Recognizing Engineering Excellence

Spreading the word about best practices and projects as widely as possible ensures that these practices and projects will be emulated, and that even the envelope will be pushed.

Compiled by BRIAN BRENNER

The American Council of Engineering Companies of Massachusetts (ACEC/MA) Engineering Excellence Awards (EEA) competition recognizes firms and projects that have made outstanding contributions to the engineering profession and society through technical excellence and innovation. The competition pays tribute, not only to these exemplary projects and firms, but also to the engineering industry at large and its profound contribution to the built environment and society in general.

Process

Each entrant prepares a project notebook, which was reviewed by a panel of judges. For the 2007 awards, eleven projects completed the requirements. The judges narrowed the field to the top five entries, and after listening to oral presentations and interviewing the finalists, selected the winners of Gold Awards, the Platinum Award and the Grand Conceptor Award. These five finalists were eligible to compete in the national ACEC EEA Competition in Washington, D.C. Both written and oral presentations were evaluated based on:

- Original or innovative application of new or existing techniques;
- Future value to the engineering profession and perception by the public;
- Complexity of the project;
- Exceeding the owner's and the client's needs; and,
- Social, economic and sustainable design considerations.

The engine behind the process was the ACEC/MA EEA Committee. In 2007, Committee members included: Steve O'Neill, co-chair, Meridian Associates; Joel Goodmonson, co-chair, Architectural Engineers; Gene Bolinger, Weston & Sampson Engineers; Bruce Conklin, CDM; Peter Piattoni, FST; Tom Spearin, Metcalf & Eddy; Terry Tolosko, SEA Consultants; Colleen Moore, [then] ACEC/MA's Deputy Executive Director; and Jim Pappas of Stantec, the committee's liaison to the ACEC/MA Board.

The panel of judges was comprised of highly respected professionals from the architec-

tural community, the construction industry, the public sector, academia and the field of communications and public relations. The judges took on the daunting task of reviewing and evaluating all of the notebooks submitted in the competition, carefully deliberating the merits of each, selecting the five finalists who made oral presentations and ultimately selecting this years' winners from a very deep and competitive field of entrants. Judges included:

- Brian Brenner, a Professor of Practice at Tufts University Department of Civil and Environmental Engineering and American Society of Civil Engineer's Chair of Committee on the Performance of Structures during Construction.
- John Carroll, the long-standing General Manager for the Town of Norwood, considered by many to be the dean of Massachusetts Town Administrators, and member of the Massachusetts Water Resources Authority Board of Directors.
- Tony Miliote, a Project Executive with Shawmut Design and Construction, a Boston-based general contracting and construction management firm.
- Daniel Perruzzi, a principal at Margulies & Associates, an award-winning architectural and interior design firm serving the corporate, real estate and institutional communities. He is also a member of the Boston Society of Architects Board of Directors.

Finalists

After reviewing all notebooks, engaging in provocative discussion and deliberating thoughtfully, the judges narrowed the field, selecting the Silver Award winners and five finalists for the Gold, Platinum and Grand Conceptor awards. On March 7, 2007, ACEC/MA honored all of the firms that participated in the competition. The Silver Award winners were:

- *Rotch Playground Rehabilitation Project*
  Presented by: CDM
  Client: Emerson College and the Boston Parks and Recreation Department
- *HDD Utility Tunnel to Peddocks Island/Fort Andrews*
  Presented by: Environmental Partners Group
  Client: The Island Alliance
- *Revitalization of the Cape Cod Rail Trail*
  Presented by: Fay Spofford & Thorndike
  Client: Massachusetts Department of Conservation and Recreation
- *Project InfoFiscal Management and Project Tracking Data Management Systems*
  Presented by: Geonetics, Inc.
  Client: Massachusetts Highway Department
- *The Jewett City Water Pollution Control Plant Replacement Project*
  Presented by: Metcalf & Eddy, Inc.
  Client: Jewett City, Connecticut, Department of Public Utilities
- *2006 MassHighway Project Development & Design Guide*
  Presented by: Vanasse Hangen Brustlin, Inc.
  Client: Massachusetts Highway Department

The five top awards were represented by three categories: Gold, Platinum and Grand Conceptor. The Gold Award winners were:

- *Runway 14-32 and Associated Taxiways at Logan International Airport*
  Presented by: HNTB Corporation
  Client: Massport
- *Creation of an Innovative Infrastructure Management System*
  Presented by: SEA Consultants, Inc.
  Client: Town of Framingham, Massachusetts, Department of Public Works
- *Providence College Fitness Center Field & Underground Parking Garage*
  Presented by: Symmes Maini & McKee Associates and JJA Sports
  Client: Providence College

The Platinum Award winner was:

- *Overhead Coverage Systems Program, Iraq*
  Presented by: Tetra Tech
  Client: U.S. Army Corps of Engineers – Transatlantic Programs Center

And the Grand Conceptor Award winner was:

- *Meadow Creek Regional Stormwater Management Plan*
  Presented by: Nitsch Engineering, Inc.
  Client: University of Virginia

These five finalists competed among over 170 projects in the national competition. In a ceremony on May 8, 2007, in Washington, D.C., the ACEC/MA Grand Conceptor Award winner — the Meadow Creek Regional Stormwater Management Plan— won an Honor Award at the national level.

Runway 14-32 & Associated Taxiways

Presented by: HNTB CORPORATION
Client: MASSPORT

For more than 84 years, Logan International Airport has been Boston's premier center for aviation and a gateway to New England. Today, Logan is the largest passenger airport in New England, the nineteenth busiest airport in the country and thirty-seventh busiest in the world. Built in 1923, Logan is New England's largest transportation center, accommodating more than 27 million passengers annually. As an origination and destination (O&D) type facility, Logan experiences significant amounts of passengers (93 percent) that either begin or end their trip there, rather than travelers looking to transfer to another aircraft. As such, to enhance the passenger's experience in Boston, it is imperative that all airport facilities remain congestion-free.

As Logan continues to function as the region's principal long-haul and international gateway hub, passenger volume is expected to significantly increase. In light of this increase and the ever-changing New England weather, improvements were needed to reduce delays by separating smaller aircraft arrival streams from larger jet arrival streams, as well as to improve aircraft taxiing operations.

In 2005, Logan was ranked the fourth highest U.S. airport in terms of aircraft arrival delays. A significant portion of Logan's delays is caused by the reduction in operational capacity during periods of strong northwest winds. In this situation, landing and departing operations are limited to one runway. On a normal day, Logan can accommodate up to 120 aircraft operations (landings and take-offs) per hour on three runways. On days with strong northwest winds, the operational capacity is reduced to 60 operations per hour. With the addition of Runway 14-32 — a 5,000-foot bituminous concrete, uni-directional runway, along with its associated taxiways — delays will be reduced by shifting the arrival of smaller aircraft to the new runway, thus correcting the operational deficiency in the runway system and rectifying inefficiencies and bottlenecks in the airfield's taxiway system.

Complexity

This project involved numerous factors that posed challenges during design and construction. Some of these factors included sophisticated construction phasing, imposed height limitations for construction equipment adjacent to three active runways, potential interference to Federal Aviation Administration (FAA) low-visibility instrument landing systems (ILS) and extensive dynamic airport security requirements.

An analysis of the runway's CFR Part 77 clear 7:1 transitional surface to the 20:1 visual approach surfaces indicated that the "7:1 transitional" surface for Runway 32 landings was penetrated by the FAA's airport surveillance radar (ASR-9) antenna located near Governor's Island.

Additional studies indicated that there was a line-of-site issue between the air traffic control tower's (ATCT) view of the proposed Taxiway J leading onto the Runway 32 end, and cargo buildings located between the ATCT and Runway 14-32. Since site grading was restricted due to existing conditions, a different solution was needed.

weather and 20 to 30 percent annually. It will now also allow 75,000 flights per year (more than double the number today) to take off and land over the water. The benefits to the airport and surrounding community include:

- Reduction of overall delays by up to 30 percent;
- Directing more than 75,000 flights a year over Boston Harbor and away from Boston-area neighborhoods;
- Greater in-air and on-ground flexibility to air traffic controllers;
- Improvement in air quality as aircraft will spend less time idling on taxiways and circling overhead; and,
- Reduction of noise pollution for surrounding communities

Creation of an Innovative Infrastructure Management System for the Town of Framingham

Presented by: SEA CONSULTANTS, INC.
Client: TOWN OF FRAMINGHAM, MASSACHUSETTS, DEPARTMENT OF PUBLIC WORKS

A geographic information system (GIS) and a risk assessment system were developed for the Town of Framingham's Department of Public Works to prepare a town-wide Comprehensive Wastewater Management Plan (CWMP) to evaluate the town's aging sewerage system. Major tasks included GIS mapping and inventory of the entire sewer system; conditional assessment of 230 miles of sewers and fifty pumping stations; hydraulic modeling; preparation of a prioritized capital improvement plan (CIP); and development of a Work Order Management System.

As documented in the *International Infrastructure Management Manual* (published by a consortium of public and private organizations in Australia and New Zealand), risk management is utilized in the field of infrastructure asset management because it provides the context to save money by strategically identifying and prioritizing work activity and capital projects. The challenge of risk management for sanitary sewer systems is that no standardized method exists to assess risk. Therefore, to realize the benefits of risk management, this project required innovation to develop an intuitive, usable and repeatable method to assess risk in a manner consistent with its definition in the emerging field of infrastructure asset management. Since most authoritative publications in the field define risk as the product of the consequence of failure and the probability of failure, the project team based the risk assessment methodology on this principle. Consequences of failure are normally defined in a manner that reflects the values of the community and stakeholders. Examples of consequences include environmental damage, health and safety, and disruption to the community. Probability of failure can be measured for a number of failure modes including condition, age, capacity, efficiency, inflow/infiltration (I/I) and sulfide levels in a sewer system. To thoroughly assess risk with consideration to all these variables, the asset management software was configured to identify the consequences, assign weights and ratings, and establish a matrix of consequences and failure probabilities to produce a utility risk factor (URF) for each pipe, structure and pump station within the town's wastewater system. With these features built in, the software allows the user to analyze the sewer system against any of the variables that contribute to the URF as well as the overall URF score. Results of the analysis can then be viewed on a GIS map, used in reports and/or used in the software's capital planning mod-

ule to formulate budgets and prioritize when and where investments should take place.

Future Value to the Engineering Profession & Perception by the Public

Over the past century, the United States and other developed countries have made substantial investments in wastewater collection systems that have had fundamental benefits to the health and welfare of modern society. Today, however, the country faces a challenge to sustain its aging infrastructure. According to the American Water Works Association, U.S. water and wastewater systems are entering a replacement era that calls for different management techniques focused on sustaining the level of service these systems provide. The transportation industry has been dealing with similar issues for the past thirty or more years and has formulated universal standards for pavement management and bridge ratings that can be used to quantify and rate the severity of deterioration. Because of these standardized techniques, the transportation industry is able to quantify and compare the needs across the country with a uniformed approach. In comparison, the wastewater industry has only recently started to create similar methods and remains a long way from standardization.

The methodologies developed for this project may be used as a major step toward bringing standardized methods to the industry using a holistic approach that considers multiple failure modes within a framework of accepted practices of asset management. Moving toward standardization is crucial for the engineering profession since it will allow faster determination of needs and will eliminate the time-consuming process of developing new methodologies. The public stands to benefit by knowing how their system compares with others. Standardization will also enable the use of information and fee structures so that the public can better determine how well their system is being managed. Even without standardization, the residents of Framingham will benefit from this program because they now have the tools to benchmark their system over time and to see that their user fees are being put to use strategically in a way that would not have been possible without this program in place.

Complexity of the Project

The goal of this project was to develop a prioritized CIP for the entirety of Framingham's wastewater collection system. The system had received only a few upgrades over the last twenty years, and substantial reinvestment was required to return the system to an acceptable level of service. This reinvestment needed to be focused and prioritized on the most "critical and urgent needs" of the system. The CIP also needed to prioritize improvements based on ways in which the system "fails" and not solely on the age of assets. Among the ways that the wastewater collection system can fail are: excessive infiltration and inflow, high sulfide, inadequate capacity, age and inefficiency. In addition, other factors associated with each asset — such as location, use, safety, cost and regulatory compliance — needed to be factored into the CIP since they affect the consequence of failure. Prioritization would determine, for example, that an old and leaky 8-inch side street lateral sewer is in less need of rehabilitation than a thirty-year-old interceptor passing through a critical intersection with insufficient hydraulic capacity and elevated sulfide.

This project took the probability of failure (capacity, I/I, sulfide, condition, efficiency and age) and factored them against the consequence of failure (environmental impact, health and safety, cost to operate, cost to repair, loss of service, property damage, public relations, regulatory impact and disruption to community). The product of these two factors results in a URF score. This score was used to assist in developing the CIP, which encompassed over 20,000 different assets in the sewer system alone.

This project was complicated by several additional factors. The tools developed to assist in the analysis had to take into account that the various assets provide very different functions in the collection system and are of different life spans and construction/rehabilitation methods. The types of assets analyzed included all types of sewer infrastructure: gravity sewers and manholes as well as force

mains, siphons and pumping stations. All of these assets require different types of analyses, but with over 225 miles of sewer pipe and fifty pumping stations, the overall program needed to effectively compare these diverse assets to develop a single prioritized CIP. The project included the flexibility to expand the analysis to other types of assets. The tools created for this project provide the ability to assess other types of infrastructure within the community, including: water distribution systems, storm drain systems and roadway networks in order to develop a comprehensive town-wide CIP.

Lastly, as with most large comprehensive plans, the project needed to satisfy many different stakeholders. The unique difference was that the CIP developed from this tool acknowledges the requirements of the regulatory agencies: the Massachusetts Department of Environmental Protection (MADEP) and its monitoring of sewer system overflows (SSOs); the Massachusetts Water Resource Authority (MWRA) and its focus on sulfide; the planning, development and desire for smart growth and multi-use development; the need to manage the costs of a large-scale CIP; and the desire to protect open space. The formulation of the analyses tools took these factors into consideration in the development of the CIP without giving preferential attention to any single group. The analytical data generated by the asset management system took all of these factors into consideration and provided the fact-based, real-time information on which the strategic and focused CIP was based.

Exceeding Client's/Owner's Needs

The Town of Framingham's vision for this project was to transform its old, out-dated paper plan system to an electronically-based, web-enabled updatable program for its sewerage system. The town's expectations have been far exceeded by the creation of this specific asset management application. With the successful development of this tool for the municipal wastewater collection system, the town decided to expand its use to the water and stormsewer systems. The town has also seen extended use in its Department of Public Works (DPW), where field personnel routinely use the software in their daily operations. Managers, operation personnel, GIS and information technology departments are also now fully dependent on the use of the asset management system. Even the town's Financial Department (where its GASB 34 system is being set up using VUEWorks) depends on it. Now, the town's annual report can be done automatically as opposed to its current more labor-intensive manual method.

This powerful planning and management tool is vital in helping the town's DPW better manage and maintain a very large municipal infrastructure system — one of the leading challenges in many cities and towns throughout the United States. This efficiency and improved effectiveness has translated into tangible savings to the town in terms of time, dollars and labor.

Social, Economic & Sustainable Design Considerations

Wastewater collection systems are fundamental to the social and economic health and welfare of modern society. But, as these systems age and the population grows, this fundamental infrastructure is becoming increasingly vulnerable and, if left alone, could threaten our modern lifestyle. At the same time, the amount of federal money available for maintaining these systems has declined substantially, leaving utilities and local governments with a greater responsibility to sustain these systems through water fees and local taxes. *Sustain* is the key word since it implies that the system must be able to maintain a target "level of service" as determined by a number of factors, including: the number of sewer overflows per year; the number of inspections required; how inspections are performed (video, visual, etc.); length of pipe cleaned; condition ratings or URF score; capacity limits; sulfide limits; I/I limits; pump station costs; the number of unscheduled maintenance calls; regulatory compliance; the number of customer complaints; and more. The asset management program placed in Framingham is designed to track all of these factors so that progress can be measured against targeted levels of service. The risk assessment measures provide the means to weigh social and economic considerations

such as health and safety, cost to operate and environmental impact — each of which carries value to modern society. To address sustainability, the software's multi-year budget planning features are used to forecast the amount of capital expenditures required to achieve target goals. The town utilizes this information to forecast revenue needs with enough time to prepare customers for fee adjustments, implement them over time and provide information to explain how the fee structure is required for sustainability (thereby increasing the likelihood of customer understanding and support). The GIS-based VUEWorks application also helps garner public support by illustrating areas of need on a map of the town.

Providence College Fitness Center Field & Underground Parking Garage

Presented by: SYMMES MAINI & MCKEE ASSOCIATES & JJA SPORTS
Client: PROVIDENCE COLLEGE

With a land-locked urban campus and significant site constraints, Providence College urgently needed creative engineering solutions to build new athletic fields to meet demand associated with fast-growing intramural and Title 9 women's athletic programs. One of the only available sites was at a small hillside parking lot site, burdened by sharply sloping terrain, unsuitable soils and layers of underground utilities. The design solution combined half the new field atop the parking structure and half installed at grade. Opened in May 2005, this solution is the first successful project of its kind in the United States.

The design consisted of a multipurpose, synthetic turf sports field constructed partially over an on-grade condition and partially over the structured parking level. This solution required a complex structural system above the parking structure, plus an innovative, subsurface design for the field to ensure a stable, low-maintenance, long-life and cost-efficient combined facility. The key accomplishment was the design: a synthetic playing surface and all-underground support systems to create equal field performance on both the at-grade and above-deck sides. The solution involves a subsurface "transition zone" to overcome drainage, waterproofing and stability problems. Because the existing parking lot had to remain in use until the end of the spring semester, construction had to occur within a short four- to five-month schedule, further challenging the design team. Innovations included the development of structural framing and foundation systems, which responded to both environments, while at the same time preventing minor differential settlement that could potentially bring the field out of compliance with both National Collegiate Athletic Association (NCAA) and International Hockey Federation (FIH) rules.

Future Value to the Engineering Profession & Perception by the Public

The solution of an artificial turf field half on grade and half on structure is the first successful project of its kind in the United States. The details for the field system, including the multiple drainage systems at both the structure over the parking and on grade (as well as within the transition system between the two conditions), will serve as a model for similar projects in the future.

The precast form system, although conventional, provides a recent successful solution for projects in which a custom design to solve durability, erection speed and appearance issues are critical to success.

Complexity of Project

Field hockey synthetic turf fields are regulated by NCAA and FIH standards, which require that competition fields maintain a level of planarity and meet strict requirements for