

Rapid Concrete Repairs

by Casimir Bognacki, P.E.

The infrastructure of our cities is in need of repair, particularly in the relatively older and larger cities of the northeast. The public sector is being challenged to repair the infrastructure with the latest technologies to realize maximum service life and with minimum disruption to the public. This is especially true when we repair the transportation systems such as bridges and roadways that have heavy traffic. The Port Authority of New York and New Jersey (PANY/NJ) maintains transportation facilities that are heavily used; therefore, we must meet these challenges.

The Engineering Department at the Port Authority has been asked to repair concrete bridge decks and pavements within a maximum eight hour closure, with a durable concrete mix. The roadway or bridge lane is usually taken out of service between the hours of 9pm and 5am. During this time, the deteriorated concrete must be removed, the surface and rebar cleaned, and the concrete placed and cured. These repairs are not 2-foot by 2-foot patches. They are between 300 and 400 square feet – all in an eight hour period.

The Port Authority has been able to place portland cement concrete in this tight construction window by using a fast setting portland cement manufactured by the CTS Cement Company. The trade name is Rapid Set Cement. A concrete mix using this cement can produce the compressive, flexural and bond strengths given below:

	Compressive Strength	Flexural Strength	Bond Strength
1 hour	1900	-	-
6 hours	4100	-	-
1 day	4400	1100	300 psi
28 days	5000	1100	300 psi

The mix typically used for overlays on concrete decks to restore wearing surface and patches is:

Cement (Rapid Set)	658 lbs
Sand	1450 lbs
Stone	1325 lbs
W/C	.4
Latex (if required)	220 lbs (emulsion)

Although interested in compressive strength, the Authority mostly wants the repair material to be durable – that is, having low permeability and low shrinkage, and good freeze-thaw durability. Repairs must be designed to last. This concrete meets that requirement.

Latex is added to the mix to achieve very low permeable concrete. Coulomb numbers less than 1000 as defined by AASHTO T-277 are achievable with this mix. Furthermore, this concrete has a tendency to shrink less when compared to Type III cement. When tested in accordance with ASTM C-157 for shrinkage, the Rapid Set Concrete had a shrinkage of -.02% whereas the concrete mix with Type III cement had a shrinkage value of -.04%. Low shrinkage potential should translate into less shrinkage cracking in the field, and it has. There is no evidence of excessive cracking in the field; in fact, it is less than with Type III cement. Samples of the concrete mix were subjected to 300 cycles of freeze-thaw in accordance with ASTM C666 and exhibited less than 2% loss of section. All the laboratory test data and field installations are performing well when installed properly. Some have been in place for five years.

This concrete costs more than conventional concrete because the cement costs more and it needs to be batched with a mobile mixer because of the cement's fast set time. However, this additional cost is probably more than compensated for by fewer delays to the public. ■

About the Author: Casimir Bognacki is Engineer of Materials for the Port Authority of New York and New Jersey.

An Inspection Minute A most frequent and important difference of opinion between the inspector and the placing crew concerns the slump of the concrete. The placing crew may want a high slump because it will flow into place with practically no shoveling or other effort. [Nowadays], instead of adding water, which increases the water-cement ratio and reduces strength, a superplasticizer can be used to greatly increase slump and produce a flowable concrete, without a reduction in strength.

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