



**Hard-Cem™ Concrete:
Robinson Abrasion Resistance Testing.
AVR Inc. Concrete Test Specimens**

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Submitted to: Cementec Industries Inc.
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1.0 Introduction:

Two concrete test panels measuring 44" W x 44"L x 3.5" thick were delivered to Cementec Industries Inc. from AVR Inc., a major Minnesota based ready mix concrete producer. The test panels were labeled #1 and #2, respectively. No mix design data was provided, however Panel #1 appears to contain Hard-Cem™ as indicated by its relatively darker appearance and tested harder surface.

At Cementec's request, Pildysh Technologies Inc. assessed the relative abrasion resistance of the concrete test panels as discussed below.

2.0 Concrete Abrasion Resistance Test Methodology:

Concrete abrasion resistance was assessed using a modified version of the Robinson test methodology (ASTM C 627.) Conceptually the Robinson test involves the following elements:

- The concrete panel surface is subjected to abrasion by three hardened steel wheels that traverse the concrete surface in a 30" diameter circular wear path.
- The 3 wheels are loaded with nearly 800 lbs of total weight to increase the wheel bearing pressure and abrasion induced on the concrete surface.
- The duration of the test is 5,000 abrasive wear cycles.
- Every 500 machine revolutions (abrasive wear cycles) the degree of concrete abrasion is measured by brushing the wear path to remove any worn concrete debris and the depth of the abraded wear path is measured with a set of vernier calipers. A total of 9 wear path measurements are taken across the width and along the circumference of the abraded wear path. The measurements are averaged at each 500 revolution measurement point (the average wear track depth.)
- The worn debris is collected from the concrete surface every 500 cycles. At the conclusion of the test, the mass of collected debris is measured. The mass loss of the Robinson machine steel wheels is also measured and subtracted from the collected debris mass to obtain the mass of concrete abraded from the surface over the duration of the test.
- Those concrete test specimens exhibiting a lower average wear depth value and concrete mass loss are deemed to have higher abrasion resistance on a relative basis.

A more detailed description of the modified Robinson test procedure is provided in the report: Hard-Cem™: Concrete Abrasion Resistance Evaluation, September 30, 2005.

The AVR panels were cast by AVR on February 24, 2009. AVR panels #1 and #2 were tested at 28 and 27 days of age, respectively. Each Robinson test requires approximately 7 hours to complete including set-up, abrasion time and measurement time.

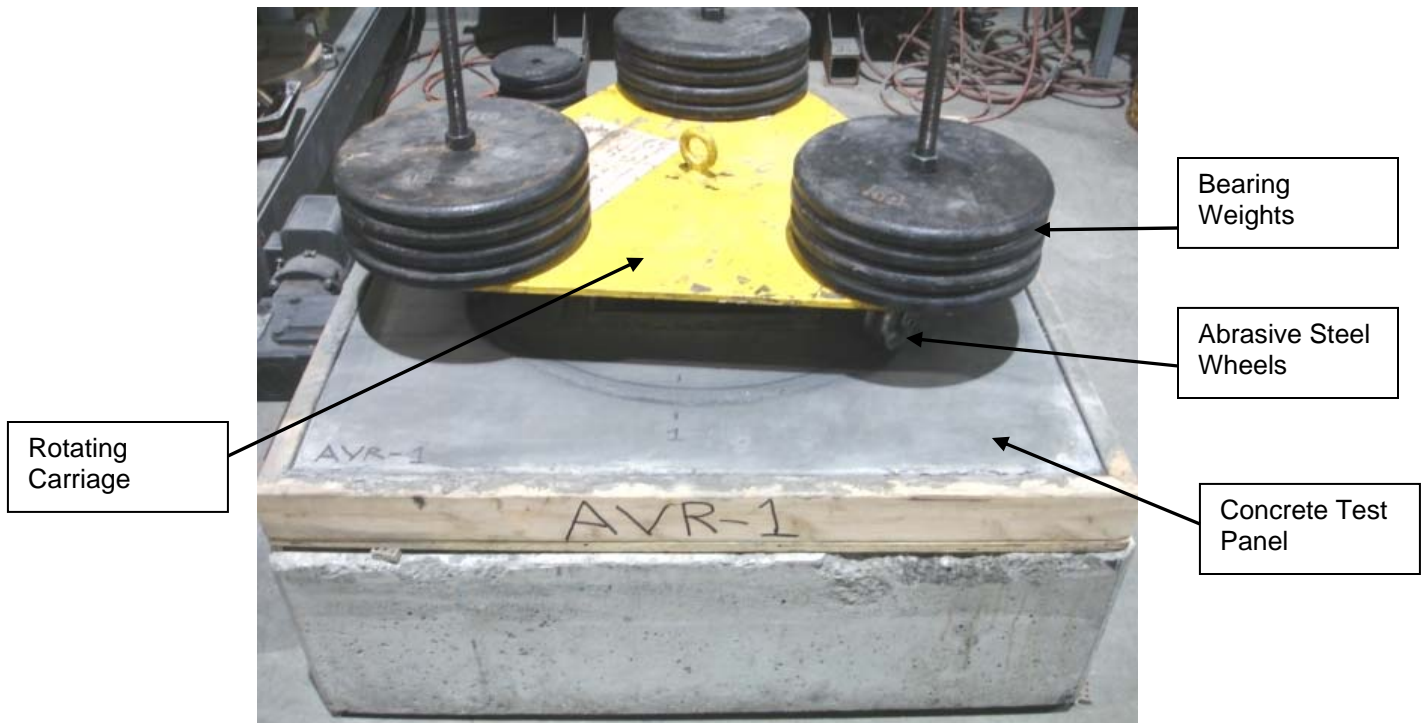


Fig. 1: Robinson Tester.

3.0 Test Results:

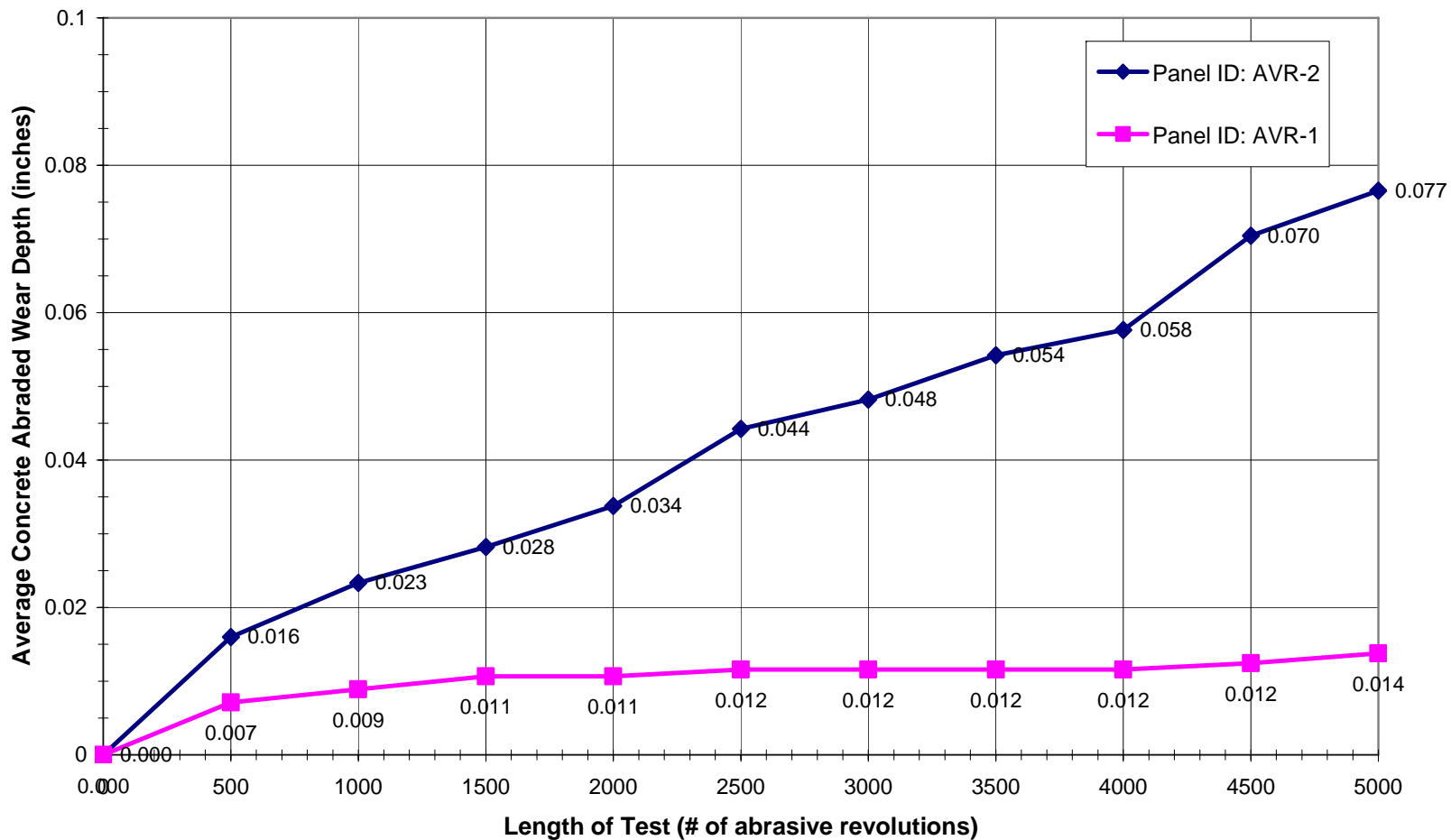
The concrete panel Robinson test abrasion resistance wear profiles are shown on Graph 1 on the following page.

The final, average concrete wear depths at the end of the respective Robinson wear tests are summarized in Table 1 below:

Table 1: AVR Concrete Panel Final Average Robinson Wear Depth		
	AVR-2	AVR-1
Final Wear Depth	0.077inches (1.96 mm)	0.014 inches (0.36 mm)
Relative % decrease in wear	NA	82% less wear

The concrete test panel mass loss results are summarized in Graph 2 below:

**GRAPH 1: Concrete Abrasion Resistance Wear Track Measurement -
Robinson Test Methodology**



**GRAPH 2: Concrete Abrasion Resistance Mass Loss -
Robinson Test Methodology**

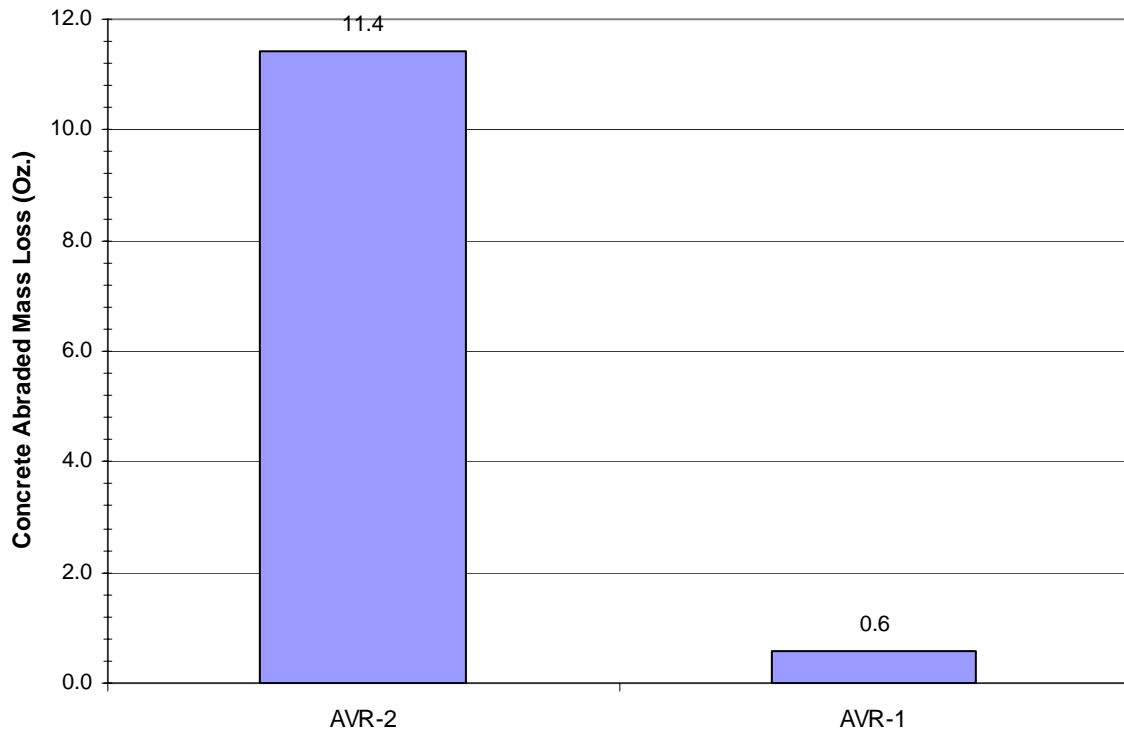




Fig. 2: Left - AVR-2 Abraded Wear Track Plan, Right – Abraded Wear Track Profile Close-up.



Fig. 3: Left - AVR-1 Abraded Wear Track Plan, Right – Abraded Wear Track Profile Close-up.



4.0 Findings and Conclusions:

1. Panel AVR-1 exhibited substantially lower abrasive wear depth than panel AVR-2 as determined by the Robinson test methodology. Panel AVR-2 exhibited an abrasive wear profile that increased throughout the duration of the Robinson abrasion test. Panel AVR-1 exhibited very little increase in abrasion depth during the second half of the Robinson abrasion test.
2. At the end of the Robinson abrasion test, panel AVR-1 possessed an average abraded wear track depth 18% of panel AVR-2's average abraded wear depth (AVR-1 possessed 82% higher abrasion resistance than AVR-2.)
3. At the end of the Robinson abrasion test, panel AVR-1 possessed an abraded concrete mass loss 5% of panel AVR-2's abraded concrete mass loss.
4. Qualitative examination of the abraded panel surfaces confirmed the higher concrete abrasion resistance of panel AVR-1 relative to panel AVR-2 as seen in the enclosed photographs. The darker abrasive wear ring seen in panel AVR-1 photographs is a result of some abraded steel wheel filings adhering to the concrete surface. In the case of AVR-1, the Robinson machine steel wheels exhibited higher wear mass loss than the concrete test panel.