A letter was received from Brooks Bryant, Concrete Structures Engineer with the New Mexico State Highway & Transportation Department, regarding accelerated curing of HPC deck concrete. The purpose of this letter is to provide some guidance on the use of HPC for bridge decks, and to bring some points to the attention of the National Concrete Bridge Council (NCBC) regarding the testing of high-performance concrete (HPC) for bridge decks.

Dear Editor,

I am writing to express some concerns regarding the use of HPC for bridge decks. Although HPC has many advantages, such as its strength and durability, there are some issues that should be considered before using it for this purpose.

One concern is the cost of HPC. While it may be more expensive than conventional concrete, the cost differential is not always as significant as one might think. In some cases, the increased cost of HPC can be offset by the reduced maintenance costs over the life of the structure.

Another concern is the curing of HPC. It is important to ensure that HPC is cured properly to achieve its full performance potential. This can be challenging, especially in cold climates where traditional curing methods may not be effective.

I would appreciate any feedback you can provide on these issues. Thank you for your attention to this matter.

Sincerely,

[Name]
[Position]
[Organization]

References

Cement, Canadian Standards Association

Concrete Technology, American Concrete Institute

Structural Concrete, PCI Journal

The National Concrete Bridge Council (NCBC) is the new web site at www.nationalconcretebridge.org.
The need for a superior and durable bridge deck concrete, and the desire for the superior and durable [bridge deck concrete], has resulted in new construction methods and materials that improve the overall performance of the bridge. These methods and materials have been developed to provide a bridge deck concrete that is more resistant to weathering, more durable, and has a longer service life than conventional concrete.

HPC Bridge Decks in Washington State

Brie Huglin and Jere Wiegel
Washington State Department of Transportation

HPC bridge deck concrete is a high performance concrete (HPC), which is designed to meet the demanding requirements of service life, durability, and performance expectations for bridge decks. HPC bridge deck concrete is a type of concrete that is specifically designed to meet the requirements of bridge decks, and is a high performance concrete that is designed to meet the demanding requirements of service life, durability, and performance expectations for bridge decks. HPC bridge deck concrete is a type of concrete that is specifically designed to meet the requirements of bridge decks, and is a high performance concrete that is designed to meet the demanding requirements of service life, durability, and performance expectations for bridge decks. HPC bridge deck concrete is a type of concrete that is specifically designed to meet the requirements of bridge decks, and is a high performance concrete that is designed to meet the demanding requirements of service life, durability, and performance expectations for bridge decks.

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The specification defined high performance concrete as a concrete containing a minimum of 500 psi (3.4 MPa) 28-day compressive strength, a slump of less than 4 in. (100 mm), and a 28-day air-vapor content of less than 5%. In addition, the concrete must meet the following requirements:

- A 28-day compressive strength of at least 5000 psi (34 MPa)
- A maximum water/cement ratio of 0.40
- A maximum slump of 4 in. (100 mm)
- A maximum air content of 3%
- A maximum water requirement of 8 lbs/cu ft

The specification also required that the concrete be tested for air-void content, and that the air-void content be no less than 11% and no more than 14%.

In the state of Washington, the specification defined high performance concrete as a concrete containing a minimum of 500 psi (3.4 MPa) 28-day compressive strength, a slump of less than 4 in. (100 mm), and a 28-day air-vapor content of less than 5%. In addition, the concrete must meet the following requirements:

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Concrete decks to provide the necessary freeze-thaw resistance and durability. Curing is one of the most important steps in the construction process to ensure the quality of the finished product and to prevent the formation of high or low quality concrete. Each work shift in the construction process must have a curing program and a curing protocol. It is necessary to ensure that the curing measures are taken at the correct time, to avoid the freeze-thaw cracking and the potential for excessive deterioration at later ages. When wet curing was first initiated, we did not know how long it would take for curing results in unacceptable surface cracks to appear. As a result, the need for the curing component of the specification was recognized. The end result specification continued to be prescriptive and have more emphasis. Therefore, the application of wet curing with less than 5°C to 10°C (50°F to 50°F) is required. The use of a prescriptive approach to the specification was eliminated in 1998. It removed many of the prescriptive aspects and gave contractors freedom with respect to mix design, testing, and confidence was gained, the ministry decided to give contractors greater flexibility with respect to mix design, testing, and their ability to carry out testing properly. Laboratories, except for strength concrete, rapid chloride permeability, and confidence was gained, the ministry decided to give contractors greater freedom with respect to mix design, testing, and their ability to carry out testing properly. Laboratories, except for strength concrete, rapid chloride permeability, and permeability of concrete have only been introduced to the industry very recently, and their use is limited. The contractors are responsible for ensuring that the concrete conform to the specification. The contractor is responsible for ensuring that the concrete conform to the specification. The contractor is responsible for ensuring that the concrete conform to the specification. The contractor is responsible for ensuring that the concrete conform to the specification. The contractor is responsible for ensuring that the concrete conform to the specification. The contractor is responsible for ensuring that the concrete conform to the specification. The contractor is responsible for ensuring that the concrete conform to the specification. The contractor is responsible for ensuring that the concrete conform to the specification. The contractor is responsible for ensuring that the concrete conform to the specification. The contractor is responsible for ensuring that the concrete conform to the specification.
The need for a superior and durable concrete in selected locations led the Ontario Ministry of Transportation (MTO) to introduce its High Performance Concrete (HPC) specification. Key aspects of the Ontario HPC Specification include:

- Use of high-range water-reducing admixtures.
- Use of high-strength concrete, typically 7000 psi (48.3 MPa) at 28 days.
- Use of silica fume to improve workability and durability.
- Use of fly ash to reduce heat of hydration.
- Use of superplasticizers to control placement and finishing.
- Use of fiber-reinforced concrete to increase durability.

The Ontario HPC Specification is intended to give contractors greater flexibility in specifying materials, while ensuring that the concrete meets the required performance. The specification is designed to improve the quality of the finished product and to reduce the costs associated with high or low quality concrete. Each work area is to be treated as a separate construction sublot.

The Ontario HPC Specification is designed to:

- Improve workability, reduction of aggregate size, and increase durability.
- Reduce the amount of water required for placement.
- Increase the strength and reduce the water-cement ratio.
- Increase the durability and reduce the permeability.
- Reduce the heat of hydration and increase the early-age strength.
- Increase the compressive strength and reduce the cost.

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Financial
Finishing of bridge deck surfaces has been significantly altered by the introduction of fog misting and finishing of less than 600 being typical. A standard of 46 days for laboratory curing has been made, so that individual operators of companies are evaluated. However, for companies to be able to continue to be monitored, I believe the committee should consider trying to achieve similar results with less materials. For example, I would like to see a 56-day test age; it was felt that the standard of 46 days is not as good. (continued from pg. 4) (continued from pg. 5)

A number of contractors have modified their standard mixing practices to allow more at elimination of high and low areas as well as providing a minor adjustment to the surface. This requires higher quality materials for the finishing of concrete decks. This requires better curing than we use today. Which is far outweighs the desire for a pristine appearance. Nevertheless, they have realized the value of applying a pozzolan as a proposed replacement for granite aggregate. It has been an issue on several jobs. Grinding of a surface is not being utilized. When we developed the very high strength concrete mixes with pozzolanic material. Storage of the test samples after placement. This requires the contractor to have the ability to store them properly. It is important to keep the surface free of water and then tested using the pad caps. Although there were some other basic differences between the two mixes, it was interesting to note that all three mixes to date included 25 percent slag as a pozzolan. The average RCP rate is high, curing compounds may be placed if the contractor moves from one concrete supplier to another. The use of fogging wands mandatory on site. Consequently, when I see statements that indicate that these systems do not work with strengths above 12,000 psi (83 MPa), I can understand but do not discuss statements that indicate that these systems do not work with strengths above 12,000 psi (83 MPa). I can respect but I have to face what I have seen with my own eyes.

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Conclusions
The philosophy for HPC has proven to be effective. Some excellent high volume contractors have had success with HPC, but in general, use of HPC is still in its infancy. There are few systems for testing HPC. The performance of an individual operator is essential for the use of HPC at its full potential. However, research has been made available in the past to test the core of the HPC bridge decks. This has led to the development of a new system for testing HPC. This system is designed to provide a good quality end product. For further information, please contact the Concrete Industry Board, 1300 New Hampshire Ave., NW Washington, DC 20036.

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The next issue of Brackets, completed, will be in print on the 15th of May. The focus of the issue will be on the development and implementation of high performance concrete (HPC) in the transportation industry. The article will discuss the benefits and challenges of using HPC in bridge construction, with a particular emphasis on the use of HPC in bridge decks.

In conclusion, it is clear that HPC offers significant advantages in terms of durability, strength, and cost-effectiveness. However, the successful implementation of HPC in bridge decks requires careful planning and execution. The lessons learned from previous projects can be leveraged to improve the performance of future projects.

Further information on the topic of HPC can be found in the following resources:
- HPC Bridge Decks: Design and Construction Guidelines (Transportation Research Board, 2010)
- High Performance Concrete in Bridge Construction (Federal Highway Administration, 2015)

The use of HPC in bridge construction is an active area of research, and ongoing developments are expected to further enhance the performance and sustainability of HPC bridge decks.