

Construction Materials Engineering Testing Can Improve Value

By William C. Johnson







ods for building projects such as Integrated Project Delivery (IPD) combined with Leadership in Energy and Environmental Design (LEED), the need for more collaborative expert support for the selection and placement of building elements has become much

more critical to overall project success.

The American Institute of Architects (AIA) currently defines IPD as "a project delivery method that integrates people, systems, business structures, and practices into a process that collaboratively harnesses the talents and insights of all participants to reduce waste and optimize efficiency through all phases of design, fabrication, and construction." The IPD method contains, at a minimum, all of the following elements: continuous involvement of the owner and key designers and builders from early design through project completion; business interests aligned through shared risk/reward, including financial gain placed at risk that is dependent upon project outcomes; joint project control by owner and key designers and builders; a multiparty agreement or equal interlocking agreements; and limited liability among owner and key designers and builders.

IPD AND A QUALITY OUTCOME

IPD is becoming recognized as one of the most advanced, value-added, and value-producing delivery methods for owners to employ to improve the likelihood of a quality outcome to their major construction projects. In order for this method of design, procurement, and construction to function well, informed decisions

on materials selection need to occur early in the process. Properly executed construction materials engineering and testing (CMET) needs to be planned for early in the process to insure that schedules are kept, costs are controlled, and quality is maintained with any deviations identified and corrected in short-term horizons.

In order to support these advanced delivery methods mere materials testing is not enough. Taking some soil samples for compaction or pouring a few cylinders for concrete testing and "calling it good" is a prescription for missing major benefits associated from integrating advanced materials choice, placement, and testing procedures. By employing these advanced procedures, owners have improved schedule adherence and slashed budgets on major projects.

CASE IN POINT

As a case in point, Tweed Airport in New Haven, Connecticut had a runway project that involved a large quantity of potentially problematic unsuitable soils-dredge materials that were going to have to be removed and replaced in order for a runway expansion project to take place. Rather than remove them, they employed a soil amendment process to modify the soils' characteristics and reuse them rather than replace them. Some of the material was brought to the lab and varying percentages of amendment material were added (in this particular case cement kiln dust), and cylinders were produced of the amended soils and subsequently tested for strength. An admixture was developed that met the required strength and was approved for use by the Federal Aviation Administration and the owner, and a simple site-mixing method was developed to amend the soil in situ as it was placed in prescribed lift quantities.

The results were impressive. The original construction schedule was maintained and the budget was cut by over \$1 million. The teaming required to effect this solution far exceeded merely viewing the process as a straight testing solution. Integration with the whole design/construction team in a collaborative manner was fundamental for a successful resolution.

With the advent of LEED as an industry-wide standard for building design and performance, materials need to be carefully evaluated from both a sustainability and suitability viewpoint. Sourcing materials and fabrication of building components close to the project site, coupled with design and engineering suitability, are all part of the advanced decisionmaking process necessary for planning and constructing an advanced facility of any type.

Engaging experts who are able to assist the design team in evaluating materials choices and sourcing issues can support the achievement of LEED goals and enhance project outcomes. By teaming with advanced CMET firms, the IPD team may also benefit the construction process by having inspection services at the fabrication sites for components and systems to ensure that materials comply with design requirements prior to being shipped to the site—potentially saving time and money and improving quality. Advanced CMET firms can place steel and concrete inspectors well versed in code and testing requirement at the point of fabrication to evaluate the strength of building materials, welded joints, fill materials, and prestressed panel requirements.

Integrated Project Delivery employs a number of expert systems to speed the process, reduce errors, and improve quality. Building information modeling and other advanced design/ visualization processes give the design team new tools to move forward in a collaborative and inclusive manner. Professional CMET firms can support these processes by providing information on materials choices and construction methods, and by providing near-real-time testing results accessible to the team during construction through cutting-edge client document websites.

Some CMET firms have expert systems that track the entire materials testing process from start to finish electronically, providing near-real-time results to the IPD team through these continually updated websites. This capability provides the team with information on any deviations and corrections in prescribed performance of materials quickly, so that if adjustments are required they can be affected with minimal disruption to the schedule.

IPD AND LEAN

A number of design firms using IPD techniques are also combining these with Lean practices. Lean is based on the Toyota method of producing everything in the least-wasteway, and is centered on making obvious what adds value to the project and what is clearly waste, then seeking to reduce this waste as effectively as possible. Embracing Lean as the basis for



Electronic tracking of materials allows the team to track product performance for future projects and to provide a robust history for the owner. It also gives the team the opportunity to work with materials suppliers to affect adjustments to mix quality in near-real-time, a major advantage over most standard processes in which the results come in days later, causing major "do-overs." There have also been instances when members of design teams have had major computer crashes, but by using the client document website format were able to maintain all of their critical testing and reporting information.

As a case in point, the Louisiana State University (LSU) Tiger Stadium project had in excess of 800 piles driven in widely varying ground conditions with refusal limits being reached at a variety of depths. These ground conditions were brought on by the proximity of the project to the Mississippi River, with soft material of various depths overlaying natural stiff material beneath. The issue was that the pile-driving contractor could not predict



Open Doors for Everyone

with America's Durable Door Openers



AMERICA'S DURABLE DOOR OPENER

where refusal was going to be, so either the piles were too long or in some cases broke during installation. The solution was to livestream blow counts during installation directly to the engineers who were running pile-driving analysis, so that as the piles were being installed, adjustments could be made in real-time. This advanced field-office-team technology saved time and money and resulted in a more efficient use of field staff.

As another case in point, the City of Charlotte, North

Carolina required geotechnical, shearwave velocity profiling, construction materials testing, and special inspections services for the NASCAR Hall of Fame project. The \$107.5 million Hall of Fame began construction in April 2007 and is located adjacent to the Charlotte Convention Center between Brevard, Caldwell, and Second streets. The Hall of Fame project included the construction of an 80,000-squarefoot grand ballroom expansion to the Charlotte Convention Center and a 1,000-space parking deck.

Rigorous geotechnical investigations and shear-wave velocity profiling, along with pre-blast surveys and anticipated rock blasting and attenuation studies, were required for the project and for the adjacent NASCAR Plaza office tower, in order to evaluate the subsurface conditions and bedrock profile. The data needed to be shared with the team quickly and accurately. As part of the advanced materials testing process, an electronic deviation log was kept and shared on a continual basis with the whole design and construction team. The use of electronic communications for both the deviation itself and the remedy kept the project on track.

A TEAM EFFORT

Whether it's the NASCAR Hall of Fame, LSU, or the University of Connecticut, owners are demanding that ancillary support services for their major construction projects deliver more value and provide greater levels of collaboration to undergird the efforts of all the players. By engaging with a CMET firm well versed in providing real-time support from conceptual design through opening day, owners have the opportunity to add significant value to their process and their project. It's not just testing—it's teaming that will win the day. (

Bill Johnson is the New England client development Manager for Terracon Consultants, Inc., and is based in Manchester, NH. He is an at-large member of the APPA Board of Directors, the coordinator of *Facilities Manager's* Power Tools column, and a frequent contributor to the magazine. He can be reached at *wjohnson@terracon.com*.

Hot water temperature so accurate, it may change your beliefs about steam-side control.

The condensate control and domestic-side blending system on the Cobrex instantaneous steam water heater safely, quickly and accurately generates domestic hot water while eliminating the need for a steam control valve with low pressure steam. We put a new spin on a 60-year-old concept by using dual water temperature control valves in a unique step-down design with solenoid over-temperature protection. Technology's changing. And your invited to join.



INSTANTANEOUS STEAM WATER HEATER

- Up to 6 million Btuh
- From 20 to 120 gpm of domestic water at 140°F outlet
- Fully factory packaged
- Domestic-side temperature control valves modulate infinitely and control temperature to ± 4°F under all load conditions
- Double-wall copper and brass ASME heat exchanger
- Clean-in-place fittings
- Easy access, lighter, smaller heat exchanger with minimal pull space





www.pvi.com