WJE ENGINEERS ARCHITECTS MATERIALS SCIENTISTS

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Mr. Ransome Wyman
Roklin Systems, Inc.
13586 Pumice Street
Norwalk, CA 90650

Re: Qualification testing for Flexset™ Rapid Concrete Repair material
WJE No. 2003.3878

Dear Mr. Wyman:

In response to your request, testing of the Flexset™ Rapid Concrete Repair material, a two-part polyurethane concrete patching compound, was conducted to assess the material's compliance with the Texas Department of Transportation's TX DMS-6170 Specifications. This letter describes the test program and presents the results.

MATERIALS

The patching compound was produced by combining equal volumes of Component A, which was a dark brown liquid having a viscosity approximately equal to water, Component B, which was gray and had a higher viscosity than A, a Flow Mix catalyst, and sand. Mixing was done in the one-gallon buckets in which all materials were supplied in pre-packaged containers. Mixing was performed using a paddle mixer in a hand-held power drill. These components were mixed using the following procedure. Approximately 565 g of Component A was mixed with 3400 g of sand for two minutes. Approximately 550 g of Component B was mixed with 27 g of catalyst and then added to the bucket and mixed for an additional one minute. The specimens for testing were fabricated immediately afterwards. All materials were at 73 ± 3ºF during mixing and were cured at this same temperature.

The repair material was resin rich and settlement of the sand was observed in the test samples. In practice, additional dry sand is broadcast over the fluid repair material. This additional sand was not used to fabricate the test samples.

Figure 1. Cube specimen fabrication

TESTING

The tests outlined in Table 1 were conducted according to the standard methods listed. The test results are also included in this table. Brief descriptions of the methods employed and observations made during testing follows.

Table 1. TX DMS-6170 Type I Physical Requirements

Test	Age at test	Method	Requirement	Result
Gel time, min.	-	Tex-614-J	5 to 60 min.	9 min.
Wet bond strength, psi	7 days	Tex-618-J	> 100 psi	176
Compressive strength, psi	24 hrs.	ASTM C579, B	> 200 psi	1,710 psi
	7 days		-	1,820 psi
	28 days		-	2,140 psi
Compressive stress at 0.1 in.	7 days	Tex-618-J	> 200 psi	733 psi
Resilience, %	7 days	Tex-618-J	> 90 %	97.2%*
				82.0%
Thermal compatibility	7 days	ASTM C884	No delam. or cracking after 9 cycles	*Pass*

* from earlier batch of material

Gel Time - The gel time was determined by probing a sample of the material with a clean wooden toothpick every minute. Since the material did not develop a hair, the gel time was interpreted as the time when the material could not be stirred.

Wet Bond Strength - The wet bond strength was determined by conducting tensile tests on half dog-bones of patching material cast against mortar half dog-bones. The dog-bone specimens were produced using molds specified by ASTM C190 (discontinued in 1991). The bonded surface of the mortar, nominally 1 sq. in., was sand-blasted and cleaned with trichloroethylene per the August 1999 revision of Tex-614-J before the patching material was applied. After casting, the specimens were air cured for five days and then immersed in water for two days prior to testing. Despite the fact that the orientation of the specimen in the testing machine was varied, the bond failure of all test specimens occurred at the bottom of the specimen as oriented during casting. This appears to be a result of sand settlement while the material was still fluid making the bottom portion of the sample more stiff. The test was conducted on nine specimens and is pictured in Fig. 2.

Figure 2. Dog-bond specimen for bond testing.

Compressive Strength - The compressive strength was measured with 51-mm. cubes (Figs. 1 and 3). Three cubes were tested at each age. To simulate most installed loading conditions, the specimens were tested with the unformed surface oriented upwards against the platen of the testing machine.

Figure 3. Compressive strength testing

Compressive Stress - The stress at a compressive deformation of 0.1 in. was measured on 2-in. cubes. This test was conducted on three specimens.

Resilience - The resilience defined by Tex-618-J is the ratio of the maximum displacement plus the height of the cube after testing minus the height of the cube before testing to the maximum displacement, where in this case the maximum displacement was 0.1 in. This test was conducted on three specimens. Two values for resilience are reported in the table above. The first was obtained from specimens produced from an earlier batch that did not contain catalyst. The compressive stress at 0.1 in. of that batch was 715 psi, essentially the same as that reported for the batch used to generate all of the other data given here. The second value is reported based on testing of cubes that were fabricated with catalyst as outlined above. Please note that measurements of the accuracy required for assessing the resilience of the product are difficult to perform on samples with rounded edges and of flexible material such as Flexset.

Thermal Compatibility - The thermal compatibility between the patching material and concrete was evaluated according to ASTM C884, except that the bonded materials were cycled nine times between 60 ºC (140 ºF) for eight hours and -21 ºC (-6 ºF) for sixteen hours. Testing

was performed on two concrete slabs which were sand-blasted, cleaned and then covered with the patching material to a depth of 1/2 in. before cycling occurred. Photos of the interface between the patching material and the concrete after thermal cycling are included in Fig. 4.

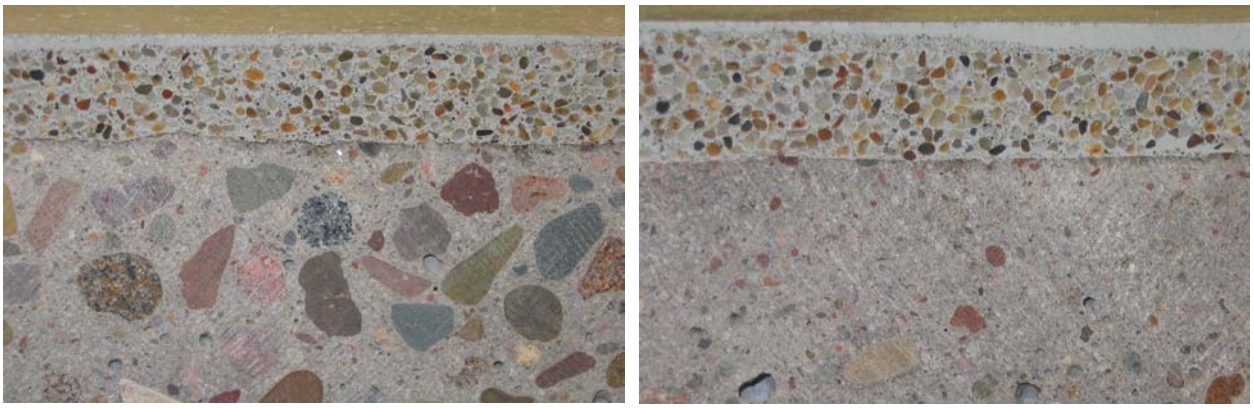

Figure 4. Thermal compatibility slabs after thermal cycling
(Left-near center of test slab, Right-near edge of test slab)

Please call if you have any questions concerning these test results.

Very truly yours,

WISS, JANNEY, ELSTNER ASSOCIATES, INC.

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