

2 February 2004

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 according to California Department of Transportation Test 551 *Method of Test for Determining Suitability of Materials for Overlayment and Repair of Portland Cement Concrete Pavement and Structures*. 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 with 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 and 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 (Fig. 1). All materials were at  $22.7 \pm 1.7^{\circ}\text{C}$  ( $73 \pm 3^{\circ}\text{F}$ ) 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 test results outlined in Table 1 were conducted according to the methods listed in CT 551, except as stated below. The only test given in CT 551 that was not conducted was the Test for Set Time by Gillmore Needles. Gel time was measured on an approximately 300 g mass and determined to be between seven and nine minutes. Brief descriptions of the methods employed and observations made during testing follows.

**Table 1. CT 551 Results**

Material Property Tested	Age at test	Result
Compressive strength (MPa)	1 hr.*	4.25
	3 hr.*	7.00
	6 hr.*	7.45
	24 hr.	11.80
	7 day	12.55
	28 day	14.75
Flexural strength (MPa)	24 hr.	5.10
	28 day	6.95
Bond strength (MPa)	24 hr.	1.40
	28 day	2.45
Modulus (MPa)	24 hr.	84.6
	28 day	163.0
Specific gravity	-	1.84
Absorption	-	0.33%

\* stress at 10 mm displacement

**Compressive Strength** - The compressive strength was measured with 51-mm. cubes (Fig. 2). 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. The cubes tested at 1 hr., 3 hr. and 6 hr. did not demonstrate a well-defined peak in the load versus displacement curve. Instead, the material continued to carry more load as the cubes were compressed through 25 mm. As a result, for these ages the value reported in Table 1 is the stress measured at 10 mm of deflection. This deflection was selected since this is approximately the deflection at which the 7- and 28-day tested specimens exhibited a peak stress.



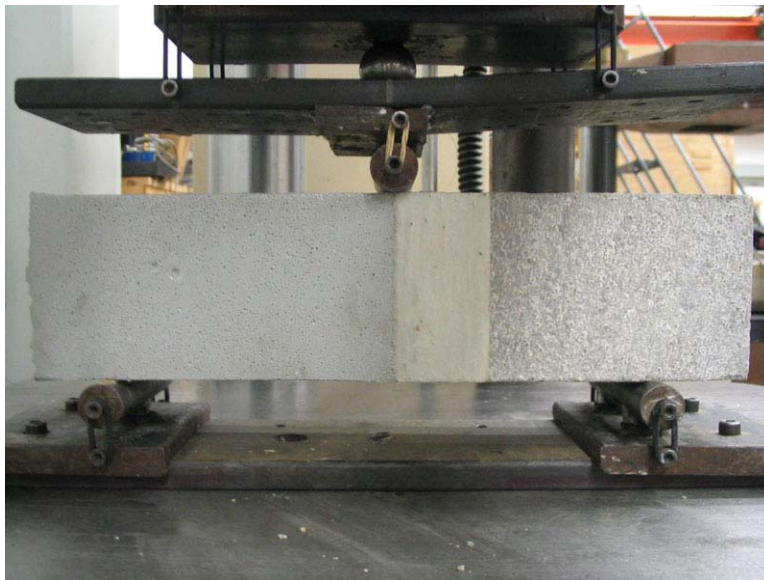
*Figure 2. Compressive strength testing*

**Flexural Strength** - The flexural strength was determined with third-point bending tests on 76 x 76 x 305 mm beams of the repair material (Fig. 3). The unformed surface faced to the side during loading. Three beams were tested at each age.



*Figure 3. Flexural strength testing*

**Bond Strength** - The bond strength was determined by conducting center-point bending tests on 76 x 76 x 305 mm beams consisting half of portland cement concrete and half of the repair material (Fig. 4). The portland cement concrete used to make the test specimens had a plastic air content of between 5 and 7 % (ASTM C231) and 28-day compressive strength of 43.5 MPa (ASTM C39). The beams were fabricated as follows: The concrete was cast as 305 mm beams, which were then sawn in half. Half of a beam was replaced in the mold kept in a saturated surface dry condition until the patching material was used to fill the mold, bonding to the cut face. Three beams were tested at each age. All failures occurred at the interface.



*Figure 4. Bond strength test specimen*

**Modulus of Elasticity** - The flexible nature of the repair material made testing of the Modulus of Elasticity using a compressometer impractical. As a result, the values reported for Modulus of Elasticity were taken from the initial linear portion of plots of the stress vs. strain response of the 51 mm cube compressive tests.

**Specific Gravity** - The bulk specific gravity of materials were determined as an oven-dry weight divided by the mass of water displaced when the specimens were submerged under water.

**Absorption** - The absorption of the material was determined from the saturated surface dry and oven-dry weights.

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

Very truly yours,

**WISS, JANNEY, ELSTNER ASSOCIATES, INC.**

John Lawler  
Associate III

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