These past few months have been very productive for the Utah Transportation Center. We are pleased to have Wes Cook represent the Center as the UTC Student of the Year. Mr. Cook attended the CUTC banquet at TRB and presented a paper on his research findings. We have also been very active in meeting the research objectives of the various projects that have been selected though our partnerships with the Tier 1 CAIT Consortium and the Mountain Plains Consortium.

Three projects are currently underway with the Tier 1 CAIT Consortium. These projects include an investigation into the behavior of four high-strength concrete bridge girders, innovative accelerated bridge construction joint details and asset management of UDOT inventory. The Mountain Plain Consortium has also funded three projects including the development of design guidelines for integral abutment bridges, the effects of price changes on fuel consumption and a two-stage approach for estimating a statewide truck trip table. All of these projects involve close partnership with private and state agencies. These partnerships have also enabled students to make valuable contacts that will assist them in defining their careers.

Finally, we recently celebrated the 25th anniversary of the University Transportation Center Program. This program started in 1987 with the Surface Transportation and Uniform Relocation Assistance Act that established one competitive center in each of the ten federal regions throughout the United States. This small start has resulted in countless benefits to the transportation community. Some of the milestones over the past 25 years include:

- The participation of over 10,000 graduate students and 6,000 undergraduate students in UTC-supported research.
- Over 1,500 PhD and 10,000 master’s degrees awarded.
- An excess of 9,000 seminars, symposia, and distance learning courses that involved the UTC programs.
- Over 2,500 research projects that were supported with UTC grant money.

While this is only a partial list of accomplishments that the UTC Program has been a part of, it helps put into prospective the numerous benefits of the program. Utah State University is proud to be one of the 65 universities that have received UTC grants from 1987 to 2012. The rate of return of the invested federal dollars is well in excess of 2 to 1. The center has funded students that have graduated with advanced degrees and have gone on to have very successful jobs in private, state and federal venues. We hope to continue to work with RITA and other partners to build on past success within the UTC Program for many years to come.
Accelerated Bridge Construction (ABC) Focus of Critical UTC Project

excerpt from Evaluation of Accelerated Bridge Construction (ABC)—A Forensic Analysis, UTC Spotlight, University Transportation Centers Program (April 2013)

In the latest State of the Union address, President Obama reported to the American public on the status of our national infrastructure: over 25 percent of the Nation’s 600,000 bridges are considered “structurally deficient” or “functionally obsolete.” In other words, these critical links to public safety, economic vibrancy, and quality of life are in need of replacement or repair. However, a wide array of structure types, material characteristics, ages, daily traffic volumes, and climate conditions makes bridge replacement increasingly difficult.

To combat these issues, a number of new methods have emerged to expedite bridge construction. Accelerated Bridge Construction (ABC) technologies are one of the top priorities of the Every Day Counts 2 (EDC2) initiative—a Federal Highway Administration program that encourages keeping infrastructure in a constant “state of good repair” through effective management and innovative technologies.

Unlike traditional construction that could take months to complete, ABC technologies help replace bridges more quickly and cost-effectively. EDC2 promotes three methods of ABC:

• Prefabricated Bridge Elements and Systems (PBES),
• Geosynthetic-Reinforced Soil – Integrated Bridge System (GRS-IBS), and
• Slide-In Bridge Construction.

Each of these implements a combination of state-of-the-art techniques and materials to expedite construction schedules, minimize congestion, reduce construction costs, and improve safety for construction workers and motorists.

The Utah Department of Transportation (UDOT) is considered to be a national leader of ABC adoption, with over 100 PBES bridges completed; PBES bridges are comprised of elements that are constructed offsite and assembled at their designated locations.

With so many PBES bridges in close proximity, Utah State University (USU) civil engineering professor Paul Barr, Ph.D., in partnership with Bridge Diagnostics, Inc., led several studies to assess the structural performance of the state’s ABC bridge network.

One of these studies provided Barr and his team an unprecedented test specimen. Due to a roadway rerouting, UDOT decommissioned the PBES 8th North Bridge on I-15 in Salt Lake City, Utah, after only 2 years service. This afforded USU and their collaborative research partners, Bridge Diagnostics, Inc., to use this bridge as a living laboratory to evaluate the impacts...
of real-world loading conditions and simulated stressors on precast bridge decks.

Testing such a young bridge gave USU researchers a unique opportunity to quantify the rate of structural performance decline near the beginning of the bridge’s service life.

First, they conducted extensive field tests to analyze the effects of weight and pressure on new bridges.

“We found these loads caused the bridge deck to shift unevenly near the supports due to insufficient placement of the shear pockets. This phenomenon is called noncomposite behavior,” Barr said.

“Conversely, the loading had little to no effect near the middle of the girder—the shear pockets, girder, and deck all behaved symbiotically, or displayed ‘composite behavior.’”

The bridge was decommissioned after the completion of the load tests. For the second part, Barr’s team was able to do something no research team has ever done before. His team transported two full-scale bridge sections that included five of the PBES deck panels and four girders—each over 35 feet long—to the USU Systems, Materials, and Structural Health (SMASH) laboratory for forensic testing.

“Based on our extensive performance tests, we recommended using a smaller shear pocket spacing near the supports to reduce the potential for the noncomposite behavior observed in the field,” Barr said.
Barr’s team suggested several other long-term recommendations to improve the service life of PBES bridges. One of those suggestions, Barr said, is investing in higher grade concrete used in these bridge decks. Higher grade concrete is more resistant to stressors presented by severe weather situations, continued weight stress, and layer separation.

The application of post-tensioning—or pulling bridge decks and girders together like a set of dental braces—can significantly extend a bridge’s service life, though it affects time and cost. As an alternative to post-tensioning, Barr’s team found that tying deck panels together with reinforced shear keys resulted in comparable structural performance.

As ABC implementation becomes standard practice, nationwide research—such as that conducted by USU—will be vital to ensuring proper construction and longevity of these structures.

“Accelerated Bridge Construction has been shown by many agencies to be beneficial in terms of reduced construction time, minimal traffic interruption, and in many cases, significant cost savings,” Barr said. “While there may never be a bridge that lasts forever, ABC provides the means to replace deficient structures quickly, safely, and with respect to the environment. It is the future of bridge construction.”

Dr. Paul Barr, lead researcher and professor of Civil Engineering at Utah State University, can be reached at paul.barr@usu.edu. The support of the following people is gratefully acknowledged: Marv Halling, Ph.D., professor of civil engineering at USU; and Patrick Szary, Ph.D., associate director of Rutgers’ Center for Advanced Infrastructure and Transportation (CAIT). The team also thanks Jeff Schulz of BDI, and Joshua Sletten and Cameron Kergaye of UDOT for their valued support on this project. USU is a Tier II UTC program and part of a UTC Tier I consortium led by Rutgers’ CAIT under the direction of Ali Maher, Ph.D. (mmaher@rutgers.edu).

Center Names Student of the Year—Wesley Cook

The Utah Transportation Center is pleased to announce the selection of Wesley Cook as the Student of the Year!

Wesley was raised in Las Cruces, New Mexico. In high school he excelled in cross country and choir. He received a full-ride academic scholarship to New Mexico State University (NMSU), where he participated in ASCE steel bridge competitions and worked at the NMSU Center of Transportation and Research performing bridge inspections, graduating in 2006. His experiences at NMSU solidified his desire to conduct research related to bridges.

After graduation, he worked as a consultant at Forsgren Associates, Inc. for three years. In 2010, he completed an MS in structural engineering at Utah State University, focusing his research on full-scale destructive testing of bridge sections that were constructed with an accelerated bridge construction technique (thesis).

His latest work (dissertation) determines epistemic risk of bridge failures from historical data which quantifiably defines the probability of bridge failures. This work has potential to transform vulnerability bridge assessments.

He is interested in expanding upon risk assessment with individual cause of failure probabilities, consequences, and consideration of predictors.

Mr. Cook was nominated to this year’s student of the year for his interdisciplinary research achievements and commitment to improved bridge management systems.

He is also a licensed engineer in Utah and is married with two daughters. Congratulations Wesley, on this well-deserved honor!
Center Projects in Progress

• “Bridge Response Due to Temperature Variations,” Dr. Paul J. Barr, PI. *Funded by Tier 1 CAIT at USU.*

• “Forensic Testing of Prestress Concrete Girders after Forty Years of Service,” Dr. Paul J. Barr, PI. *Funded by Tier 1 CAIT at USU.*


• “A Bicycle Network Analysis Tool for Planning Applications in Small Communities,” Dr. Anthony Chen, PI. *Funded by the Mountain-Plains Consortium.*

• “Realization of a Coarse Position Verification System for an Automated Highway System,” Dr. Ryan Gerdes, PI. *Funded by the Mountain-Plains Consortium.*

• “Real-Time Traffic Management to Maximize Throughput of Automated Vehicles,” Dr. Tam Chentem, PI. *Funded by the Mountain-Plains Consortium.*

• “Forensic Testing of Prestressed Girders,” Dr. Paul J. Barr, PI. *Funded by Tier 1 CAIT at USU.*

• “Accelerated Bridge Construction Deck Testing,” Dr. Marv W. Halling, PI. *Funded by Tier 1 CAIT at USU.*

• “Sign Management,” Dr. Kevin Heaslip, PI. *Funded by Tier 1 CAIT at USU.*

• “A Two-Stage Approach for Estimating a Statewide Truck Trip Table,” Dr. Anthony Chen, PI. *Funded by the Mountain-Plains Consortium.*


• “Develop Design Guidelines for Integral Abutment Bridges,” Dr. Paul J. Barr, PI. *Funded by the Mountain-Plains Consortium.*