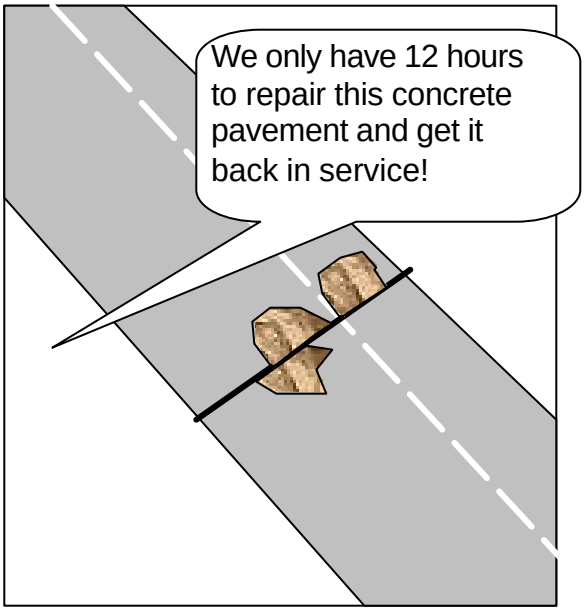
Tech Brief

Development of Fast-Track Concrete - 2

FHWA-NJ-2001-014-TB July 1998

HERE'S THE PROBLEM

In order to minimize congestion for the traveling public, we needed to develop techniques to rapidly repair highway concrete pavements so that they could be opened to traffic within 12 hours after closing the lane. h order to achieve this, we needed a concrete that could develop 350 psi of flexural strength in 6.5 hours.



We refer to this concrete as Very Early Strength (VES), or fast track, concrete. Previous research consisted of developing the basic mix design for the fast track concrete, establishing in-place field monitoring procedures and demonstration of the fast track technology in actual field applications.

In the initial research project, the scope was limited to a single cement brand, a single type of cement (Type I), and a single type of concrete accelerator. The research results were limited to the development of fast track concrete with that particular brand. This study expanded the investigation to include different cement brands, and types as well as different accelerators to determine what combinations would produce acceptable fast track concrete mixtures.

THESE ARE OBJECTIVES OF THE STUDY…

- To explore the capability of Portland cement types I and III from different manufactures in achieving fast track properties.
- To examine the use of chloride and non-chloride hardening accelerators in achieving the necessary strengths in the required time.

AND, HERE'S WHAT WE DID…

The original study used Essroc cement with Sika Rapid One hardener accelerator. The follow-up study involved the development of fast track mixes with cement types I and III with brands such as Essroc, Hurcules, Lafarge and Allentown with Sika Rapid One non-chloride hardener accelerator and Plastocrete chloride hardener accelerator. Also, Blue Circle brand was employed in a series of batches, but these mixes did not yield favorable results with the accelerators used.

The mixes contained a maximum coarse aggregate size of 1.5 inches and the gradation of both the coarse and fine aggregates conformed to ASTM specification C33. In addition, the maximum amount of wash for coarse aggregates (passing sieve No. 200) was kept to less than 1.0 percent. Finally, the quality control tests were performed in order to assure the maximum amount of moisture absorption (to be confined to less than 0.6 for coarse and 1.5% for fine aggregates).

Goal:

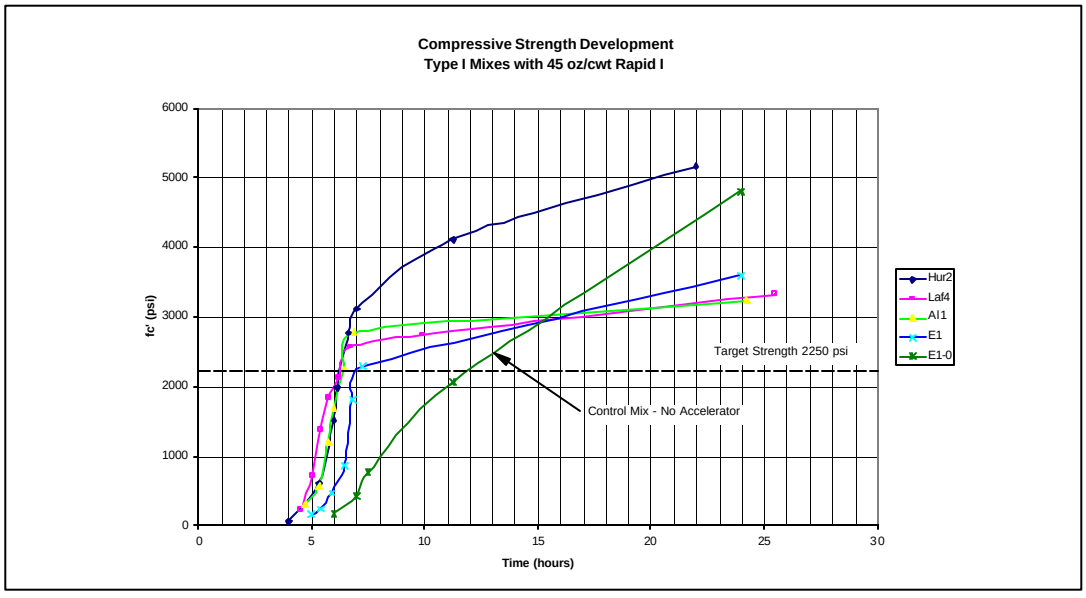
Concrete Mix with Accelerator
Achieving 350 psi Flex Strength
(2250 psi Comp) in 6-8 hrs

Concrete Temperature 70-80 ºF — Ambient >60 ºF

Mix Design:

Cement	**799 lbs**	**Type I**	
Water	280 lbs	max w/c	**0.37**
Coarse Agg	1720 lbs		
Fine Agg	1100 lbs		
Accel	45 oz/cwt		
Water Red.	12 oz/cwt		
Air Ent	1.2 oz/cwt		

The analysis compared the time required for achieving the required 350 psi flexural strength needed for opening to traffic for each brand of cement and cement type for the chloride and non-chloride hardener accelerator.



What We Found…	Our Recommendations…
• The study showed that there was very little difference between the cement brands. • The type III (high early) cement types generally shortened the time required to achieve the desired strength by one hour. • The chloride accelerator did not perform as well as the non-chloride accelerator. • While both the mixing and batching operations were similar to the procedures involved in the previous study, it was concluded that the combination of hardening accelerator and proper mix temperature of 70^0 to 75^0 F would achieve the required high early strength, since a hardening accelerator increases strength gain after the initial set of the concrete. • Cracks develop on long slabs (>20 ft) • Strength Decreased (85%) of non-accelerated concrete	•Initial Mix Temperature should be (70-78 ^{o}F) •Sub-base/Sub-grade Temperature should be greater than 60 ^{o}F •Max Concrete Temperature should be less than 150 ^{o}F •Amount of cement (799 lb) •Coarse Aggregate Size (#57) •Use non-chloride accelerators

WHAT IS THE NEXT STEP?

The next step is development of a concrete mixture with similar properties, but with less cement and larger coarse aggregate to reduce the shrinkage. The goal is to design a mixture that can be used to replace our 78-foot standard pavement slabs overnight.

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A final report is available online at http://www.state.nj.us/transportation/research/research.html

If you would like a copy of the full report, please FAX the NJDOT, Bureau of Research, Technology Transfer Group at (609) 530-3722 or send an e-mail to Research.Bureau@dot.state.nj.us and ask for:

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NJDOT Research Report No: FHWA-NJ-2001-014