwater Design Guide**

Essential tools of the trade

July 2010 » Products » ENGINEERED SOLUTIONS

Design and analysis software programs support the entire project lifecycle.

By Bob Drake

Within one generation, design and analysis software programs have become essential tools for almost every sector of civil engineering. Effective use of the tools — based on a solid knowledge of engineering principles and theory — can take civil engineers into creative realms previously unattainable because of time and data constraints. But the benefits can extend throughout the design, build, operate, and maintain project cycle.

Workflow benefits

“Software for civil engineering has often been operated as free-standing ‘islands’ within the project lifecycle,” said Adam Strafaci, senior industry marketing manager, Infrastructure, AEC Solutions Division, Autodesk. “For example, planners use one piece of software for planning a project and then hand off the results, often in the form of a paper plan set, to civil engineers for design. The planning information is then recreated and manually built upon for design. This hand-off process continues into construction and beyond. While it works, it can result in fragmented and error-prone workflows that require information to be recreated multiple times.”

Model-based software provides a more seamless workflow process where coordinated and consistent digital information is built upon throughout a project, according to Strafaci. “Starting with planning, GIS and CAD information is aggregated from multiple sources to better understand the potential impact of a project,” he said. “That same information forms the foundation of design where rich 3D models of the project are developed. The information can then be leveraged to simulate and visualize project performance and to extract quantities for construction. And ultimately, owners can access the information and employ it in their asset management system.”

Ron Gant, global marketing director, Bentley Systems, Inc., said that civil engineers currently are more concerned with full project life cycles in part because of a shift to more resurfacing, restoring,

Related Engineering Channels

BIM CHANNEL Building Information Modeling



Your HUB for transportation news, products and events

STRUCTURAL CIO Forum and News for Structural CIO's

Exclusive

[EPA strengthens NPDES program to protect U.S. waters](#)

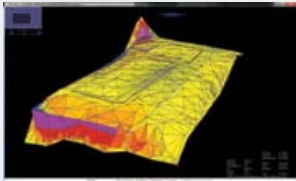
Stormwater discharges from developed areas are a major cause of degradation of our nation's waterways. Stormwater carries many pollutants to surface waterbodies. The increased volume and velocity of discharge from developed areas erodes stream banks and carries excess sediments and other pollutants downstream. In fact, stormwater discharge from urban areas is the primary source of water quality impairment in an estimated 13 percent of streams, 18 percent of lakes, and 32 percent of estuaries nationwide (and is likely a significant . if not primary . cause of impairment in many more).

News

[Elkton, Md. wastewater treatment plant named System of the Year](#)

and rehabilitation projects than new design and construction projects. "As such, information modeling becomes paramount in the life cycle," Gant said. Programs such as Bentley's Civil software can produce information-rich designs (information modeling) and transfer information throughout the phases of the project, he said. This reduces unnecessary, redundant data entry, decreases the potential for error in data translations, and provides the deliverables necessary for construction, inspection, maintenance, and operations.

One of the biggest benefits, according to Steve Biver, civil product line manager, Eagle Point Software, is that today's software technologies allow for sharing of data through electronic means rather than just through paper plans. "Building information modeling (BIM) allows for the data to be communicated to all stakeholders," Biver said. "Adopting a BIM workflow ties together many software packages and allows designers to analyze numerous alternatives quickly. Even if there are changes late in the design process, BIM can help identify the scope of the changes and convey them to all team members involved. Using today's technology in this workflow also provides contractors the mechanisms to immediately find what they are looking for versus combing through hundreds of pieces of paper."



BLUERIDGE Analytic's SITEOPS can produce quick, cost-optimized conceptual grading and plans, with cut and fill numbers calculated in real time. *Ware Malcomb.*



This \$15.2 million bypass extension in Bethlehem, N.Y., was a pilot project for New York State Department of Transportation to test the integration of automated machine control grading and the use of Bentley technology's quantity managing capabilities. Creighton Manning Engineering developed 3D digital terrain models (DTMs) and worked with the estimating software to meet the project goals. The quantity manager capability linked the InRoads DTM features to the pay items database. *Bentley Systems, Inc.*

upfront operating and maintenance expectations and [greater] confidence prior to construction instead of guess work or litigation after the fact."

For example, Trimble's Quantm Alignment Planning System and Quantm Desktop software can address stakeholder concerns by combining rich information from GIS databases with construction cost and engineering design requirements, Richardson said. "This allows an engineer or planner to produce optimized corridor alternatives that meet all project constraints while simultaneously considering construction and earthworks costs," he said. "Planners can also provide a process audit that tracks individual scenario investigations, considers alternatives and costs, and documents the methods used in reaching a preferred corridor or alignment."

As another example, auto-drawing tools and the ability to generate and evaluate millions of grading and piping combinations quickly allows BLUE-RIDGE Analytics, Inc.'s SITEOPS program to handle mundane drafting and grading tasks of the site layout process, and puts engineers back in the creative design business, according to David Settlemeyer, P.E., P.L.S., support engineer for

Managing mounds of data is a daily task that can occupy a significant amount of time, according to Brent Jones, industry manager, survey/cadastral/engineering for ESRI. "Forty to 60 percent of an engineer's time is spent locating and validating data," he said, referring to a 2004 National Institute of Standards and Technology study, "Cost Analysis of Inadequate Interoperability in the U.S. Capital Facilities Industry" (NSIT GCR-04-867;

www.bfrl.nist.gov/oe/publications/gcrs/04867.pdf). "Solving this data management problem contributes to the engineer's bottom line and competitiveness. Many engineers are leveraging GIS technology to centralize and manage project data (CAD, imagery, et cetera), creating efficiencies within the firm."

And centralizing and properly managing data throughout the design and construction phases gives the engineer more deliverables for clients. "Instead of delivering drawings and manuals, the engineer can deliver a GIS-based facilities management system," Jones said.

Comprehensive planning and design Managing data, however, is only one step in the design process. "Civil engineers and planners are under increased pressure to meet the demands of numerous project stakeholders," said Chris Richardson, marketing manager, Trimble Planning Solutions. "Environmental groups, community organizations, government agencies, and project financiers all want assurance that their concerns are being addressed when creating new road and rail infrastructure projects."

According to Colby Manwaring, P.E., president, XP Software, engineers are accumulating increasing amounts of data about projects and they need to have the tools to manage and take advantage of this data. "Current software programs for civil engineers, whether for design, analysis, operation, or maintenance, can help engineers make the most effective and efficient decisions based on the most complete data available," he said. "Software helps the engineer optimize designs for maximum efficiency by allowing experimentation and optimization in a virtual world, built from real-world data. Project owners benefit from more discovery or knowledge in the design and simulation phase [that] allows conflicts to be detected or avoided, provides a basis for more accurate

» [NY state considers transit benefit program for large companies](#)

» [American Water awarded contract for wastewater treatment plant in Islip, New York](#)

» [Headlines from around the Web, Thursday, July 8, 2010](#)

» [Headlines from around the Web, Wednesday, July 7, 2010](#)

»

New & Noteworthy



[Pipe and software](#)

» [Wastewater mixer, stormwater guide, and software](#)

» [Software, workstations, and insurance](#)

» [Software, stormwater, erosion control, and reference book](#)

» [Software and stormwater treatment](#)

»

Progressive Engineering



[Opening the QDOR](#)

» [Connecting GIS and asset management tools](#)

» [Reinforcing the practice](#)

» [Advancements in digital signature technology](#)

» [Engineering better solutions](#)

»

Editor's Comment



[Water infrastructure needs are staggering](#)

» [The complexities of engineering education](#)

» [Power & influence ... and women](#)

» [Growth and great firms](#)

» [Civil engineers and Haiti relief](#)

»

Stagnito Media Upcoming Events



[ARTBA Public-Private Partnerships in Transportation Conference](#)

Date: July 22, 2010 - July 22, 2010

Location: Washington D.C.

[EngEx 2010](#)

Date: July 29, 2010 - July 31, 2010

Location: San Diego

[Earth Retention Conference 3](#)

Date: August 1, 2010 - August 4, 2010

Location: Bellevue, Wash

[StormCon](#)

Date: August 1, 2010 - August 5, 2010

Location: San Antonio, Texas

[Maptek North America Users Conference](#)

Date: September 13, 2010 - September 15, 2010

Location: Denver Colorado

Events



BLUERIDGE. "For clients, this means they can make quicker, more informed site decisions, because they get more options and cost information earlier in the process," he said.

Cloud computing power

As the amount and sources of data increase and design analyses become more complex, web-based cloud computing may offer advantages for civil engineers.

"Cloud computing will impact civil engineering in two major areas: collaboration and analysis," predicted Autodesk's Strafacci. "Increasingly, infrastructure projects are being completed by geographically dispersed teams, whether around the country or around the world. The cloud will make it much easier for those teams to access shared data and collaborate more effectively. For example, the Autodesk Buzzsaw software-as-a-service (SaaS) application allows dispersed teams to store, update, and automatically synchronize project data."

Additionally, when working "in the cloud," platform and version compatibility issues are no longer a problem, according to Settlemeyer. For example, he said, "everyone is using the most up-to-date version of SITEOPS the moment they log in. Having an online system naturally makes project collaboration and data sharing easier because team members are working in the same 'space.'"

Manwaring suggested that access to data and engineering models can be enhanced with cloud-based software systems by sharing results and inputs for parallel analysis or evaluation, which may allow discovery of more broadly based solutions.

By leveraging the cloud, computationally intensive analytical tools will be easily accessed to conduct analysis throughout a project, ultimately leading to better designs, Strafacci predicted.

Eagle Point's Biver agreed: "The notion of using the cloud to harness the power of shared computing (or parallel computing) is perhaps where the biggest benefit will lie. To be able to 'rent' the processing of large data sets or perform hundreds of thousands or millions of calculations for simulation with little capital expenditure will drastically reduce time and make those types of analyses more cost effective."

In addition, cloud computing will simplify the IT requirements of managing desktop software as well as provide access to data and geoprocessing models that are not currently available to all engineers today, according to ESRI's Jones. "ArcGIS Server is currently available in the Amazon cloud," he said. "It is very simple to configure and begin using it. This will empower many engineering firms, large and small, to use the GIS analysis and data management capabilities without the overhead of an IT staff and servers."

Settlemeyer agreed that in cloud computing, some of the major IT requirements that can be a headache for engineering firms, such as software installations, secure data storage and backup, and software support, can be handled by the software provider instead of by the engineering firm.

But cloud computing presents both great opportunities and real challenges, Manwaring said. "In terms of interactive design and analysis, the user experience with a cloud-based software interface may be difficult," he said. "An interface that requires massive amounts of data to move from a desktop (or local server) to the cloud and back would likely present real logistical problems. That said, some benefit would be seen in the analysis of very large or complex data models. Once the preparation and setup of such models is done, number-crunching time can be fairly long. Cloud computing could conceivably assist to reduce the runtimes for large models that process a lot of data. If hurdles such as long processing times are reduced, it is more feasible for engineers to become more detailed in their modeling [and] provide clients with more accurate analyses of their systems."

Technology drivers

So what is the future of design and analysis software for civil engineering? According to Strafacci, three key factors are driving civil engineering software development today:

- An increase in geographically dispersed project teams is driving the rapid evolution of software and SaaS offerings to facilitate multi-location, multi-discipline model collaboration.
- Adoption of BIM for infrastructure projects and model-based design products focused on the specific needs of users are evolving to provide a more seamless BIM workflow.
- A new generation of civil engineers who grew up in a world of 3D video games and social networking are demanding software tools that provide instant feedback and information in rich visual formats.

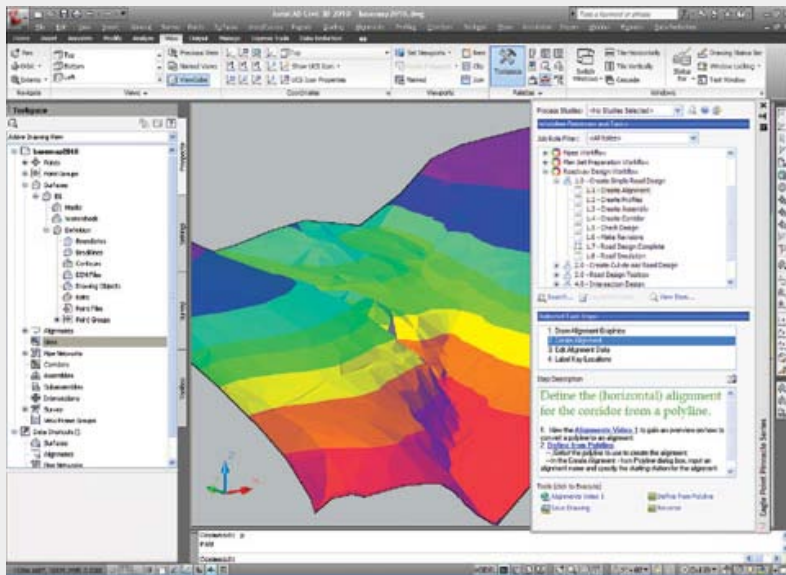
[SPAR International 2011](#)

- » [11th International LiDAR Mapping Forum](#)
- » [SPAR Europe 2010](#)
- » [Trimble Dimensions 2010](#)
- » [2010 Design-Build Conference & Expo](#)
- »



Centralizing and properly managing data throughout the design and construction phases gives the engineer more deliverables to its client, such as a GIS-based facilities management system.

ESRI



Using links to execute the correct commands, Eagle Point Pinnacle Series workflows guide users to complete their work faster while consistently following a firm's standards and best practices.

Eagle Point Software

"Civil Engineering is going through a paradigm shift," said Bentley's Gant. "No longer is our primary concern just the immediate construction. Civil engineering software must provide accurate, concise information modeling that can be done without taking engineers out of the decision process. The Professional Registration is held by the engineer, not the software. So, civil software must allow engineers to take advantage of their knowledge.

"Additionally, we must realize that there is no one, all-encompassing data model that produces a 100-percent complete model. Rather, engineers are dealing with many disparate data repositories or sources that must be molded into a Federated Data Model that allows interdisciplinary review, design walk-throughs, clash detection, and intelligent designs that are aware of all the impacts of surrounding and encompassing information."

The total cost of facility ownership is another significant driver of software development, according to Jones. Many types of software are used in the infrastructure life cycle — planning, data collection,

environmental analysis, design, construction, and as-built — contributing to higher design costs. Integrating systems and centralizing data is helping deliver efficiencies, he said. Owners are asking for systems to support operations and for engineers to supply data used in the design and construction. This is providing new opportunities for engineers. Additionally, as-built surveying is contributing to the operational data necessary for efficient facilities operations.

Richardson sees the widespread adoption of 3D machine control as the most significant factor driving civil engineering software today. "Civil engineers and planners are now expected to provide detailed 3D design models from civil engineering software that can be adapted and used through to the ensuring phases of a construction project, from earthworks to project completion," he said. "This is a two-way data flow where as-built information is also passed back from the field into the civil engineering software for project tracking and design revision as required."

Data is the recurring theme that Manwaring identified. "With advancing technology, engineers have access to better and more data," he said. "For example, 20 years ago, gauged rainfall data was fairly simple. Now, engineers have access to data from providers like OneRain, which provides massive amounts of dynamic storm information. Twenty years ago, surveyors had to go out and meticulously measure our landscapes. Now, airplanes fly overhead using radar technology to get infinitely more measurements of our terrains. It is the goal of software development to find ways to accept more data and produce more accurate results in the same amount of time or less.

Settlemyer cited a financial driver: "Business development is one of the biggest challenges facing civil engineering firms right now. Firms are looking for creative, efficient ways to compete for bids in a competitive environment." Software can help firms differentiate themselves, he said, and exceed their customers' expectations for conceptual designs.



570 Lake Cook Rd, Suite 106
Deerfield, IL 60015
Ph: 224-632-8200
Fax: 224-632-8266

Print / Electronic Media

CE News
Structural Engineering & Design
Rebuilding America's Infrastructure
AEC Technology Strategies
Sustainable Engineering
BIMchannel.com
HubDOT.net
StructuralCIO.com

Events

AEC Technology Strategies Conference
Best Firms To Work For Summit
Engineering Design Tech eConference
Integrated Project Delivery Conference
Structural Engineers' Buildings Conference and Expo

© 2010 Stagnito Media. All rights reserved.