2010

OBSI Testing of MnROADs I-94 WB Exposed Aggregate and Diamond Ground Test Sections

Preliminary Draft

On June 18, 2010, OBSI testing was conducted on MnROADs cells 72, 9, 8, 7 and two sections of diamond grinding on I-94 west of MnROADs near Montecello. The sections tested included a recently constructed exposed aggregate surface, NGCS and CDG surfaces ground into the exposed aggregate section, CDG, NGCS LITE, and NGCS sections previously installed on I-94. The NGCS on exposed aggregate produced the lowest ACPA measured OBSI overall level ever at 98.8 dBA. The conventional NGCS was 99.8, the CDG on exposed aggregate 101.4 and the exposed aggregate section 101.7; 2.9 dBA louder than the EA-NGCS section and 1.9 dBA louder than the older NGCS section.

ACPA
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6/23/2010

AMERICAN CONCRETE PAVEMENT ASSOCIATION

Introduction

On June 18, 2010 the ACPA conducted OBSI testing of six test sections located on I-94 WB at MnROADs and two additional test sections on I-94 WB a few miles west of MnROADS near Montecello, Minnesota. Testing was conducted using the ACPA dual probe OBSI system and the 2009 ACPA SRTT Tire. Testing was conducted at 60 MPH and generally in accordance with AASHTO TP 76 except that the analysis is conducted between 500 and 5000 Hz to be consistent with earlier testing. Testing was conducted between 2:30 PM and 8 PM and temperatures ranged from 80 to 86^{o} F with most testing conducted between 83 to 86^{0} F.

Between April and June, 2010 MnROADs constructed an exposed aggregate test section on I-94 WB. In addition to the conventional exposed aggregate section, MnROADs also constructed an NGCS and CDG texture into the western most 495 ft of the exposed aggregate section. This is the first time an NGCS section has been constructed on an exposed aggregate texture. The NGCS is located in the travel lane while the CDG texture is located in the high speed lane adjacent to the NGCS section.

The CDG and NGCS sections that were previously constructed at MnRAODs are approximately 32 months old at the time of this testing and the NGCS LITE test section approximately 19 months old.

Photos of each of the test sections are included in Appendix 1 thru 5. It should be noted that the CDG, NGCS, and NGCS LITE sections, previously constructed on a 14 year old existing pavement, are exhibiting surface distress as indicated in Appendix 2 thru 5. The pavement distresses may be affecting the time series results. For the last two evaluations the tested wheelpath has been shifted to the left to avoid some of the potholes. However, it is also evident that the sealant continues to fail which can cause additional increases in measured levels which are not a result of changes in texture. For the Montecello sections backer rod was lying on top of the pavement surface at several joint locations in the EB direction.

2010 OBSI Test Results

Figure 1 indicates overall A-weighted OBSI level for each of the sections. For the newly constructed textures at MnROADS (e.g. Exposed Aggregate, EA-NGCS, EA-CDG) the EA-NGCS texture is the quietest followed by the EA-CDG and then the conventional exposed aggregate. It should also be noted that since the EA-CDG section is located in the high speed lane, the OBSI equipment is now exposed to traffic which when testing in the travel lane does not occur. What effect, if any, this has on the results is not known. No trucks were alongside the test vehicle during testing, only passenger cars. For the older diamond ground textures at MnROADS, the NGCS is the quietest followed by the NGCS LITE and then the CDG.

Since the exposed aggregate test sections were only recently opened to traffic on June 14, 2010, little if any effect from traffic has occurred. However, the previously constructed NGCS surface is still quieter than all the surfaces except the new NGCS texture constructed on the exposed aggregate section.

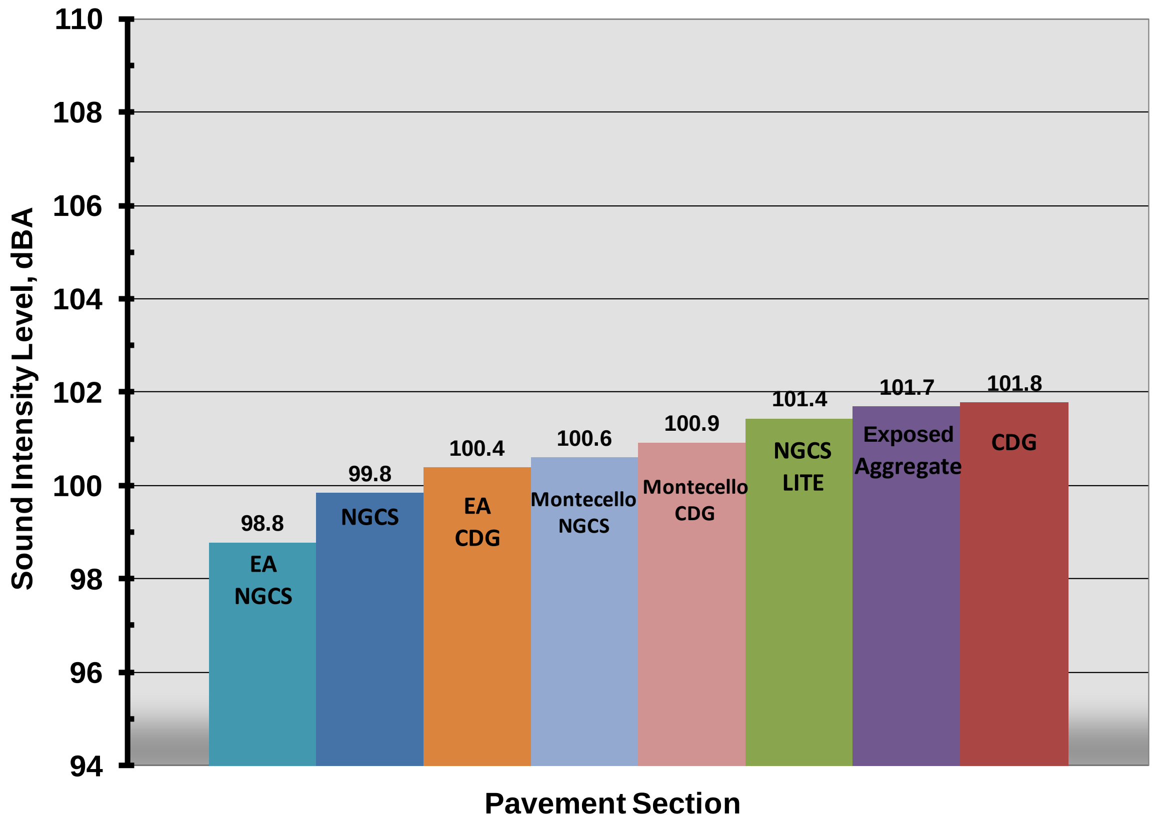

Figure 1 OBSI Overall Level Results for All Diamond Ground and Exposed Aggregate Test Sections

Figure 2 indicates the one-third octave spectra for each of the tested surfaces. It should be noted that the NGCS exposed aggregate surface produced a dramatic reduction in the center band frequencies below 1000 Hz. This is probably why it achieved the lowest overall level. The exposed aggregate texture generally had the highest levels at center band frequencies below 1000 Hz and generally the lowest at center band frequencies above 3150 Hz.

Time Series OBSI Results for MnROADs I-94 NGCS, NGCS LITE, and CDG Section

The MnROADS I-94 WB NGCS and CDG test sections (e.g. Cells 7 & 8) were constructed between October 18-20, 2007 and opened to traffic immediately thereafter. Over the past three years there have been periodic measurements obtained to evaluate changes in OBSI levels over time. The dates, test temperatures, and tires used during these evaluations are indicated in Table 1. It should be noted that there is an approximate range in temperature of 25 degrees over the three years and two different SRTT tires used in the testing.

Figure 3 indicates the overall level measured during each of the periodic tests for each of the MnROADS I-94 WB test surfaces (eg. Cell 7, 8, 9). The NGCS LITE surface was constructed in October of 2008 and the first OBSI measurement obtained in July 2009.

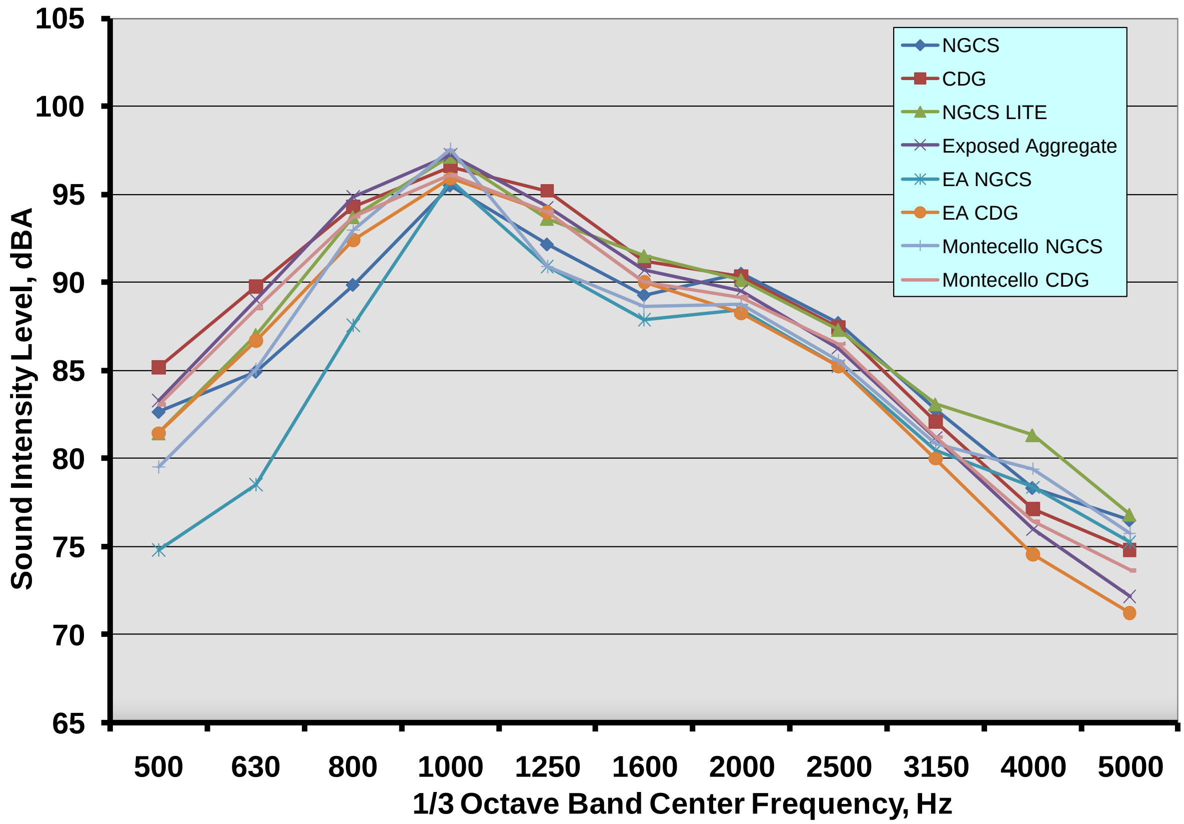

Figure 2 One-third Octave Center Band Levels for All Diamond Ground and Exposed Aggregate Test Sections

TABLE 1 OBSI TEST DATES AND TEST CONDITIONS

Test Date	Temperature Range During Tests (°F)	Tire Type	Months of Traffic
10-25-07	58-59	2006 ACPA SRTT	0
5-12-08	70-75	2006 ACPA SRTT	7
7-7-09	80-82	2009 ACPA SRTT	21
6-18-10	80-86	2009 ACPA SRTT	32

Prior to reviewing the results indicated in Figures 3 thru 6, the reader is advised to review the photos of the respective surfaces provided in Appendix 2-4. As evident in the photos, the roadway surface has several defects that may adversely affect the time series measurements. In addition, for the 2009 and 2010 measurements the tested wheel path was shifted to the left to avoid some of the roadway features. However, by shifting the measurement location it is possible to add variability to the process. Also, in 2008 the left lane was tested instead of the right lane as MnROADs had instrumentation trenches open and the travel lane could not be accessed. So the tested wheel path location has varied over time.

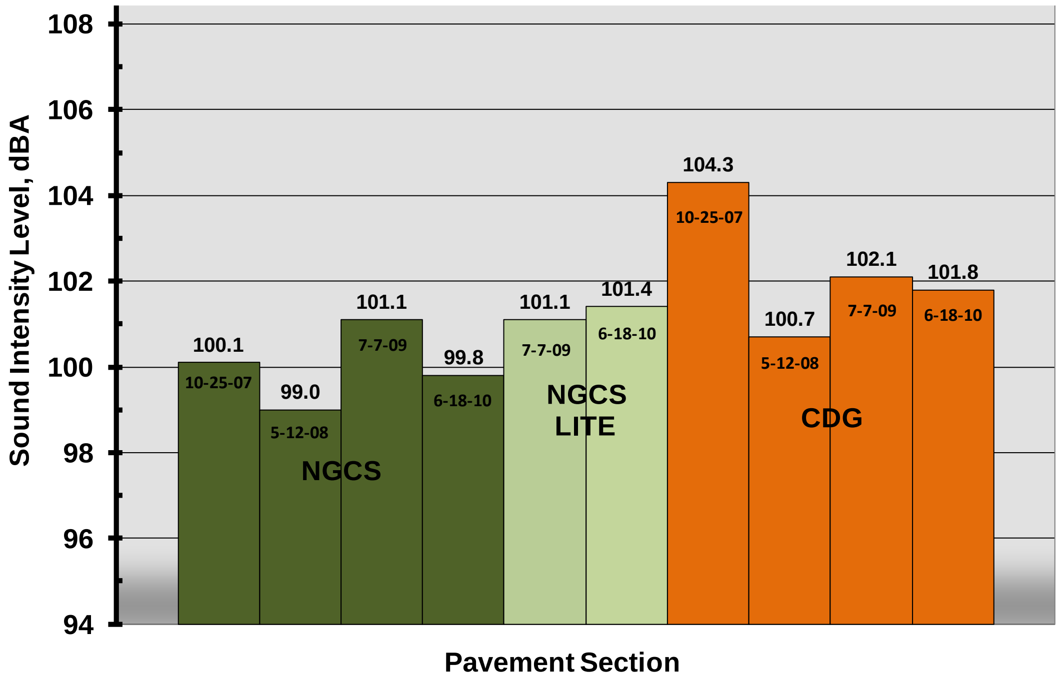

Figure 3 Overall OBSI Level as a Function of Time

Figures 4, 5, and 6 indicate the change in one-third octave spectra for the NGCS, NGCS LITE, and CDG surfaces respectively, over time. For the NGCS surface, the only noteworthy trend is that the 2010 measurement indicates a sudden rise in frequencies below 800 Hz. No explanation is offered at this time.

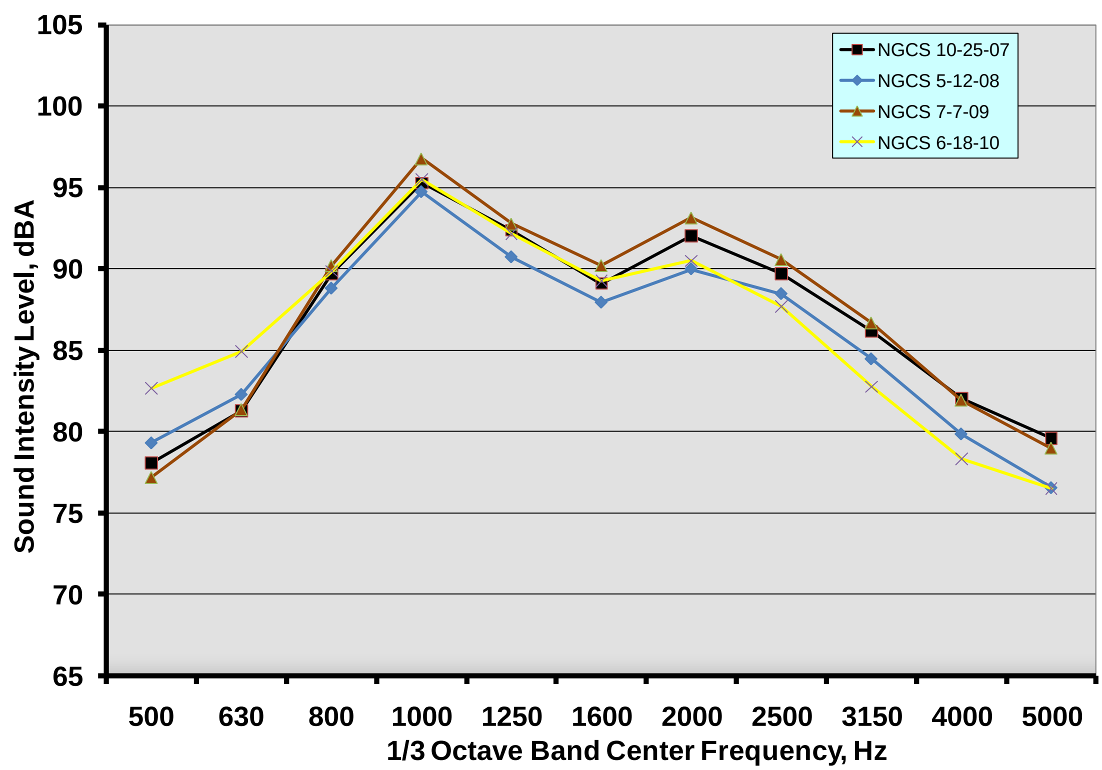

Figure 4 Time Series 1/3 Octave Band Spectra for NGCS Surface

Since only two test periods are available for the NGCS LITE texture, nothing remarkable appears to be occurring. In Figure 6 it is evident that fin reduction of the CDG texture which occurs after the initial construction has resulted in lower center band frequency levels below 1000 Hz. This is to be expected as the original construction had significant fins at the time of construction.

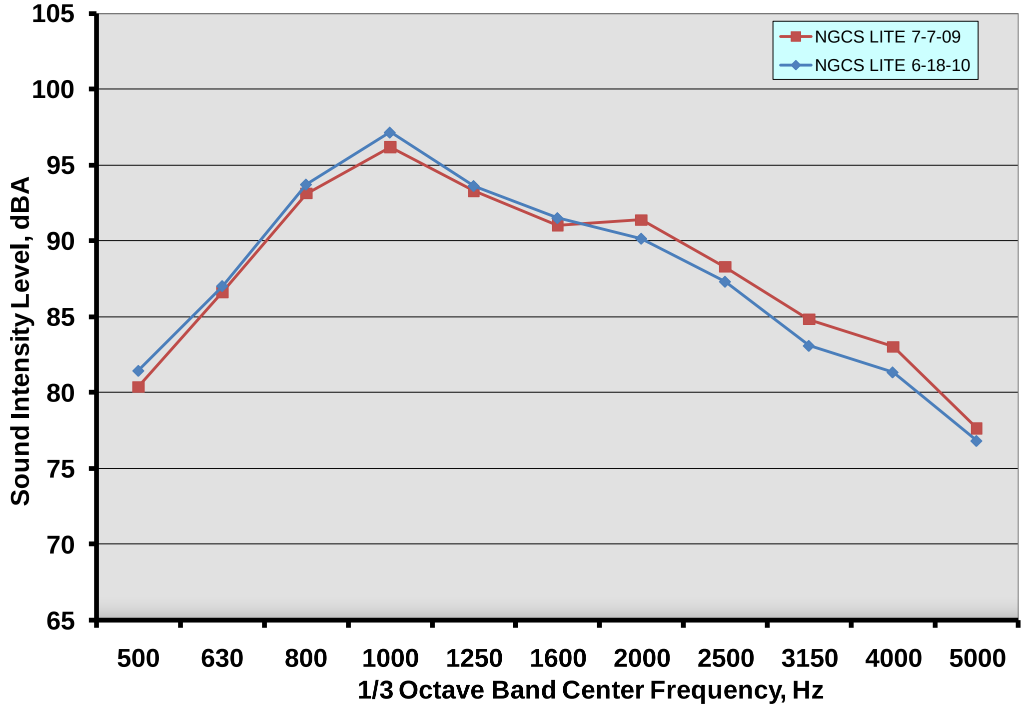

Figure 5 Time Series 1/3 Octave Band Spectra for NGCS LITE Surface

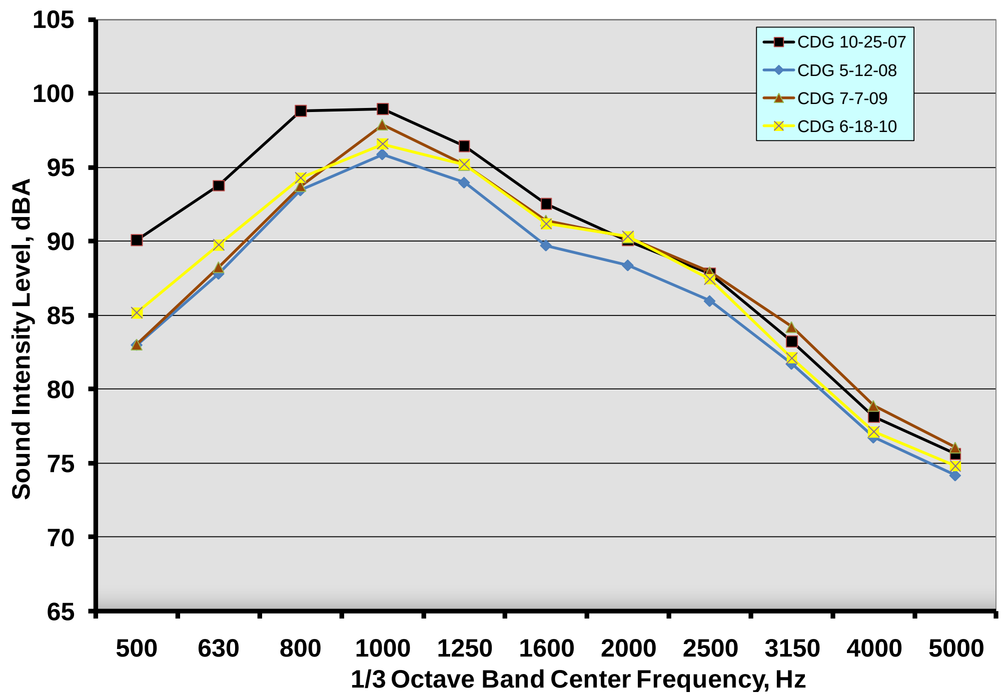

Figure 6 Time Series 1/3 Octave Band Spectra for CDG Surface

Appendix 1 Photos of Exposed Aggregate Test Section and Additional NGCS and CDG Sections Constructed within the Exposed Aggregate Area

Figure 1-1 Exposed Aggregate Surface

Figure 1-2 Overview of Exposed Aggregate Test Section

Figure 1-3 Close up of Exposed Aggregate Texture and Transverse Joint

Figure 1-4 Close Up of Exposed Aggregate Texture

Figure 1-5 NGCS (Shinny Surface) and CDG Section at End of Exposed Aggregate Section

Figure 1-6 NGCS (Travel Lane) and CDG (High Speed Lane) Ground Into Exposed Aggregate Test Section

Appendix 2 Photos of MnROADs Cell 9 NGCS LITE Test Section

Figure 2-1 Spalling in NGCS LITE Texture (Cell 9)

Figure 2-2 Depressed 12 “Core Hole Repairs and Existing Transverse Tining

Figure 2-3 12" Core Holes with Good Patches

Figure 2-4 Spalling at Joint and Backer Rod Exposed on Pavement Surface

Figure 2-5 Spalling and Backer Rod Failure

Appendix 3 Photos of MnROADs Cell 8 CDG Test Section

Figure 3-1 Hand Hole in Test Area

Figure 3-2 6” Core Hole Repairs

Figure 3-3 Spalled Joint and Failed Repair

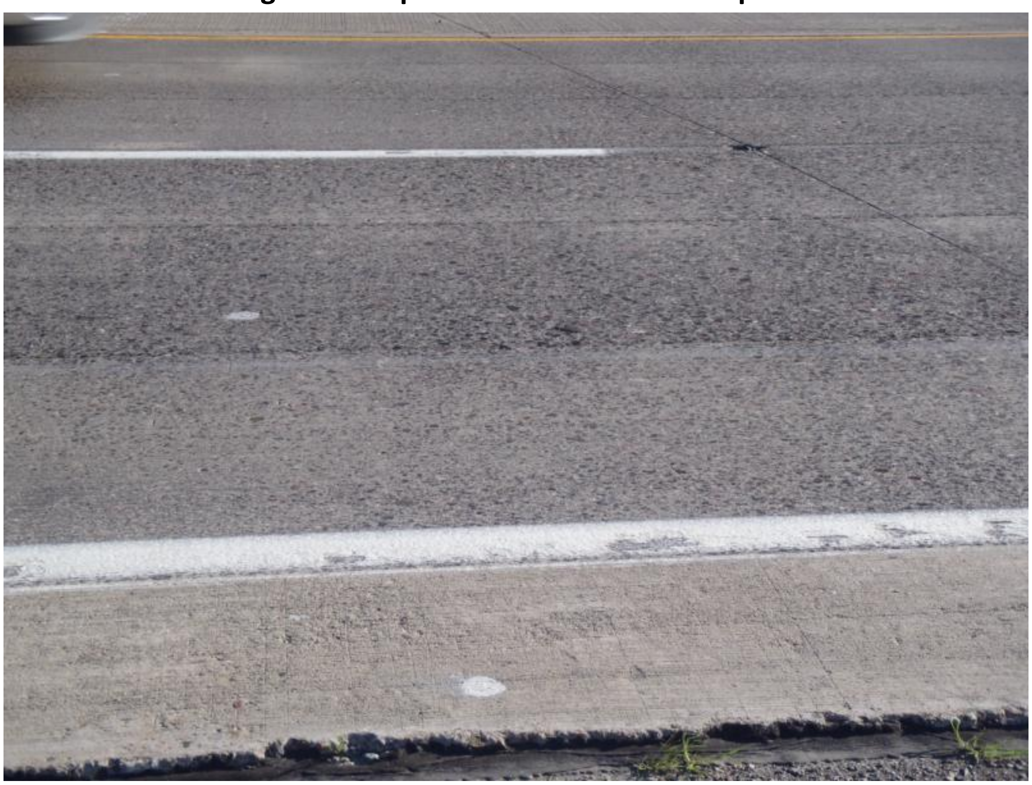

Figure 3-4 Texture in Outside Pass Appears Different

Figure 3-5 More Hand Holes in Section

Figure 3-6 Pot Hole Repair at Edge of Pavement

Figure 3-7 Spalls on Surface of Roadway

Appendix 4 Photos of MnROADs Cell 7 NGCS Test Section

Figure 4-1 Spalling at Joint

Figure 4-2 Hand Hole with Grass and Sealant Failure in Transverse Joint

Figure 4-3 6" Core Hole Repairs and Spalling at Joint

Figure 4-4 Hand Holes in Pavement

Figure 4-5 Spalling at Joint

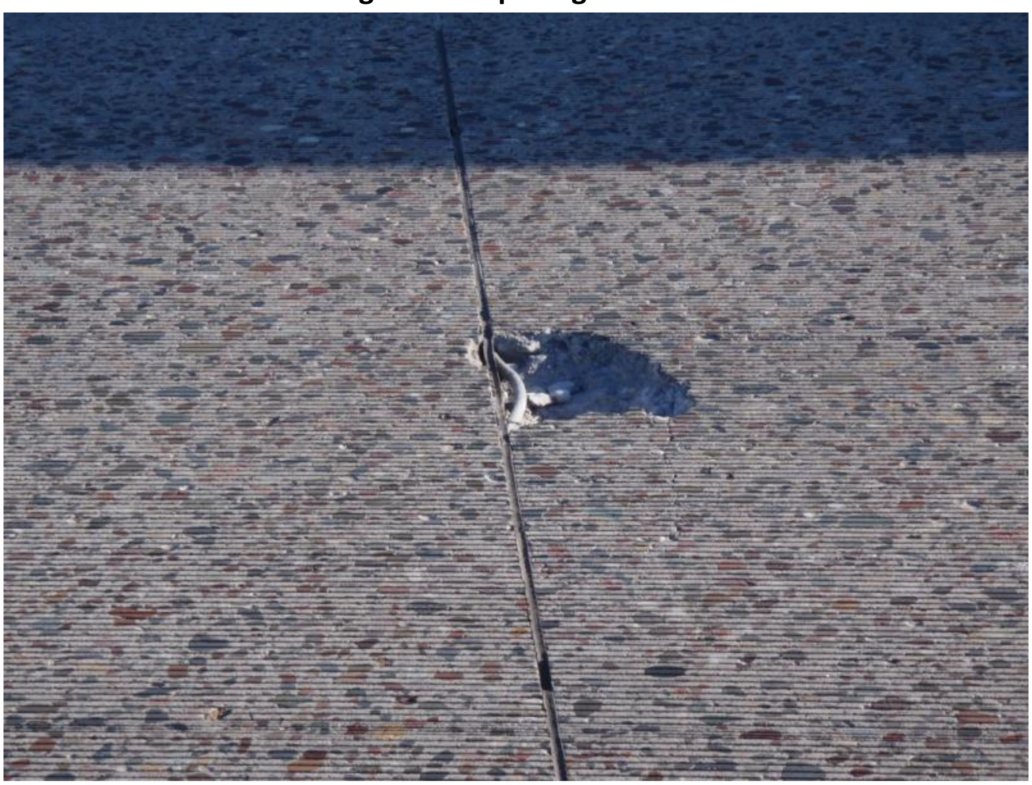

Figure 4-6 Spalling at Joint

Figure 4-7 6” Core Hole Depression

Appendix 5 Photos of I-94 Montecello CDG Section

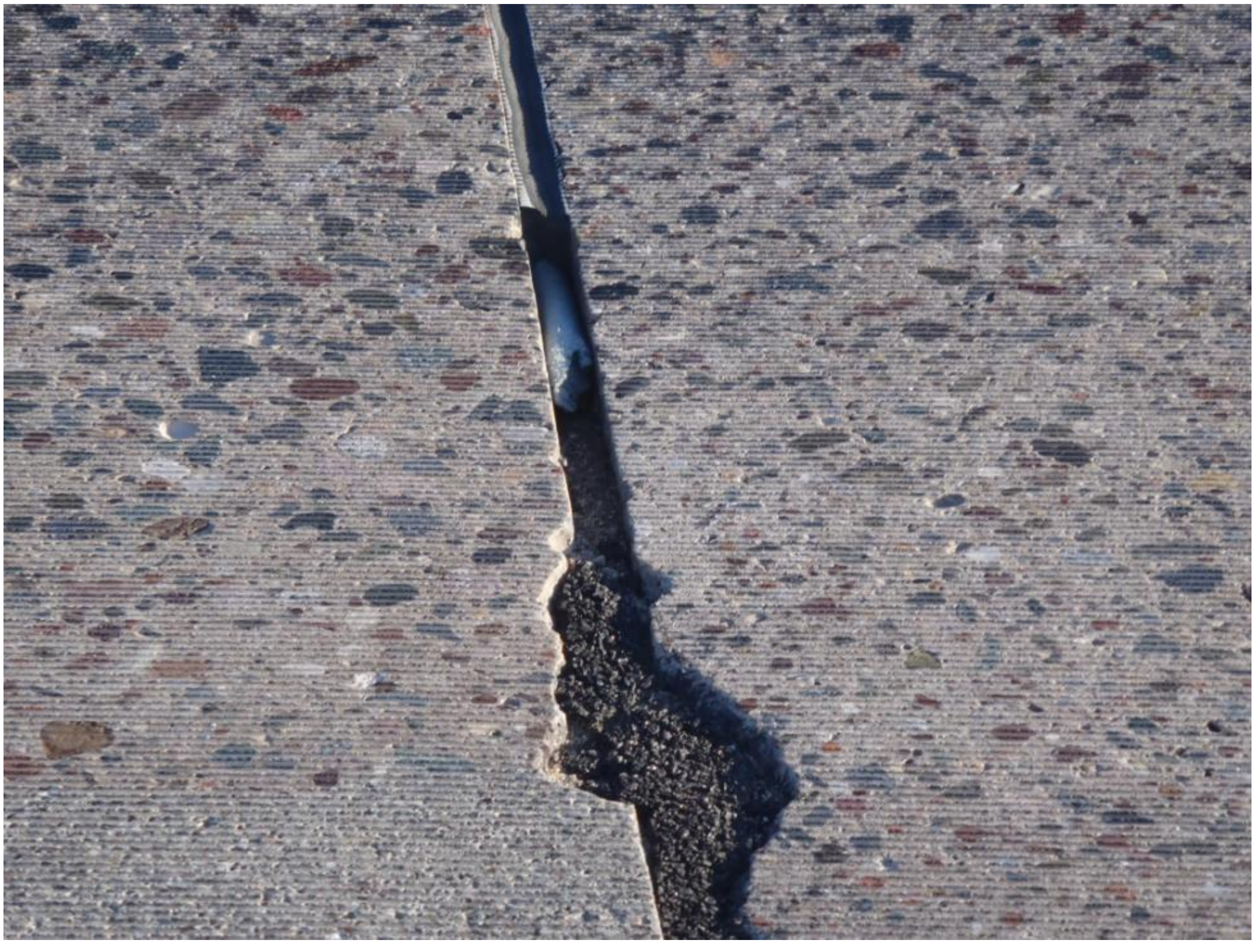

Figure 5-1 Spalled Joint and Failed Sealant in Wide Joint

Figure 5-2 Failed Sealant on Shoulder of Roadway