A2E05: Committee on Concrete Materials and Placement Techniques
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Concrete Materials and Placement

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Admixtures and cementitious materials are not the only factors affecting the performance of concrete. Performance is determined by a combination of many factors, including not only admixtures and cementitious materials, but also aggregates, material batching and handling, construction techniques, curing practices, and environmental conditions. These factors must all be considered in addressing the performance challenges to be met by concrete used for transportation systems.

DURABILITY

Much concern within the transportation industry currently revolves around the need for longer-lasting, more durable concrete. Many transportation organizations are seeking concrete that will be useful for very long periods of time; for example, service lives of 75 to 100 years are desired for bridges. To this end, concrete mixes are being modified to achieve less permeability, reduced potential for cracking, and increased strength, while handling characteristics and workability are maintained or improved.

ENVIRONMENT

Increasing demand for pollution reduction has led to changes in the characteristics of the standard materials commonly used in concrete. The chemical composition of cements has changed over the years, resulting in concomitant changes in the properties and performance of concrete. The characteristics of pozzolans and their reactions with cements have also changed. The greatest challenge is to ensure that the materials used in concrete are consistent so that variations in composition from batch to batch are minimized. An example of this challenge is the regulatory changes occurring in the production of fly ash used in concrete. The demand for less pollution from energy generation has altered the chemical composition of the fly ash, specifically changing the carbon content. This change affects the ability and ease of generating air in concrete, which is needed for durability.

Demand to reduce pollution has also created the need to find a use for waste products instead of disposing of the materials in landfills. Many outside of the concrete industry regard concrete as a suitable repository for waste materials, rendering the waste materials innocuous and solving a pollution problem. This practice may be beneficial to the performance of concrete, or may compromise its quality and severely reduce its performance and durability. Engineers are thus challenged to determine the effects of these materials on a concrete's mechanical properties and durability. The testing currently

performed may not be adequate for this purpose; new tests may need to be developed and proven before use of waste materials can achieve widespread acceptance.

EXPEDIENCY

Another demand being placed on concrete in the transportation industry is the desire to complete work as quickly as possible, without severely impeding the traveling public. Highways and bridges, whether being rehabilitated or newly constructed, must be open to traffic as quickly as possible. Meeting this demand has historically meant using rapid-setting concrete or a concrete that contains more cement in the mix. Today, however, a number of new products that can reduce the set time of concrete are available. Manufacturers have put considerable effort into the development and testing of these new products, yet the question remains of whether the resulting concrete will have the long-term durability desired by the transportation industry. Many studies are under way, and many more are being considered, that will provide insight into the durability of concrete used for transportation structures. The public is demanding smooth, durable highways while also expecting unimpeded travel. The result is more construction being performed at night. In the new millennium, the transportation industry will have to find materials and means for concrete construction that will allow the concrete to be placed quickly, achieve the necessary strength in as short a time as possible, and provide long-term durability.

INNOVATION

There is increasing demand for the inclusion of new and unique materials in concrete mixes, such as corrosion inhibitors, new types of pozzolans, and shrinkage-reducing admixtures. Again, manufacturers have expended considerable effort and resources on developing and testing these innovative products. However, long-term performance data are not available for these materials, and there is thus some concern about whether the expected performance will be achieved. This concern has led many manufacturers of these innovative materials to undertake lengthy investigations into service-life testing techniques.

RESTORATION AND REPAIR

Many of the transportation systems in existence today were either built or reconstructed after World War II. These systems are aging and in need of repair. Emphasis is therefore needed on repair, restoration, rehabilitation, and maintenance of many concrete transportation structures. The preparation of existing concrete and reinforcement for rehabilitation is more extensive than is the case for new construction. Investigation of new materials, different material combinations, and construction techniques can be expected in the 21st century, with the ultimate result of improved durability.

POLICIES

In the new millennium, the challenge will be to do more with less. Many transportation organizations are required to prioritize work to be performed; as a result, certain tasks may not be completed. Some of these tasks relate to concrete use in the transportation industry. Engineers are being asked to produce durable, long-lasting transportation systems while meeting the challenges of being environmentally conscious, using innovative products, and performing the necessary work in as timely a fashion as possible. Individually, each of these demands can be met; in combination, they make the completion of work substantially more

difficult. Objectivity and sound engineering judgment are necessary to achieve the desired goals.

CONCLUSION

The challenges facing users of concrete in the transportation field are great. The future will see the evaluation of new materials, the development of new tests, and reductions in the overall time required to perform concrete construction. In the process, clear and effective communication to all the parties involved—designers, material suppliers, producers, contractors, and the public—will be of the utmost importance.