New Technologies in Architecture, Engineering and Construction

Guest Editor

Kristen Kurland
Associate Teaching Professor
Carnegie Mellon University
Heinz School of Public Policy and Management/School of Architecture

Architects, civil engineers, construction managers, facility managers, urban planners and others in the AEC field develop drawings, renderings, plans, and reports to better manage projects. Prior to the invention of electronic systems for drawing, these professionals produced illustrations on paper in pencil and ink. Changes to drawings meant erasing and redrawing. Major changes often meant the entire drawing needed to be redone. The creation of Computer Aided Design (CAD) and electronic databases has fundamentally changed the way design and project management is done.

The articles in this issue of Pittsburgh Engineer will explore how local firms are currently using CAD (Computer Aided Design), CAFM (Computer Aided Facilities Management), Civil Design software, GIS (Geographic Information Systems), and 3D Visualization applications. The following is a brief background on some of these technologies.

A brief history of CAD and 3D Tools

One of the first "graphic" applications was developed by the US Air Force in the mid 1950's. The system was developed at Massachusetts Institute of Technology's Lincoln Laboratory and was the first major real-time, computer-based command and control system. Designed as a new air defense system to protect the United States from long-range bombers and other weapons, the SAGE system sent information from geographically dispersed radars over telephone lines and gathered it at a central location for processing by a newly designed, large-scale digital computer. As the system evolved, SAGE broke new ground in radar, communications, computer, information display, and computer programming technologies.

The Pittsburgh region has connections to the early work on algorithms for Computer Aided Design programs through work produced by Prof. Charles Eastman at Carnegie Mellon University. Eastman developed simple algorithms to display patterns of lines at first in two dimensions, and then in three dimensions. He developed the Building Description System which is a library of several hundred thousands architectural elements, which can be assembled and drawn on screen into a complete design concept.

Commercial CAD applications first appeared in the early 1980's. In 1982 powerful mini computers began to appear at (relatively) low costs. The affordability of hardware was a major step forward and by 1984 CAD technology was competitive with traditional methods of drawing. Later in the decade, basic 3D tools began to appear. Not only aircraft were designed using computers, now it was possible to economically design saucepans and other domestic products with complex 3D shapes using a computer.

The early 1990s saw even lower hardware costs which allowed CAD applications to become commonplace in many architectural and engineering firms. Throughout the 1990s, CAD programs evolved, becoming much more sophisticated. Many will recall 1993 - the remarkable year that the first Window's based CAD platform was released. It required 8 MB RAM and 34 MB hard drive space for complete installation (amazing!). CAD programs began to "talk" to other applications via SQL (structured query language) and interfaces were established allowing links between CAD and databases. Advanced rendering and modeling applications also appeared in many firms. In the mid-90s rendering programs enabled CAD users to visualize their work like never before. High-end rendering and animation packages allowed users to describe the shape and intensity of light energy distribution from a light source, ray tracing, natural light according to location and orientation of objects.

In the new millennium, many CAD programs are being sold on the Internet, most have a set of Web-based tools, and sites that provide designers, engineers, and architects with a centralized online community and resources that are used by many. CAD programs continue to integrate with and enhance the functions of other applications like those highlighted in the ensuing articles.

Geographic Information Systems

Geographic Information Systems (GIS) are computerized systems for the storage, retrieval, manipulation, analysis, and display of geographically referenced data. Since they can include physical, biological, cultural, demographic, or economic information, they are valuable tools in the natural, social, medical, and engineering sciences, as well as in business and planning. GIS software, data, and services are a $2 billion per year high technology industry and are believed to be growing at about 20 percent each year.

Although its antecedents go back hundreds of years in the fields of cartography and mapping, GIS is a young field. GIS as such began in the 1950s and 1960s and were used primarily in the public sector. The City of Pittsburgh and Allegheny County were among the pioneers in GIS development for the public sector. In the 1970s and 1980s a vigorous GIS industry developed with ties to many industries.

Today, GIS products are poised for even greater growth. Innovations in computer technology allow sophisticated GIS operations to be performed in the field on a personal

digital assistant (PDA), on desktops, and throughout the enterprise. Faster and cheaper computers, network processing, electronic data publishing, and easier-to-use tools are fueling rapid growth in the desktop arena. Private businesses are adopting GIS technology as a decision support tool. And with the introduction of live mapping applications to the Web, anyone with a computer has access to the benefits of GIS technology.

Computer Aided Facilities Management

Business and Facilities Management (today known as Infrastructure Management) has always been a complex activity but with the introduction of computers things have become a lot easier. A classic example of this is CAFM (Computer-Aided Facility Management). CAFM can bring about a remarkable change in an organization.

To understand the role computers can play in facility management and to appreciate the change it can bring about in the same, it is useful to first understand the meaning of facility management.

"Facility Management is the practice of coordinating the physical workplace with the people and work of the organization by integrating the principles of business administration, architecture, and the behavioral and engineering sciences". (IFMA, World Workplace)

Computer Aided Facility Management applies the concept of Facility Management and brings it alive by recording and tracking facility management related activities through the use of CAD technology. CAFM systems provide a database of facility related information linked to digital floor plans, giving the facility manager the tools to track and report on facility information. Facility Management information such as assets and work requests are recorded and tracked in drawing "layers" over the CAD drawing file. This information is linked together in a database for ease of data entry and retrieval.

Typically, CAFM systems track data such as

- Building and real estate inventory
- Space characteristics and usage
- Square footage calculations
- Departmental occupancy
- Employee information
- Furniture and equipment assets
- LAN, IT and telecom and life safety data

Therefore, an effective CAFM system provides the following tools:

- Space management
- Move planning
- Strategic planning
- Building operations management
- Help desk / work order system
- Preventive maintenance
- Asset management
- Life safety monitoring
- Disaster recovery planning

The primary benefits of CAFM can be grouped into three major categories. They are savings in facility management staff time, improvements in the delivery of facility management services, and improvements in organizational efficiency. CAFM has all the ingredients to keep businesses well oiled and running smoothly. This translates into improved efficiency for the organization. These benefits, though sometimes difficult to quantify, can result in substantial cost savings.

Conclusion

The invention and development of these tools over the past 25 years has undoubtedly changed the way architects and engineers design and manage projects. Some may argue that these automated technologies have negatively affected the designs of those who use them. Others argue that information and options provided to the designers and clients help enhance the project's outcome and make project management much more efficient. There is no doubt that these tools have enabled many to make better and more informed decisions about their projects.

Biography of Kristen Kurland

Kristen Kurland holds a joint faculty appointment at Carnegie Mellon University's H. John Heinz School of Public Policy and Management and School of Architecture. Her focus at CMU includes technologies in the fields of Computer Aided Design (CAD), Computer Aided Facilities Management (CAFM) and Geographical Information Systems (GIS). Kristen works closely with the School of Architecture's Urban Laboratory and Heinz School Policy students on Urban Sustainability issues.

In addition to her full time position at CMU, she is the president of a local consulting firm that has implemented CAD, CAFM, and GIS programs in numerous organizations since 1989. Her clients include architects, engineers, hospitals, universities, corporations, as well as local, state and federal government.

She is also the author and instructor for Keystone Learning Systems' AutoCAD and 3D Studio training books and video tapes. She has written numerous manuals for CAD and CAFM software programs, and is a co-author of Heinz School's gisTUTORIAL learning series. Ms. Kurland received the 1998, 2000, and 2003 Excellence in Education award from ARCHIBUS, Inc. for her teaching programs in the community and at Carnegie Mellon.

Civil Engineering Software HELPS Achieve NEAR-Real-Time Revision and Re-permitting

David A. Hornicak, P.E.
Burt Hill Kosar Rittelmann Associates

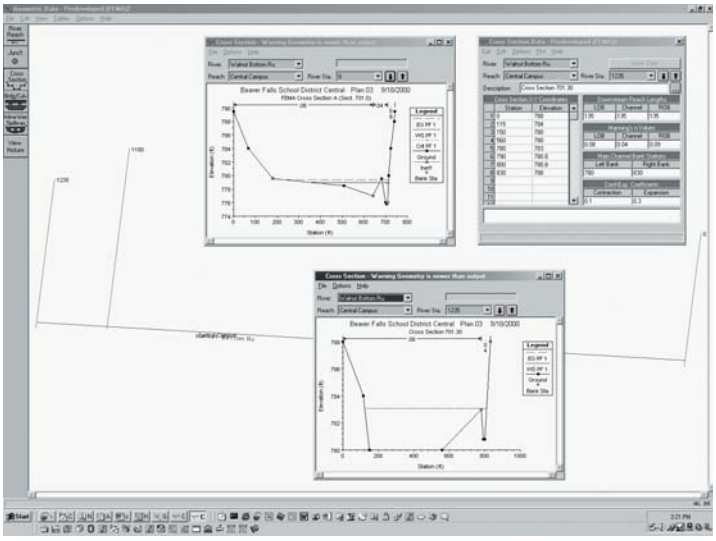
Civil engineers have routinely relied on software tools to perform the multitude of analyses and calculations required on a building project. Some tools are now finding new applications. Equipped with fast, powerful laptops, civil engineers are using design software in marketing presentations and, in the early design stages, to interact with clients to pin down project details. More and more, contractors and regulators are using the same or compatible software to streamline information exchange, reduce data transfer errors and cut the time required to revise and re-permit projects.

This article reviews some powerful civil engineering design packages and innovative ways to use them.

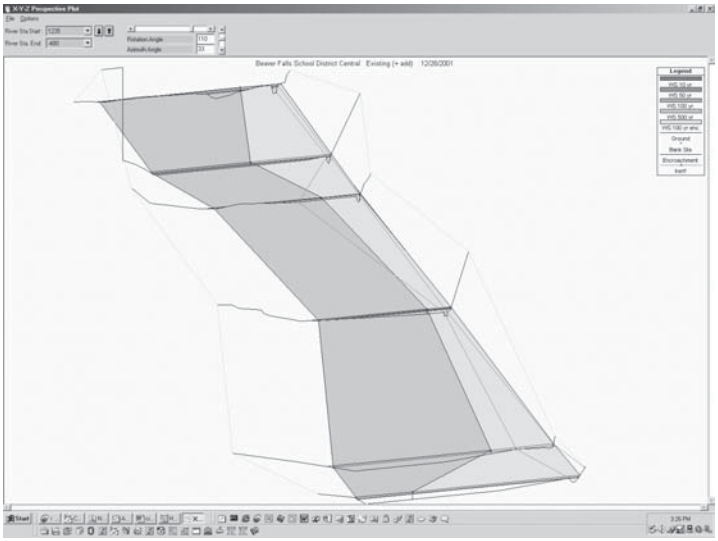
PowerPoint and Photoshop are standard tools in developing "knock 'em dead" marketing presentations. But digital design software such as **GeoPak** can create vivid three-dimensional views of a proposed project under existing conditions and display various development options. The software provides a wide range of design tools that encompass earthwork, drainage, and roadway layout. Its primary advantage is that it enables the designer and client early in the process to play out different scenarios and immediately see their implications for the scope of work and project costs.

One of the major environmental concerns in civil design is the encroachment or obstruction of watercourses or bodies of water. **HEC-RAS** (Hydrologic Engineering Center – River Analysis System), developed according to US Army Corps of Engineers specifications, provides a hydrological and hydraulic approach to calculating the hydraulic impacts, e.g., water surface elevations, velocities, flood limits, of a project on a watercourse.

Many state departments of environmental protection and other government agencies use HEC-RAS to review projects for issuance of watercourse encroachment permits. The Pennsylvania Department of Environmental Protection and consultants for the Federal Emergency Management Agency are among them. A designer and regulatory reviewer who have the same software can exchange and discuss analytical files, including input data, computational results, cross sections and profiles by email, shaving days off the review process. Reducing the time between data input and regulatory approval from weeks to a few hours is critical: idle equipment and crews cost the client money.



Typical Data Entry Menus Incorporated within HECRAS Software. Information can be Entered and Modified in a Format that can be Shared by Regulatory Agencies in the Review Process

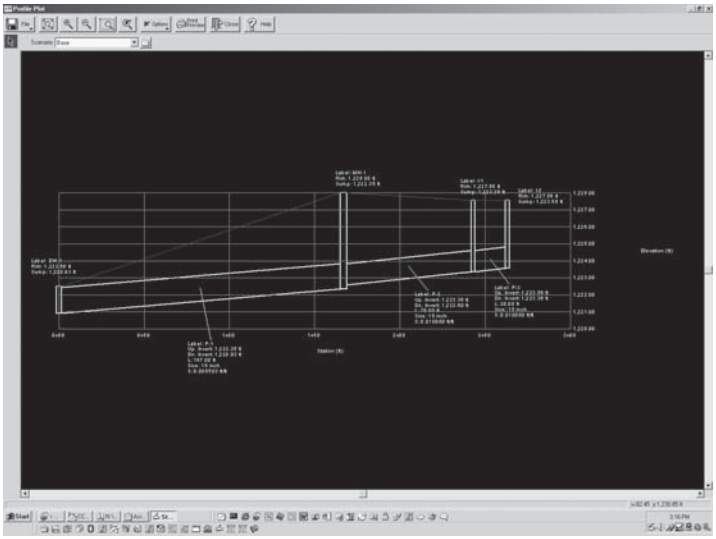


X-Y-Z Perspective Plot of Stream Channel using HEC-RAS Program Determining Flood Encroachment Limits

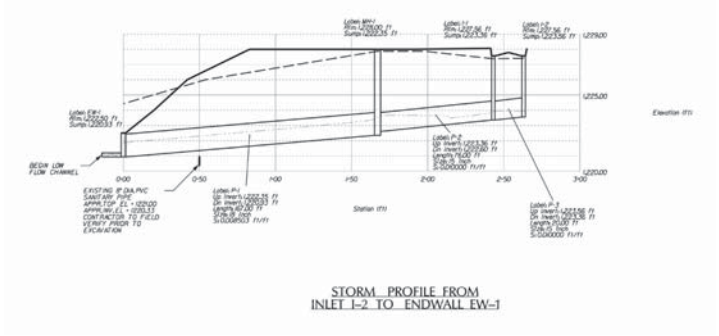
StormCad, a software design tool developed by Haestad Methods, is one of many analytical software applications that enable the civil engineer to quickly complete the necessary layout, design, and presentation of a stormwater conveyance system. It stores hydrologic and hydraulic variables such as watershed areas, runoff coefficients, pipe sizes, structure types and associated elevations for review and modification by the engineer. Once the engineer has developed the final design, the software quickly generates storm system profiles in dxf format so that they can be exported to construction documents in, for example, Microstation. Machine-to-machine transfer greatly reduces the chance of error.

Auto Turn analyzes the turning radius of vehicles of various sizes at varying speeds. The program, invoked through Microstation, digitally defines the limits of vehicle accessibility and performance in a traffic circulation situation. An example would be the ability of a 55-foot long delivery truck to access a loading dock of a certain area with adequate clearances. The user can "drive" a digitized vehicle through a site to determine clearances and see how, for example, a school bus behaves in the turnaround/dropoff area of a public school.

PondPak performs hydrological and hydraulic analysis and design of stormwater management detention facilities and outfall systems. The program helps the designer calculate the hydrologic characteristics of a watershed area and associated runoff volumes and rates under pre-developed and post-developed conditions. The program gives the engineer an analytical tool that presents information acceptable to local and state government agencies verifying compliance with stormwater run-



Schematic Profile of Storm Water Conveyance System Produced by Storm CAD Program



Final Construction Profile Produced by MicroStation Utilizing the Imported Schematic Profile Developed by the StormCAD Program

off management ordinances.

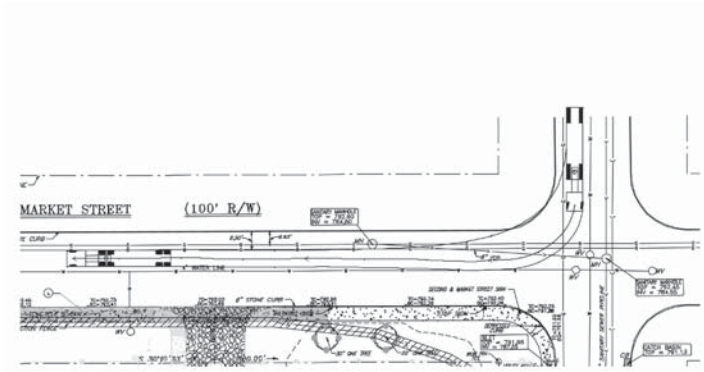
Although **GeoPak** was originally developed for roadway layout, it can be used to calculate earthwork quantities for other kinds of projects. The program analyzes the existing and proposed topography and tells how much cut and fill will be required for a project. It has proven highly effective on sites as large as 200 acres.

One project, for example, called for an underground retention tank eight feet in diameter. When construction began, the contractor discovered extensive buried foundations that limited the excavation depth to four feet. The survey crew on site, equipped with PondPak, entered data reflecting actual site conditions into the software, emailed the file to the engineer, who redesigned the retention tank, implemented the changes throughout the rest of the project documents and submitted revised documents to the regulator in hours, instead of days or weeks. The client saved about $75,000.

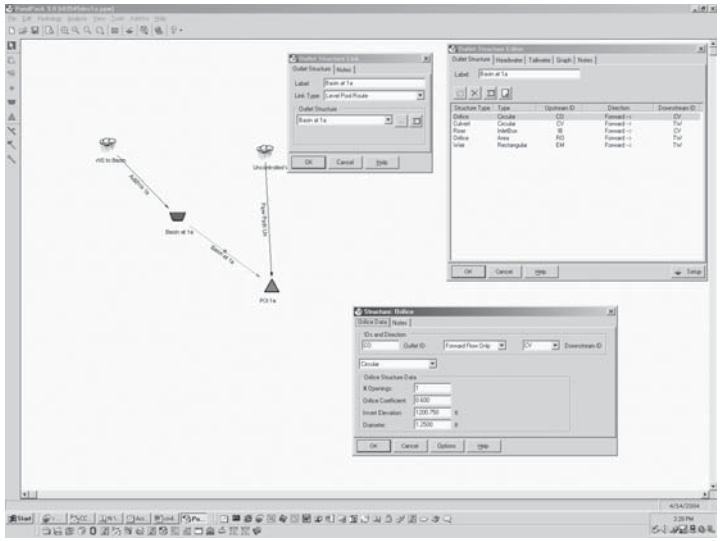
In another project, contaminated soils on the site where an elementary school playfield and competition baseball field were to be built required three sediment ponds to collect runoff during construction. Once construction was underway, the contractor found a way to consolidate the runoff into one pond. With PondPak the engineers revised the design documents and emailed them to the Department of Environmental Protection for re-permitting, again within hours, saving the school district about $300,000.

These technological advances come with some caveats. New software packages that make it possible to revise documents and deliver them to regulators, the client and contractors in almost real time may raise new liability issues in an already litigation-prone industry. With large volumes of information moving among project participants, it may prove difficult to track who is accountable for an error, omission or a wrong decision.

Technology is no substitute for an engineer's judgment. It's tempting for a design professional to become dependent on fast, high-power software to solve problems. But an engineer must always have the opportunity to apply creativity, intuition and knowledge gained from experience to the problem at hand.



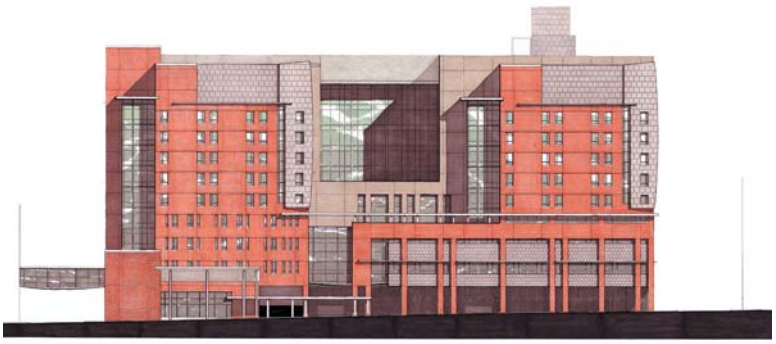
Typical AutoTurn Graphic Product Illustrating Turning Radius Limits for Vehicles along a Thoroughfare



Typical Data Entry Menus Incorporated within PondPak Software. Information can be Entered and Modified in a User Friendly Environment

Insight into Architectural Design

By Louis D. Astorino, FAIA
Chairman and CEO of Astorino



Before:
Prior to the incorporation of the ZMET research in the Deep Design Process, the initial design for Children's Hospital was a contextual study that fit within the community. With traditional uses of brick, stone and darker hues, the design blended seamlessly within its Lawrenceville neighborhood.

Traditionally, architects achieve great design through ideas that support established, relevant goals. Design elements are selected based upon the design team's experience, as well as client needs assessments, interviews and surveys conducted during predesign. While these planning tools offer insights as a starting point for determining necessary physical attributes, they do not enable the architect to connect with the end users on a profound emotional, intellectual or experiential level.

Achieving this deep level of insightful understanding about the user experience became our mission. To find the answers we needed, we turned to Harvard University Professor Dr. Gerald Zaltman. The end result is a new approach to architectural design.

Dr. Zaltman, one of the nation's top-ranked marketing scholars, has been researching subconscious thought for decades. His research proves that people think and communicate in complex ways that traditional methods do not capture. In fact, research indicates that because 95 percent of human thought is unconscious, traditional verbal interviews only reveal five percent of a person's true meaning.

In order to extract information from the subconscious, Dr. Zaltman developed the Zaltman Metaphor Elicitation Process (ZMET) process. ZMET is based on social and biological sciences, and digs deeper than traditional methods of surveys and focus groups. Designed to get unconscious thoughts to the surface, ZMET elicits inner thoughts by listening to the metaphors people use when being interviewed by researchers.

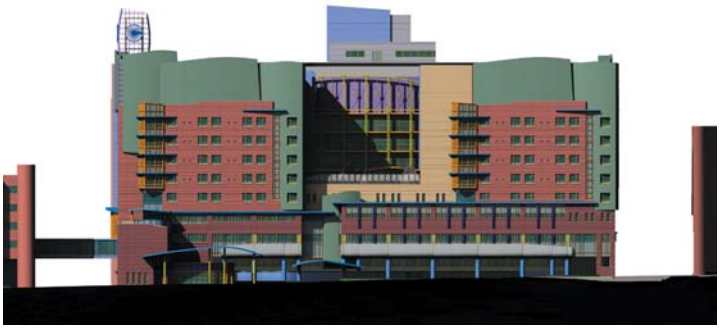
The whole technique is based on visual feelings, and architecture is such a visual art that the alliance is logical. This revelation forever changed the way Astorino provides architectural design services.

Never before used in the field of architecture, ZMET allowed our design team to learn from clients what buildings are like from the users' perspective and their vision for improvements. Then we developed a design filter that could organize and prioritize the information provided by the ZMET analysis. This unique process, patented by Astorino, combines ZMET with a design filter.

The need for a non-traditional visualization technique was the catalyst for the inimitable practice. Central to Astorino's unique predesign process is the integration of the ZMET process, which together allow architects to translate the thoughts and feelings of users, staff and owners.

When the Children's Hospital of Pittsburgh commissioned Astorino to design its new 1.45 million-square-foot facility, we quickly realized that the ZMET process would help obtain knowledge, needs and vision from those who will use the facility on a daily basis. This was the first time ZMET was put into practice in the field of architecture.

Following the completion of a Master Plan, Astorino began working closely with Children's Hospital to develop a preliminary design of the hospital. A group of 30 people — patients, families, medical staff and administrators — participated in this process. The group was asked to prepare for a two-hour interview by thinking about their experiences in the hospital and what the "ultimate" experience should be like. Each person was asked to bring to the interview six to eight pictures that express feeling about their experiences in Children's Hospital.



After:
While not yet final, current designs for the hospital are introducing deep, rich colors that are not seen typically on buildings in the region. The transformative process of healing is reinforced through elements such as a water feature and kinetic sculpture at the front entrance. Colors, forms and shapes illustrate a building that is alive and dynamic. (As pictured on the cover.)

ZMET researchers conducted individual interviews with each of the 30 participants and several common themes surfaced. On a fundamental and metaphoric level, feelings about the ideal hospital emerged as a transformative experience, providing a "sense of renewal," as one employee noted.

To that end, the refiltering process produced unique design solutions that are incorporated throughout the hospital. The building's exterior communicates that Children's Hospital of Pittsburgh is a facility that is dynamic and alive. Water features and a kinetic sculpture at the front entrance provide movement and appeal to all senses. Upon entering the hospital, patients, visitors and staff will travel through the main "Transformation Corridor," which expresses the evolution of healing through design elements suggestive of change or transformation.

Other design solutions were prioritized based on the group's desires for Control, Energy and Connection.

- Control: patients', families' and hospital staffs' need for control over their life and environment
- Energy: the need for energy from all sources to give people the strength and hope they need to make it through their hospital journey, whether as patient, parent, staff or administrator.
- Connection: the need to connect with the "inside" and "outside" world.

Common to all hospital users, was a need to recharge or rejuvenate. Referred to as "Energy" this

component has led to design solutions that include more lounges for family and staff, a fitness center and the Healing Garden — a natural extension of the enclosed atrium providing the restorative powers of nature for children and their families.

Control was more clearly defined as a need for personal space, including private patient rooms, separations for privacy/family areas, and fabrics and colors that are more homelike should take precedence over some other design options.

In response to the domain of Connection, and its corresponding dimension of "escaping" through color, specific color palettes were introduced. Based on deeply held thoughts that color contributes to the healing process, designers incorporated Grass Green, Robin's Egg Blue and Sunshine Yellow into both the interior and exterior of the hospital.

The end result is a design for Children's Hospital that contributes to shaping an experience of transformation, as desired by both the healers and the healed.

Astorino's success with this unique process at Children's Hospital has led to new and exciting projects. Recently, our firm was hired as a consultant to conduct the Deep Design Process for the design of the new Riley Children's Hospital, Indianapolis, IN.

Beyond healthcare, this process has proven successful in other types of facilities, from schools, office buildings and sports venues. For instance, Astorino's residential group has found great success using the technique to learn about and incorporate the client's lifestyle, culture and personality into the design of their home.

For more information about this exciting practice, contact Christine Astorino Del Sole at 1-800-518-0464 or marketing@ astorino.com.

Better Client Management for Facilities and Physical Assets

By John Palmer, The Design Alliance Architects

As the business environment continues to evolve, becoming faster and more competitive, most companies are looking for new ways to manage their workplace. One approach to this is through facilities management services.

In addition to our architectural and interior design services, facilities management has become an integral part of our client service program at The Design Alliance Architects. Our approach to facilities management is simple: provide clients with the power of information so that they can efficiently manage their facilities. Specifically, we enable our clients to use Computer Aided Facility Management (CAFM) software. CAFM programs are used as a tool for controlling facility data by assisting a company in managing the people and work of the organization within their physical space.

We provide our CAFM service by becoming an extension of each client we serve. Typically, this means implementing a client's CAFM system and then educating their staff on how to use its functions per the specific needs of the organization. This allows a company to maintain control over their facility, while we both extend their existing abilities and fill any voids in what they have in-house. We can then leave the control of the system and its information in the client's hands or, should it be required, we would continue to update the information on a regular basis.

CAFM, integrated with AutoCAD floor plans allows our clients to:

Plan and manage space — Companies can easily track the square footage occupied by each of its departments for an electronic inventory of the facility. This information can be automatically updated in the database when changes are made to the drawings.

Manage furniture and accessories — CAFM enables the client to track furniture, artwork and other assets that are in use and in inventory, providing reports based upon the cost of assets, depreciation and churn rates and planned moves.

Manage telecommunications and cabling — A living inventory of a client's entire telecommunications infrastructure as well as connectivity information can be produced and maintained, in order to more easily troubleshoot problems and move employees with minimal disruption.

Manage human resource information — Can allow Human Resource departments to manage employee data/information including location, department, telephone, photography, records, etc.

Manage building operations — For clients who own and manage an entire facility, document engineering systems, repair work, employee and/or contractor scheduling and supply inventory is controlled through CAFM, reducing operating costs and streamlining facilities functions.

Retrieve information quickly and easily — By printing existing reports or creating queries for specific information, their facility management department can provide critical data to other department managers within the organization.

ATTENTION GOLFERS!
RESERVE EARLY FOR THIS YEAR'S GOLF OUTING

MONDAY, AUGUST 2, 2004

Sewickley Heights Golf Club and Allegheny Country Club Sewickley, Pennsylvania

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA
ANNUAL GOLF OUTING

We are pleased to announce the return of the ESWP Annual Golf Outing to the hills of Sewickley. Join friends and colleagues for an enjoyable day of golf and fun at two of Pittsburgh's premiere private golf clubs. Dinner and the Awards Presentation will take place at Sewickley Heights Golf Club, but space is limited. More than 200 golfers enjoyed the event last year, so do not delay in making your reservations for this year's event. With team and individual prizes awarded for golf, as well as door prizes presented in a raffle, most everyone is a winner!

AGENDA:

11:00am Practice Range Opens
11:00am Luncheon Buffet
12:30pm Shotgun Start – Sewickley Heights G. C.
12:15pm Shotgun Start – Allegheny Country Club
7:00pm Dinner

Registration fee include these benefits:

- Luncheon Buffet
- Driving Range Usage
- Local Celebrity Awards Presentation
- Golfers Entry in the Raffle Drawing
- Dinner
- Greens Fees
- Golf Cart
- Souvenir Gift Pack

Cost is $250 per player. Non-golfers can still be a part of the fun, cost is $40 per person for the dinner only.
Call 412-261-0710 ext. 16 to register.

3D Software for Design, Presentations and Marketing

By Walter Tien, The Design Alliance Architects

Architectural design has taken on a new dimension in the last several years with the advent of desktop 3D modeling capabilities. Bringing this technology to the workstation has given architectural firms, regardless of size, the ability to articulate a client's, or potential client's, visions in a powerful and detailed manner.

The Design Alliance Architects, with our mid-sized firm of architects, interior designers and facilities managers located in downtown Pittsburgh, features a specialized group of architects who use 3D modeling tools for architectural design as well as the support of our marketing services. Client presentations have become a more interactive and exciting experience, by taking simple design concepts and bringing them to life on screen or paper.

Creating a physical model was once a time-intensive job, taking days for an architectural designer to complete. Now, using existing floor plans, elevations and sections, a fully 3 dimensional electronic model can be completed within a matter of hours. At The Design Alliance Architects, we use a host of software resources to accomplish this work, which include Autodesk Architectural Desktop R3.3, Autodesk Viz R4, and Adobe Photoshop CS. Each program plays an integral role in the development of a 3D model.

Architectural Desktop is used as our primary tool for creating the basis structure of a 3D model. The program has the ability to reference existing 2D CAD drawings, and as changes are made to during the design and documentation process, the changes are also automatically coordinated with the 3D files. What is produced from this program is a wireframe model that is very similar to wire framing required for a physical model.

This developed wireframe model is then imported into Autodesk Viz. Viz is used to apply materials, simulate lighting and generate the final rendered models. The Viz program allows the designers to study different architectural finishes and lighting in a more realistic environment. Architects and interior designers can then easily present a variety of solutions in client presentations. Viz also allows our firm to choose between still image renderings, or to apply motion throughout or around the model, presenting our clients with a better perception of size or depth.

We also use the Adobe Photoshop CS program to enhance the models by creating texture maps. These maps are typically applied to the 3D wireframe model and used by our interior design staff to study finish selections. Photoshop is also utilized after the completion of a model to composite rendered elements. For example, a 3D rendered building can be inserted into an existing site photograph, giving the client an even closer look at the possibilities for their project within its context. With the opportunity to view the model from any angle, 3D modeling has proven to be far more flexible as compared to our previous hand-created capabilities, giving us the ability to show our clients a dramatic full color and often times, animated glimpse at their concept.

Our firm has received an overwhelmingly positive response from our clients in regards to our use of 3D modeling technology. We have not only been able to utilize a visually superior end product to detail and study designs, finishes and lighting, but have often provided our clients with a fundraising tool, when needed, to secure support from various resources. In our experience, we have found that the highly technical and interactive nature of a 3D rendering or animation gives a sense of security to potential clients and project donors that the design is well established and attainable.

Master Builder's Association Board Room

Hot Metal Grille, South Side

Continental Competition for North Shore

Mapping the Future With Geo-Spatial Information Technology

By Robert F. Austin, Ph.D.
Director of Business Development GIT
Michael Baker Jr., Inc.

By Anna Robertson
Project Manager
Michael Baker Jr., Inc.

Introduction

The U.S. Department of Labor recently identified geo-spatial technology as one of the most important emerging and evolving fields of science and industry. Geographic Information System (GIS) technology combines the power of computer-assisted drafting and the intelligence of a digital database with information about geographic location, topography and network topology. Geo-Spatial Information Technology (GIT) is the term used to describe the tools and data that provide geo-spatial intelligence and solve geo-spatial problems using GIS and related tools. Entities from both the private and public sectors are maximizing their information infrastructure investments by implementing these geo-spatial tools. The following demonstrates how some of these companies and agencies are mapping their futures with geo-spatial information technologies.

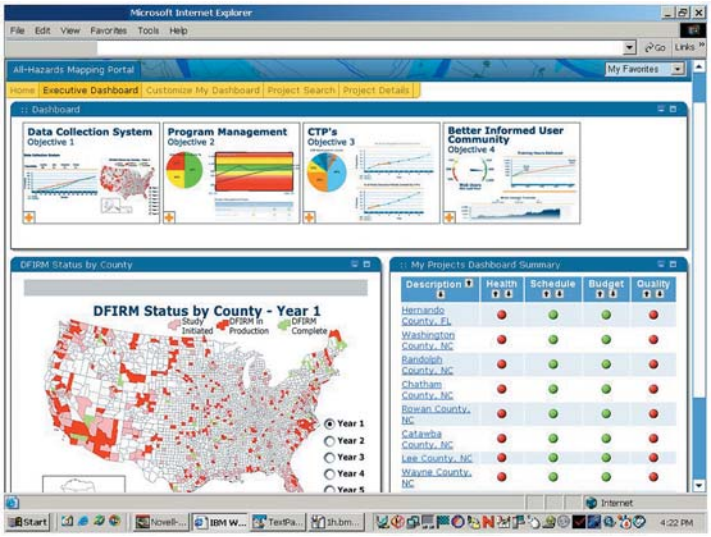
Federal Emergency Management Agency (FEMA)

The Department of Homeland Security's Federal Emergency Management Agency (FEMA) has recently embarked upon a five-year program to modernize its flood mapping system. The demands of this effort include developing, planning, managing, implementing, and monitoring the Multi-Hazard Flood Map Modernization (MHFMM) Program for flood hazard mitigation across the United States and its territories A daunting challenge, but one that will benefit from the advancements in GIT.

A Baker "Mapping On Demand" (MOD) team will help FEMA to work with state, local and other federal partners to develop digital flood and multi-hazard data for the entire United States, including the establishment of 10 Regional Management Centers across the country to manage and monitor flood studies locally and provide support to FEMA's 10 regional offices. The intention of the MOD is to facilitate public access to Digital Flood Insurance Rate Maps (DFIRMs) through an Internet web portal. The program also has a component designed to expedite DFRIM production through decentralization. FEMA benefits from the streamlining of map production and delivery. The geo-spatial data collection and delivery system will be fully developed within 90 days after the contract commences.

Virtual Pittsburgh

In recent years, three-dimensional (3D) modeling has become more prevalent in developing and supporting internal engineering and architecture requirements, including the ability to generate design drawings directly from 3D models. All plans, sections, profiles and similar documents are "cut" from a model and placed on sheets that are plotted to create the 3D image. Because all discipline drawings come from the same model, design errors and discrepancies are minimized. Compared with two-dimensional drafting, a typical 3D project streamlines the design process and reduces the total amount of resources needed to complete projects.



Example screen from newly-developed web-based, All-Hazard Mapping Portal

The "Virtual Pittsburgh" project (a *virtual city and master planning tool)* is an ongoing effort that has created a model of Downtown Pittsburgh using the latest 3D engineering software. Current uses for the model include planning, private land development and multi-modal transportation design.

Allegheny Power

Allegheny Power's expansive service area in southwestern Pennsylvania inherently made power transmission inventories expensive and error prone. To make inventories more cost effective and accurate, Allegheny Power developed an Electric Distribution System Field Inventory application that allowed field crews to collect geo-referenced electric distribution feature and attribute data, along with network connectivity relationships for translation into Allegheny Power's AM/FM/GIS (automated mapping/facilities management/ geographic information system). This project was one of the largest GPS/GIS field inventory and data collection efforts ever undertaken by an electric utility at that time. More than 520,000 poles, sub-transmission infrastructure and distribution facilities along 24,500-circuit-miles of Allegheny Power's 12,000-square-mile service area in West Virginia, South Central Pennsylvania and Southern Ohio were mapped in a 12-month period.

Utilizing GeoLink® GPS software, a patented Baker product that combines GPS and GIS technologies for field inventory projects, the data collected for Allegheny Power included poles (location, size, age, condition); conductors (location, size, material, phasing); equipment (transformers, reclosers, cutouts, voltage regulators); and substation fences. Subsequently, comprehensive inventory and mapping of Allegheny Power's transmission facilities has been incorporated into the system using the same technologies.

SBC Communications

During the past four years, SBC Communications West Region (California and Nevada) has invested heavily in the production of high quality digital base maps and database of their regional service

area. The difficulties in producing a digital landbase for such a large area were compounded by having to integrate newly acquired data with legacy systems. The initial business objectives of landbase investment included referencing customer access lines, creating a seamless spatial database to allow data flows with legacy systems, and introducing a mechanism to manage a dynamic update environment reflecting the population growth in the region.

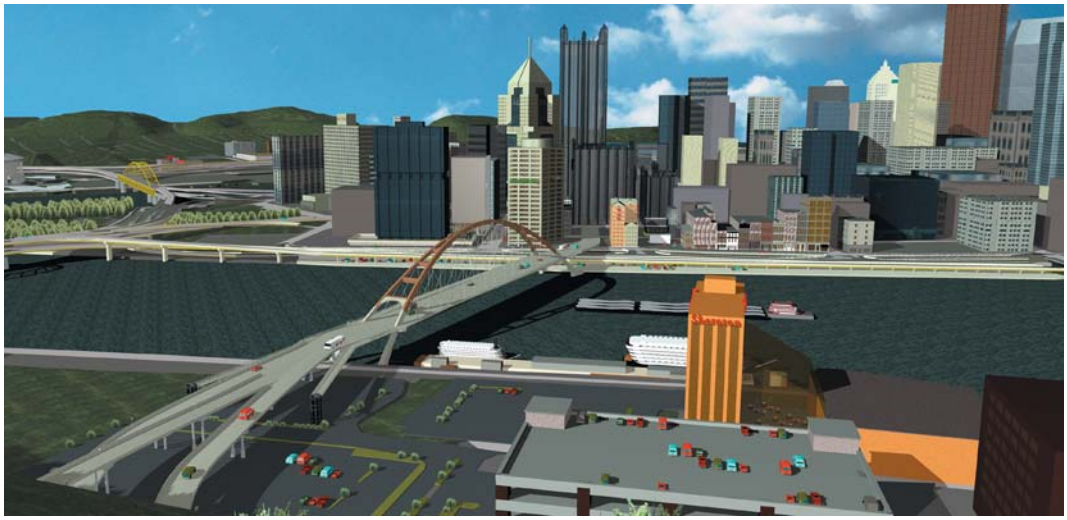
The process of building this digital landbase included:

1) Acquiring vector data files from US Bureau of the Census
2) Digitizing SBC engineering wire center boundaries
3) Adjusting feature centerlines and cartographic class features to orthophotography
4) Adding new cartographic features
5) Digitizing telecom class objects (for example, central office, exchange, district, rate areas, legal)
6) Adjusting governmental boundaries
7) Generating reference grids and telecom facilities grid
8) Introducing public land survey system (PLSS) data
9) Exporting data to other platforms for engineering design uses

Multiple users have adopted the landbase within SBC and it has defined a master source record adopted by the California Public Utility Commission for service area delineation, making SBC's investment rewarding for both internal and external users.

Harris County Toll Road Authority

The Harris County Toll Road Authority (HCTRA) located in Houston, Texas, needed to convert 30,000 engineering drawings that included information about lighting, signage, storm sewers, pavement edges and utilities. By linking the drawing system to the digitized features, a single click drawing access system was created using a GIS interface. Sign inventories and condition assessments for 6,000 signs were performed by photographing these assets and linking them to the GIS. Real-time GPS tracking has been integrated into the GIS system in the field so that the GIS display follows drivers as they travel on the road network.



The latest in Virtual Reality applications are being used to create a complete Virtual Pittsburgh

Subsequent to the system design and implementation, a mock hazardous spill exercise with HCTRA, the Harris County Hazardous Material Response team and many other local agencies was conducted on an unopened section of the new Westpark Toll Road. The HCTRA Incident Management department operates a mobile control center in the form of a trailer equipped with power generation, air conditioning and computer workstations capabilities. The drill consisted of overturning an 18-wheeler in the eastbound lanes, with barrels of colored water and dry ice simulating a chemical spill. Three other vehicles were placed in the westbound lanes simulating an accident adjacent to the overturned truck. The focus of the demonstration was to improve communication between the different agencies and to implement recent technological innovations.

In this exercise, GIS was used to inform the HAZMAT team of an underground storm sewer and provide the direction of flow and the location of outfall for that piping system. The HAZMAT team then blocked the inlet and focused on cleanup. Because there also were simulated airborne chemicals, the weather station in the incident management control trailer indicated that the wind was blowing in a northern direction at five miles per hour. The GIS was used to locate schools, churches and other public structures that would need to be evacuated in the event of a real disaster. The drill, considered a huge success, demonstrated the robustness and flexibility of mobile GIS, now viewed as a valuable tool for emergency responses of all types.

Conclusion

Geo-spatial technology is indeed one of the most dynamic fields of activity in the 21st Century. As newer data capture technologies such as Hyperspectral Imaging, LIDAR (LIght Detection And Ranging), IFSAR (Interferometric Synthetic Aperture Radar and Airborne Digital Sensors gain acceptance, increasing volumes of data will be available for processing and integration with existing geo-spatial technologies. As new paradigms evolve for geo-spatial data analysis and display, such as the FEMA MOD web portal and location-based service tools, innovations in implementation will continue. The compelling benefit of geo-spatial information is recognized not only by agencies such as the Department of Defense and Department of Homeland Security, but also by private sector enterprises such as SBC and Allegheny Power.

The key to successful implementation of geo-spatial technology solutions is in understanding the scalability of these solutions for agency and business operations. Look at the "big picture" of a company or agency's mission and identify appropriate solutions, at the appropriate levels, to increase operational efficiency and to reshape and support their day-to-day operations and strategic decision-making processes.

About Michael Baker

Michael Baker Corporation (AMEX:BKR) provides engineering and energy expertise for public and private sector clients worldwide. The firm's primary services include engineering design for the transportation and civil infrastructure markets, operation and maintenance of oil and gas production facilities, architecture, environmental services, and construction management for building and transportation projects. Since entering the GIT industry in 1979 with a focus on photogrammetric mapping and data conversion, Baker's GIT services have evolved and grown with the industry and with changing technology. Today, Baker has the unique ability to offer the wide spectrum of GIT products and service needed to take an organization or agency from a "paper mapping system" to a fully integrated enterprise geo-spatial information solution. Baker has more than 4,400 employees in over 30 offices across the United States and internationally. (www.mbakercorp.com).

Pittsburgh Teens Win the National Future City Competition

Riverview Junior/Senior High School team: Natalie French, Allison Garda, Cara Hartz Photography by Ben Zweig

Avenir is now alot closer to Alabama that you might have previously thought, especially if you were on the National Award Winning Future Cities Team, from Riverview Junior-Senior High School. *Avenir* is the name of the City of the Future designed by the Team. And, *Alabama*, (Huntsville to be precise), is home to U.S. Space Camp where the winning team will celebrate their victory later this summer.

Members of the Riverview Team, Cara Hartz, Natalie French and Allison Garda, who represented the Pittsburgh Region on February 24-25 in Washington, D.C., thought they designed a "pretty good" city, but doubted their chances in the National Competition. From across the Country, 33 Regions were represented, featuring teams from New York, Philadelphia and Chicago. The team, along with engineer mentor Bill Brooks, and teachers Brian Ludwig and Janiece Calfe, had spent a considerable amount of time designing and constructing their model and written essay since the beginning of the school year in 2003. You can only imagine the surprise, jubilation and celebration released when their winning entry was finally announced after two continuous days of competition.

After returning home, the Team was congratulated by many dignitaries and greeted with numerous media requests. The Team was honored at an ESWP Celebration Dinner held at the Pittsburgh Engineers' Building on March 3, and presented with Award plaques for members of the Team and Riverview School. At the Dinner, the Team performed their Award Winning presentation and entertained questions from the audience about their experience through out the competition.

The Pittsburgh Regional Future Cities Competition is presented by the ESWP and Carnegie Science Center, and is supported financially by our sponsors. For more information, please visit www.futurecitypittsburgh.org.