Concrete Materials for Bridges Program at the Concrete Bridge Engineering Institute

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As part of a series of articles on the Concrete Bridge Engineering Institute (CBEI), an article in the Fall 2022 issue of *ASPIRE®* explored the key components of CBEI and presented the institute's Transportation Pooled Fund (TPF) study. This article presents information about the Concrete Materials for Bridges training program and highlights CBEI's collaboration with the National Concrete Bridge Council (NCBC).

Concrete Materials for Bridges

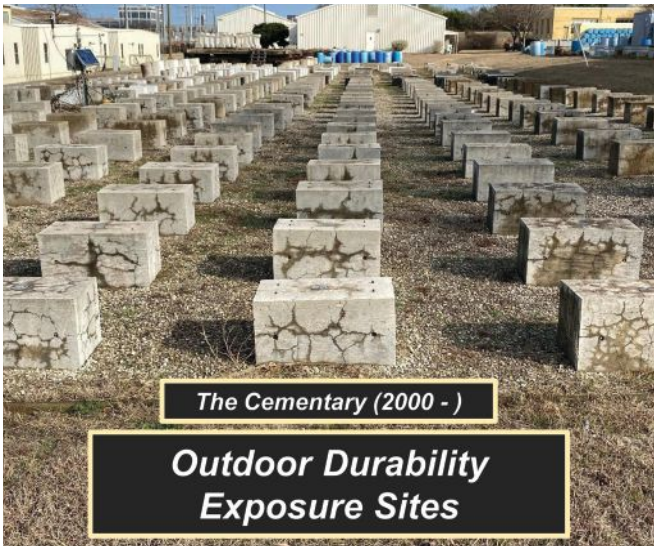
Previous articles in this series discussed the three "pillars of learning"—concrete materials, bridge deck construction inspection, and post-tensioning—of CBEI's initial training and certification programs. The first course, which is scheduled to be offered later this year, is the Concrete Materials for Bridges training program.

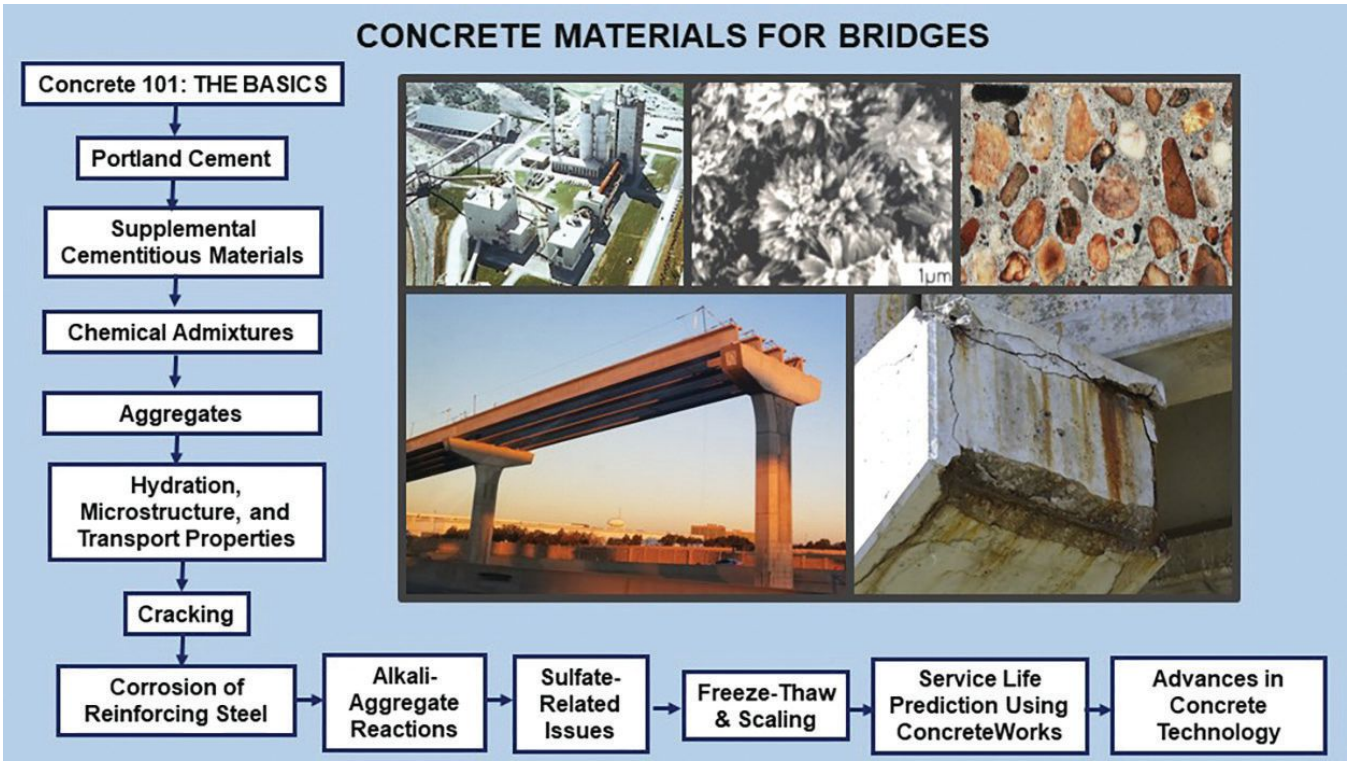
Recognizing the critical role that concrete materials play in long-term bridge performance, CBEI has developed a three-day training course. It is anticipated that this course will be offered four times per year, with a target of 25 students per course offering. The course is intended for laboratory technicians, engineers, inspectors, and contractors and will provide important background information about concrete materials and user-friendly tools for concrete design, analysis, and performance prediction. Its goal is to guide students to improve concrete mixture designs for their projects.

The course will include formal lectures and group projects as well as tours of laboratory facilities, outdoor durability exposure sites, and the concrete bridge component collection. It is anticipated that two instructors will teach each of the three-day courses. The instructors will include Dr. Kevin Folliard and Dr. Thano Drimalas of the University of Texas at Austin, Dr. Anton Schindler of Auburn University, and Dr. Michael Thomas of the University of New Brunswick.

This comprehensive course will cover the constituent materials used in concrete bridge elements and focus on the key durability issues that can affect various bridge components. It is recommended that course participants have a basic knowledge of concrete materials; however, the course starts off with a basic "Concrete 101" module to provide an introduction to concrete materials.

The Concrete Materials for Bridges course will include tours of outdoor durability exposure sites, known as the Cementary (left) and the Concrete Bridge Engineering Institute's concrete bridge component collection (right). All Figures and Photos: Concrete Bridge Engineering Institute.





Outline for the Concrete Materials for Bridges course, a three-day course focusing on the critical role of concrete materials in bridges.

The course then goes into more detail on how to select the appropriate mixture proportions for concrete in a given environment and addresses many of the variables in both materials and the environment. In addition to describing the underlying causes of potential deterioration, this course will provide guidance on how to minimize or avoid durability-related issues during the intended service life of a bridge.

The course will also cover current industry trends, including how evolving changes to improve sustainability may affect other relevant concrete properties, and how these issues can be addressed. Advances in materials and different types of cements, including portland-limestone cement, will be discussed.

An additional topic within the curriculum will be the availability of fly ash. Fly ash is sometimes used in mixtures to improve concrete workability and durability; however, with changes in fly ash quality and quantity spurred by new emissions standards and changes in fuel sources, there is a concern that fly ash may not be as readily available or effective in the future. The course will provide the latest information on the availability of concrete materials and the necessary considerations for using different materials.

The course will include a group project where teams will design the concrete mixture for a bridge designed for a 100-year service life in an aggressive marine environment. Bridge elements such as

During a tour of the Concrete Bridge Engineering Institute, students presented ongoing research projects at the Ferguson Structural Engineering Laboratory to attendees of the 34th Annual American Segmental Bridge Institute Convention in Austin, Tex.

As part of a tour of the Concrete Bridge Engineering Institute, Dr. Kevin Folliard and Dr. Thano Drimalas showed the outdoor durability exposure sites to attendees of the 34th Annual American Segmental Bridge Institute Convention in Austin, Tex.

bridge decks, mass concrete elements, and precast concrete components are among those that will be evaluated using real-world scenarios. This exercise will be done in class using laboratory software that considers concrete designs, analysis, and performance prediction. Features of the software include mixture proportioning, cracking probability, chloride concentration prediction, and predicting the heat generated during early ages of concrete.

The course will also present information on coatings/sealers for concrete bridges for both new and existing bridges and how they can potentially extend the life of the structure.

The ultimate goals of the Concrete Materials for Bridges course are to help students improve their understanding of concrete as an integral material for bridges and to help facilitate the long-term durability and sustainability of concrete bridge design and construction. Upon completion the course, participants should be able to do the following:

- Describe portland cement hydration and reaction products.
- List the most common supplementary cementitious materials and explain how they can improve concrete performance.
- Describe the various types of chemical admixtures.
- Describe the most important durability problems that affect concrete bridges.
- Describe how to identify different types of materials-related distress.
- Understand the importance of designing and constructing bridges with a focus on sustainability and long-term durability.
- Discuss recent innovations in concrete technology that can be applied to concrete bridges, such as ultra-high-performance concrete.

Collaboration with the National Concrete Bridge Council

In addition to the invaluable vision, support, and collaboration of the partner agencies of the TPF, including the participating state departments of transportation and the Federal Highway Administration, CBEI has received tremendous support and contributions from NCBC and NCBC members. A Perspective article in the Fall 2022 issue of *ASPIRE* featured the NCBC and presented its mission, activities, and partnerships.

The members of NCBC have been actively engaged in helping to develop the programs in support of the CBEI mission. For example, in December 2021, leadership from the American Segmental Bridge Institute (ASBI), Precast/Prestressed Concrete Institute, and Post-Tensioning Institute—all of which are NCBC members—kicked off discussions in a two-day workshop together with CBEI staff. These meetings were helpful in identifying needs and goals from an overall industry perspective.

CBEI has hosted representatives of several of the NCBC member organizations over the past year, and CBEI representatives have presented at NCBC meetings and conferences, including the July 2022 NCBC summer meeting, which was held at the CBEI facility in Austin, Texas. During the 34th Annual ASBI Convention in Austin, Dr. Bayrak presented information about CBEI, and an on-site tour of the CBEI facility was offered to attendees. During the tour, the CBEI component collection was highlighted, and students gave presentations about ongoing research projects at the Ferguson Structural Engineering Laboratory and the concrete materials/outdoor durability exposure sites.

The collaboration and support of NCBC and its members are crucial and instrumental in creating valuable and effective programs. The CBEI programs are designed to complement and work in conjunction with existing training and certification programs offered by NCBC member organizations.

Conclusion

This is the third in a series of articles about CBEI and its impact on the construction industry. Articles in upcoming issues of *ASPIRE* will explore other CBEI technical programs in greater detail and provide a status update.

For more information about CBEI, please visit www.cbei.engr.utexas.edu.

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