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RESEARCH

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# Ultra-thin Bonded Wearing Course Performance Update, Minnesota

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# Ultra-thin Bonded Wearing Course Performance Update, Minnesota

## Final Report


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16. Abstract (Limit: 250 words)


Ultra-thin bonded wearing course (UTBWC) is a method of extending pavement life for both hot mix asphalt (HMA) and Portland cement concrete (PCC) roads. For this reason the Minnesota Department of Transportation (Mn/DOT) proposed and constructed test sections in the summer of 2004 and 2005 in the Twin Cities to demonstrate the effectiveness of this type of design.

The focus of this report is about how a construction of UTWBC would improve ride quality of a pavement and if any distresses occurred after the construction. By obtaining data from Mn/DOT Pavement Management Office, UTBWC showed promise for future pavement maintenance design. After the construction of UTBWC, ride quality index (RQI) improved without any major distresses. Some of the minor distresses observed after construction were longitudinal and transverse joint distresses that were a reflective cracking from the bottom of the in-place concrete joints.


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# Executive Summary

Ultra-thin bonded wearing course (UTBWC) is a method of extending pavement life for both hot mix asphalt (HMA) and Portland cement concrete (PCC) roads. For this reason the Minnesota Department of Transportation (Mn/DOT) proposed and constructed test sections in the summer of 2004 and 2005 in the Twin Cities to demonstrate the effectiveness of this type of design.

The focus of this report is about how a construction of UTWBC would improve ride quality of a pavement and if any distresses occurred after the construction. By obtaining data from Mn/DOT Pavement Management Office, UTBWC showed promise for future pavement maintenance design. After the construction of UTBWC, ride quality index (RQI) improved without any major distresses. Some of the minor distresses observed after construction were longitudinal and transverse joint distresses that were reflective cracking from the bottom of the in-place concrete joints.

# Chapter 1
# Introduction

This paper reviews the performance of ultra-thin bonded wearing course (also referred to by the proprietary name Novachip$^{TM}$) on high traffic volume pavements in Minnesota. Much of the performance evaluation involved ride quality data and photos obtained from ultra-thin bonded wearing course overlays on four different sections. These sections were in the Twin-Cities area and were chosen as part of an ongoing assessment.

## UTBWC History

Ultra-thin bonded wearing course (UTBWC) is used as a pavement maintenance and rehabilitation mainly on hot mixed asphalt pavements. This method was invented in France in 1986. Specially built paving machine is used during the construction, it sprays relatively thick and warm emulsion onto the pavement surface and places thin gap-graded hot mix asphalt that meet the design thickness. This process was used in 1999 on an US-169 section in a rural area of Minnesota. A study of the US-169 project was performed in 2007 and appeared to show a promise in pavement surface rehabilitation, and in providing the maintenance engineers with a cost-effective alternative solution [1].

Some of the advantages for using UTBWC instead of other surface treatment practice are speedy application during construction, immediate opening to traffic and reduces tire noise. UTBWC can be used as a surface seal for hot mix asphalt pavements to slow down deterioration caused by traffic, weathering, raveling and oxidation [2]. It can be used to seal small cracks and provides a wearing surface with excellent frictional resistance when non-polishing aggregates are used for the coated chips.

## Material Used and Construction Procedure

Construction of UTBWC is the application of a warm polymer modified emulsion membrane followed immediately with an ultra-thin wearing course. Hot mix asphalt composed of about 6% asphalt binder of PG 70-28. Depending on the 3/8" gap graded coarse aggregate in the mix, the binder content slightly varied from 6% binder content to meet Mn/DOT mix design. This type of coarse aggregate, Mn/DOT define as Class A aggregate or specifies as Mn/DOT 3139.2A2a and meets the testing requirements in Table 1 below.

**Table 1: Coarse aggregate testing requirements**

| Tests | Method | Limit |
|---|---|---|
| Flat & Elongated Ratio @ 3:1, % | ASTM D 4791 | 25 max |
| % Crushed, single face | ASTM D 5821 | 95 min |
| % Crushed, two or more Mechanically crushed faces | ASTM D 5821 | 85 min |
| Micro-Deval, % loss | AASHTO TP58 | 18 max |

Specially built paver was used during the construction of all the UTBWC sections. This paver machine incorporated a receiving hopper, feed conveyor, a storage tank for polymer modified emulsion membrane. The paver can place UTBWC at a rate of 10 – 30 meters/minute [30 to 90 ft/minute]. The screed of the paver had the ability to crown the pavement at the center both positively and negatively and had vertically adjustable extensions to accommodate the desired pavement profile. Polymer modified emulsion membrane was sprayed by the machine prior to the application of the UTBWC at range temperature of 50 – 80 $^{o}$C (120 – 180 $^{o}$F) and spray rate of about 0.20 gal/yd$^2$.

**Table 2: Polymer modified emulsion membrane requirements**

| **Test on Emulsion** | **Method** | **Min.** | **Max.** |
|---|---|---|---|
| Viscosity, Saybolt @ 25 $^{o}$C[77 $^{o}$F] | AASHTO T59 | 20 | 100 |
| Storage Stability Test[1], 24h, % | AASHTO T59 | | 1 |
| Sieve Test | AASHTO T59 | | 0.05 |
| Residue by Distillation[2], % | AASHTO T59 | 63 | |
| Oil Distillate by Distillation, % | AASHTO T59 | | 2 |
| Demulsibility, 35 ml, 0.8% dioctyl sodium sulfosuccinate, % | | | |
| **Tests of Residue From Distillation** | | | |
| Penetration @ 25$^{o}$C[77$^{o}$ F] | AASHTO T49 | 60 | 150 |
| Solubility in trichloroethylene, % | AASHTO T44 | 97.5 | |
| Elastic Recovery, % | AASHTO T301 | 60 | |
| [1]Note: After standing undisturbed for 24 hours, the surface shall be a smooth homogenous color throughout.<br>[2]Note: AASHTO T59 with modifications to include a 200 $^{o}$C [392 $^{o}$F] maximum temperature to be held for a period of 15 minutes. | | | |

**Table 3: Mix requirements, composition by weight percentages**

| SIEVES Typical application rates | | **9.5 mm [3/8-in.] - Type B 65-75 lbs/sy** |
|---|---|---|
| ASTM mm | in | Design General Limits % Passing |
| 19 | 3/4 | |
| 12.5 | 1/2 | 100 |
| 9.5 | 3/8 | 85 - 100 |
| 4.75 | #4 | 28 - 42 |
| 2.36 | #8 | 22 - 32 |
| 1.18 | #16 | 15 - 23 |
| 600 µm | #30 | 10 - 18 |
| 300 µm | #50 | 8 - 13 |
| 150 µm | #100 | 6 - 10 |
| 75 µm | #200 | 4 - 5.5 |
| Asphalt Content, % = 4.8 - 6.0 % | | |
| Draindown Test, AASHTO T305 = 0.10% max | | |
| Film thickness = 9 µm [0.41 mil] min. | | |
| Moisture Sensitivity, AASHTO T282 = 80 % min | | |

During the compaction processes, a steel double drum asphalt roller was used with a minimum weight of 10 metric tons. These rollers are equipped with a functioning water system and scrapers to prevent adhesion of the fresh mix onto the roller drums.

# Chapter 2
# Performance Evaluation

All UTBWC applied sections have had performance data collected annually. These data were Average Annually Daily Traffic (AADT) including percent of trucks, Ride Quality Index (RQI), Equivalent Single Axle Loading, International Roughness Index, rutting and video log for inspecting surface condition. Most of the measurements mentioned in this paragraph can be found in the appendix section.

Mn/DOT currently collects pavement condition data by using a special vehicle that measure rutting, International Roughness Index (IRI) and records video log of the pavement surface. In 1997 Mn/DOT modified a conversion formula for finding RQI from IRI. This was base on 32 citizens rating 120 different sections by rating the ride condition with a scale of 0 to 5, and it was correlated to IRI data. Also the IRI correlated was only based on the left path wheel. Before 1997, RQI was base on average of IRI for both wheels and was a used slightly different conversion formula.

Performance evaluation of this project primarily focuses on RQI and photos obtained from Mn/DOT's van that collects annually IRI and video for pavement surface.

**UTBWC Section on I-94 (WB)**

West bound interstate highway I-94 near Rogers, MN.  UTBWC was constructed in the summer of 2005 as a test section. A special paver-machine as mentioned previously was used, the machine applied modified emulsion membrane to the pavement surface and immediately placed ¾ inch of HMA with a gap graded aggregate. Prior the construction of the project, the inplace concrete pavement was grooved in 1990 and the UTBWC was placed directly on grooved PCC pavement.

**Table 4: I-94 (WB) section, mile post 209.293 -- 208.323**

| Description layer | DEPTH | DATE |
|---|---|---|
| UTBWC | 0.75 | 2005 |
| Groove concrete | N/A | 1990 |
| Concrete joint repair | N/A | 1985 |
| Concrete (Doweled) built | 9.00 | 1974 |
| Aggregate base | 6.00 | 1974 |
| Grading | N/A | 1973 |

As of May, 2008 the major distress in this UTBWC section occurred along transverse and longitudinal joints. The cracks appeared to be propagating from the bottom. After further visual inspection, it was found that cracks occurred where the longitudinal/transverse joints of the concrete pavement were located. Figure 1 & 2 below illustrates the findings.

**Figure 1: Transverse joint deterioration, photo taken summer of 2008.**

**Figure 2: Longitudinal joint deterioration, photo taken summer of 2008.**

Another distress observed was missing pieces of UTBWC along cracks, revealing the concrete pavement surface.

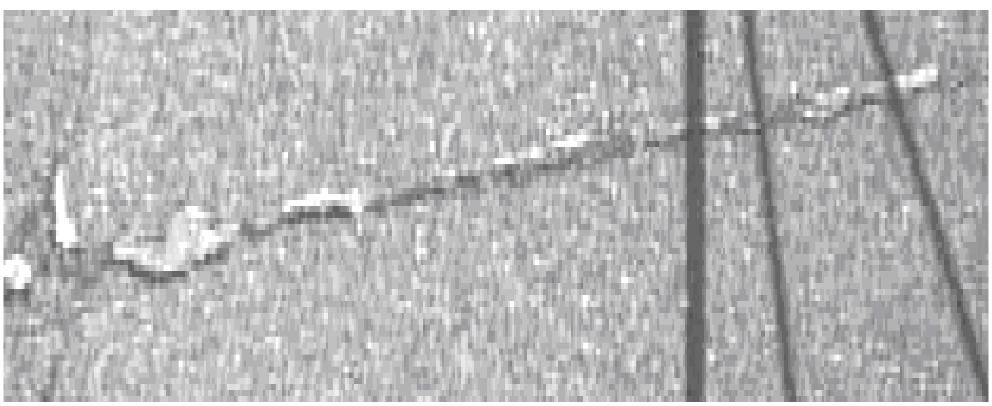

**Figure 3: Close-up of transverse crack on I-94 section, photo taken summer of 2008.**

As part of Mn/DOT pavement condition rating, the RQI was measured every year in order to study and predicted when to rehabilitate or reconstruct a new pavement section. Figure 4 below shows the RQI of the section. It shows that ride improved after the UTBWC was applied in 2005 and dip down a little bit the following year and then stay about same for the next two years.

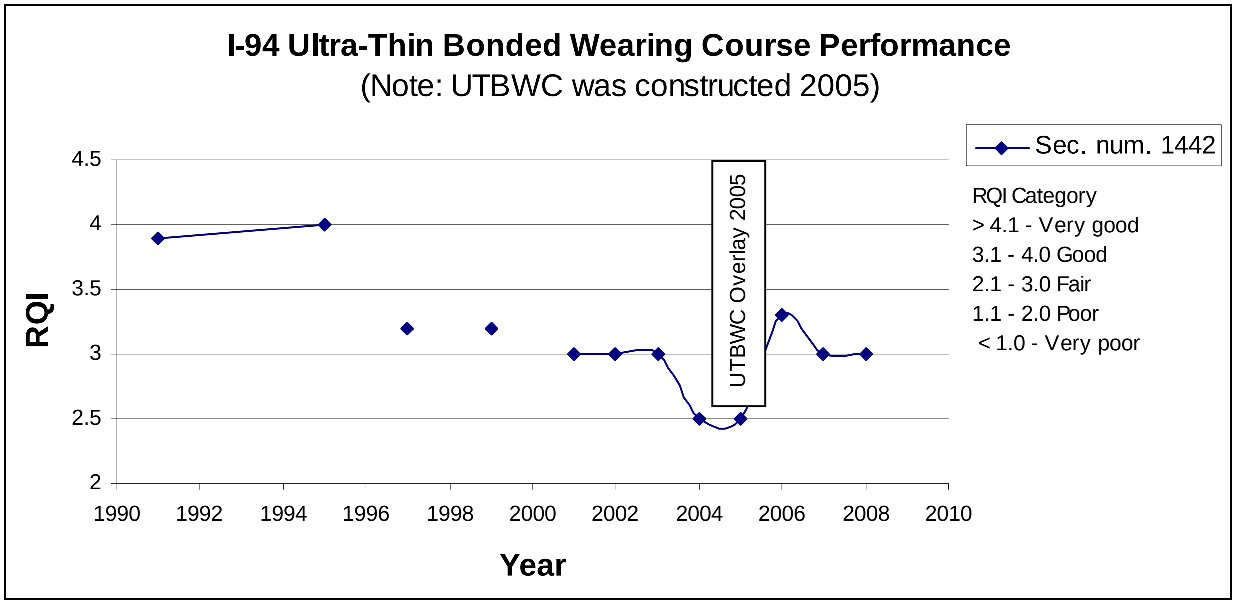


**Figure 4: I-94 (WB) section, mile post 209.293 -- 208.323.**

**UTBWC Section on I-35 W (SB)**

This UTBWC section was constructed in the summer of 2005 on I-35 W (SB) in Bloomington, MN. The limits of this project were between MP 9.190 to MP 3.163. This section is composed of a jointed plain concrete pavement (JPCP) with bituminous overlay that was built in 1992.

**Table 5: I-35 W (SB) section**

| Description | DEPTH | DATE |
|---|---|---|
| UTBWC | 0.50 | 2004 |
| Bituminous overlay | 3.00 | 1992 |
| Mill bituminous (Partial depth) | 3.00 | 1992 |
| Bituminous overlay | 3.00 | 1982 |
| Mill bituminous (Partial depth) | 1.00 | 1982 |
| Bituminous overlay | 1.00 | 1978 |

This section has 0.5 inch of UTBWC. The overall condition of the surface was intact with no major cracks except minor reflective cracks along the longitudinal joints.

The section composed of three adjacent subsections. These subsections had relatively good RQI according to Mn/DOT rating with an RQI greater than 3 prior the construction of UTBWC. After the construction of the UTBWC the RQI jump by an average of 7.0% and stayed about the same for a year. After that the RQI dipped down to the value of RQI just before the construction and stayed the same the following year (2008). Figure 6 below illustrates behavior of RQI explained in this paragraph.

**Figure 5: UTBWC on I-35W section with no major distresses, photo taken summer of 2008.**

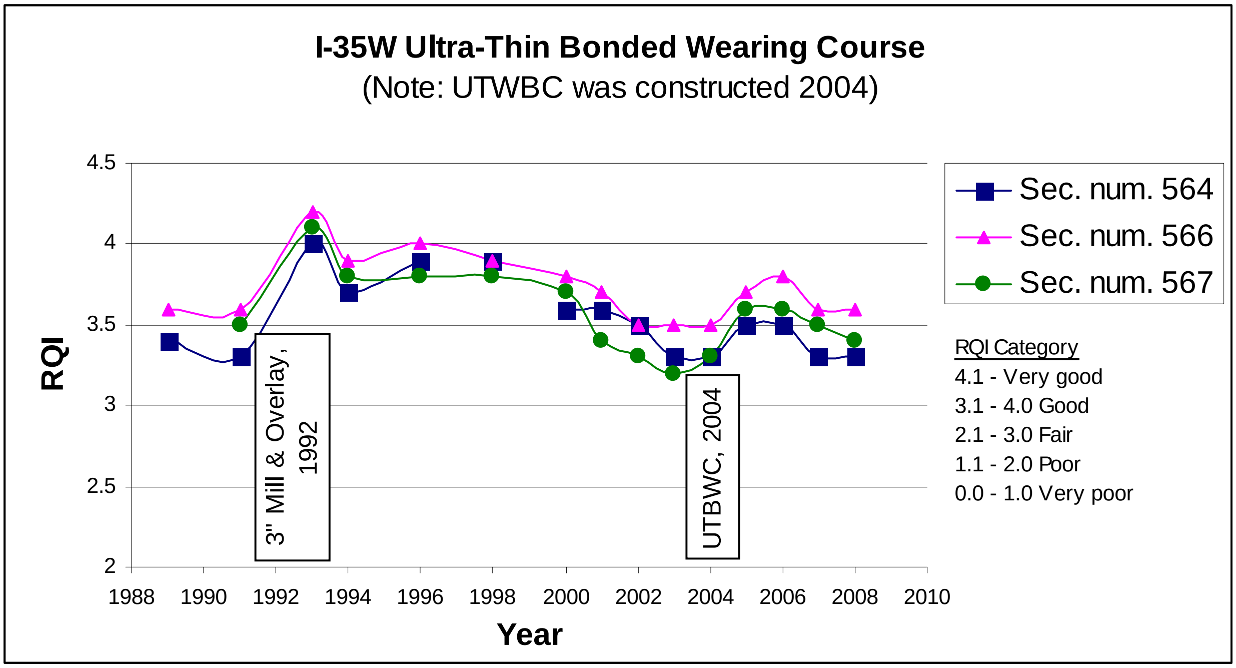


**Figure 6: I-35W (MP 9.190 – 3.163) section.**

**UTBWC Section on I-394**

The construction of UTBWC of this Interstate highway was finished in the summer of 2004. Prior to the UTBWC, the sections both east and west bound were milled off an existed 1.75" overlay exposing inplace doweled concrete pavement surface and placed ¾" of UTBWC. Brief description is in Table 5 below.

**Table 6: I-394 section (MP 6.246 -- 7.596), both directions**

| Layer Description | DEPTH | DATE |
|---|---|---|
| UTBWC | 0.75 | 2004 |
| Mill bituminous (Partial depth) | 1.75 | 2004 |
| Bituminous overlay | 1.75 | 1996 |
| Concrete (Doweled) built | 10.00 | 1991 |
| Aggregate base | 3.00 | 1991 |
| Grading | N/A | 1991 |

In 2008, the Mn/DOT video log showed that the section was in good condition except a few spots where the UTBWC came off exposing the inplace concrete surface.

**Figure 7: I-394 (EB) section, photo taken summer of 2008.**

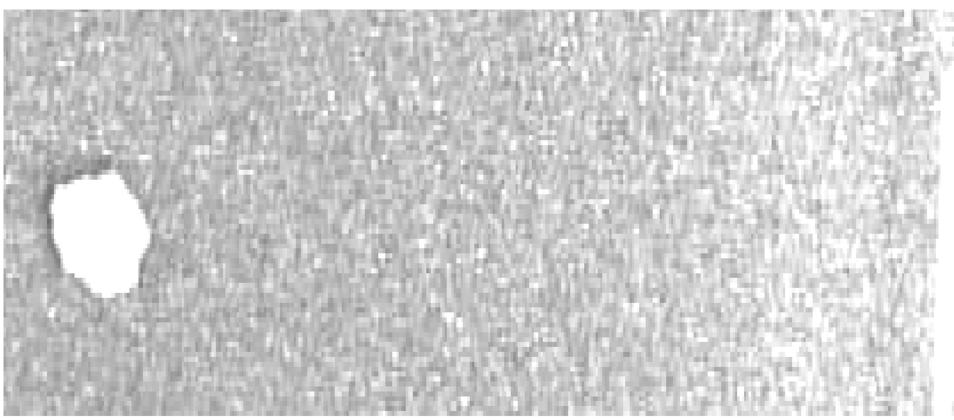

**Figure 8: I-394 (WB) section, this figure is about 5 ft wide. Photo taken summer of 2008.**

Measurement of RQI for both east and west bound sections showed relatively the same behavior in terms of increasing or decreasing RQI values over the years, between 2001 to 2006 west bound had higher RQI than east bound at one time about 17% differences. Figure 9 below shows RQI vs. Year for both lanes.

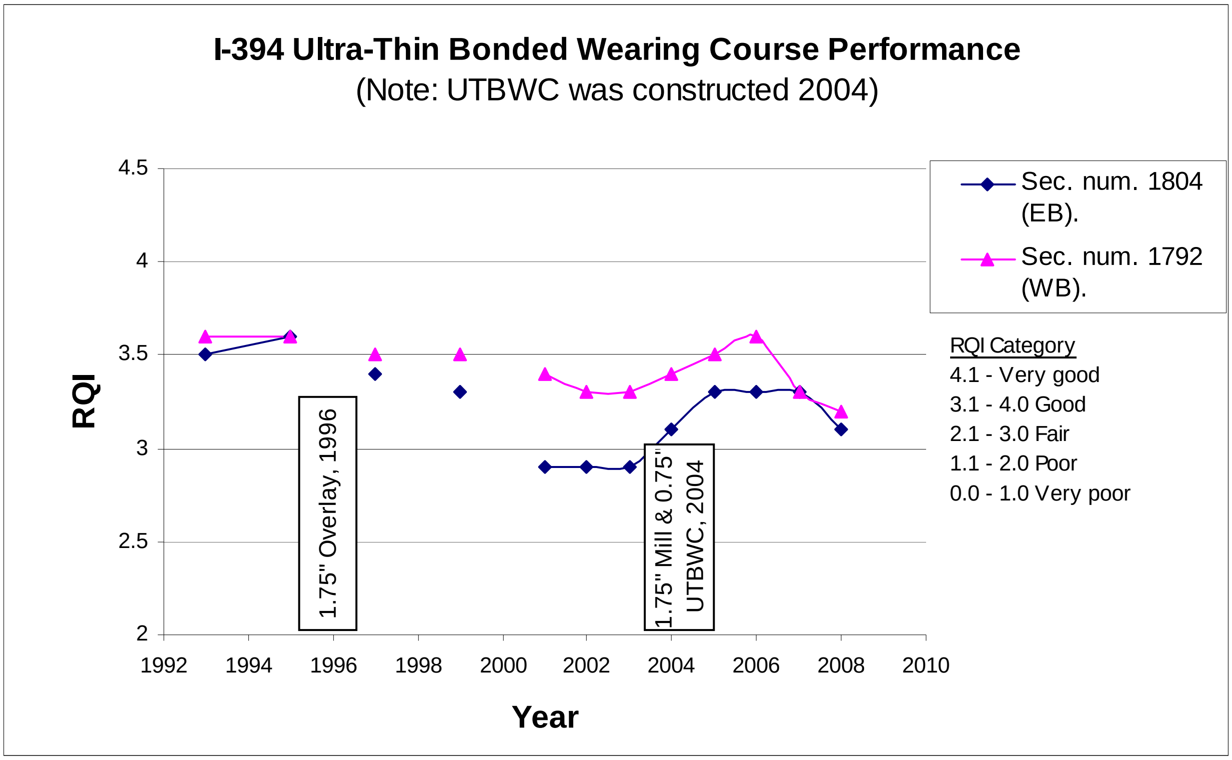


**Figure 9: I-394 section (MP 6.246 -- 7.596), both directions.**

**UTBWC Section on MNTH-55 (WB)**

The construction of UTBWC was completed in the summer of 2005. On this project the UTBWC was placed on an existing bituminous overlay that had been crack repaired in the summer of 1999.

**Table 7: MNTH-55 (WB) section, mile post 184.630 -- 180.591**

| Layer Description | DEPTH | DATE |
|---|---|---|
| UTBWC | 0.75 | 2005 |
| Major crack repair | N/A | 1999 |
| Bituminous overlay | 4.50 | 1996 |
| Mill bituminous (Partial depth) | 3.00 | 1996 |
| Bituminous overlay | 4.50 | 1984 |
| Mill bituminous (Partial depth) | 2.50 | 1984 |
| Aggregate seal (Chip seal) | 0.63 | 1972 |
| Aggregate seal (Chip seal) | N/A | 1966 |
| Bituminous layer | 3.00 | 1955 |
| Bituminous base | 1.00 | 1955 |
| Aggregate base | 5.00 | 1955 |
| Grading | N/A | 1952 |

Review of the video log taken in the summer of 2008 showed that the UTBWC was in a good condition with minor longitudinal and transverse cracks that propagated from the bottom.

**Figure 10: MNTH-55 (WB), photo taken summer of 2008.**

This section has two subsections (Secnum 11541 and Secnum 11542) adjacent to each other. According to the collected RQI values, these adjacent subsections had fluctuating values, but after UTBWC was constructed the values were similar. In 2006 and 2007 the RQI of both subsections improved and decrease slowly without major dipping in 2008. Figure 8 below shows RQI values for both subsections (i.e. Secnum 11541 and 11542).

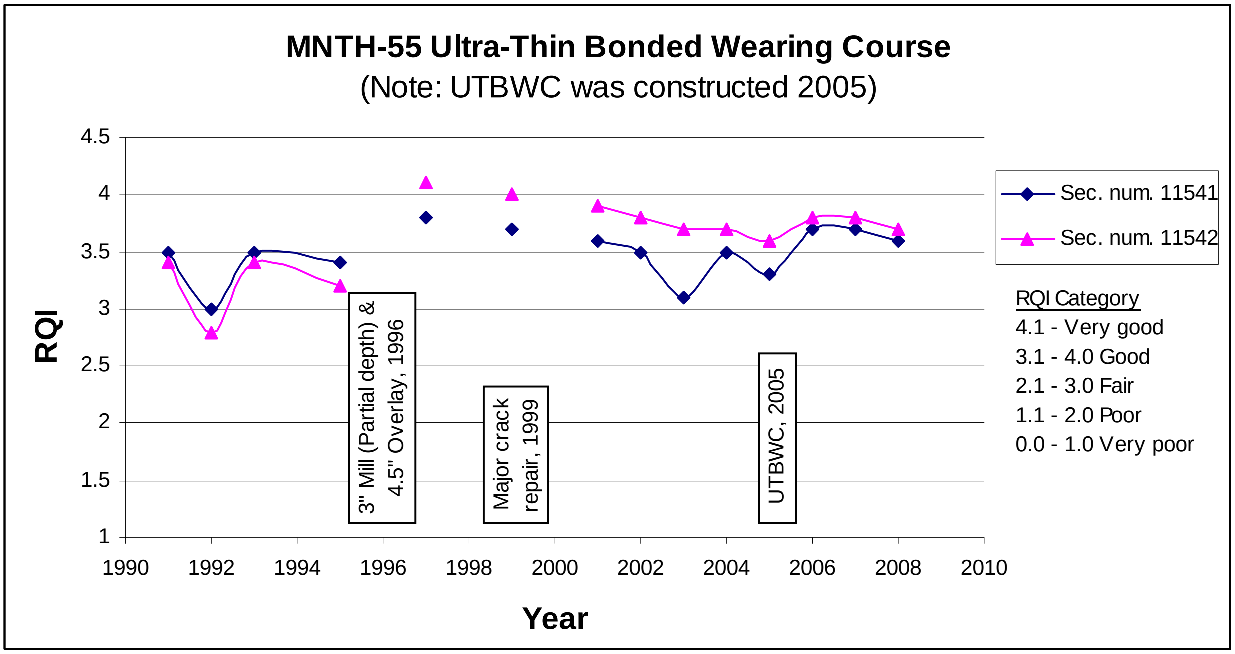


**Figure 11: MNTH-55 (WB) section, mile post 184.630 -- 180.591.**

# Chapter 3
# Conclusion

Overall condition of all the UTWBC sections constructed in the summer of 2004 and summer of 2005 in the Twin Cities showed a promising performance up to now with only minor deterioration. Most of the distresses were along transverse and longitudinal joints; this type of distress is common on bituminous overlay on Jointed Plain Concrete pavement.

This product dramatically improved the IRI of all the sections. It showed a good bond both on bituminous and concrete surfaces. All sections revealed no major cracks in 2008 which stop runoff water and deicing chemicals from getting into the pavement.

Constant increase of traffic flow on Twin Cities highways and the need for shortening highway lane closure time, UTWBC would give a better choice for pavement engineers when needing to maintain and improve the ride quality of a pavement.

A good decision can only be made when the life service of these sections is achieved and compared with the Mn/DOT current pavement maintenance life expectancy and cost.

# REFERENCES


1. Ruranika, M. and Geib, J. (2007). *Performance of Ultra-Thin Bounded Wearing Course (UTBWC) Surface Treatment On US-169*, Princeton, MN, Minnesota Local Road Research Board, Report No. MN/RC – 2007-18.
2. Pierce, L.M., Uhlmeyer, J.S., and Weston, J.T. (2003). *NOVACHIP® Post Construction/Performance Report*, Washington State Department of Transportation, June.

# Appendix A
# Data about Traffic and Distresses of the Road Sections

| ROAD | Direction | Sec. num. | Year | AADT | ESAL | Truck Percent | IRI (m/km) | RUTTING (in) |
|---|---|---|---|---|---|---|---|---|
| I-35W | SB | 564 | 1989 | | | | | |
| I-35W | SB | 564 | 1991 | | | | 1.96 | |
| I-35W | SB | 564 | 1993 | | | | 0.91 | |
| I-35W | SB | 564 | 1994 | | | | 1.23 | |
| I-35W | SB | 564 | 1996 | 100768 | 1188077 | 8.1 | 1.06 | |
| I-35W | SB | 564 | 1997 | 105101 | 1258737 | 8.1 | | |
| I-35W | SB | 564 | 1998 | 109827 | 1063910 | 6.5 | 0.77 | |
| I-35W | SB | 564 | 1999 | 112683 | 1108221 | 6.5 | | |
| I-35W | SB | 564 | 2000 | 109877 | 1140130 | 6.7 | 0.99 | |
| I-35W | SB | 564 | 2001 | 114272 | 1203284 | 6.7 | 1.18 | 0.22 |
| I-35W | SB | 564 | 2002 | 109584 | 1245269 | 7.2 | 1.19 | 0.17 |
| I-35W | SB | 564 | 2003 | 111557 | 1279751 | 7.1 | 1.31 | 0.23 |
| I-35W | SB | 564 | 2004 | 110257 | 1373439 | 7.6 | 1.31 | 0.18 |
| I-35W | SB | 564 | 2005 | 111359 | 1397606 | 7.6 | 1.15 | 0.22 |
| I-35W | SB | 564 | 2006 | 109201 | 1364885 | 7.5 | 1.13 | 0.17 |
| I-35W | SB | 564 | 2007 | 109201 | 1407760 | 7.6 | 1.25 | 0.15 |
| I-35W | SB | 564 | 2008 | | | | 1.3 | 0.18 |

| ROAD | Direction | Sec. num. | Year | AADT | ESAL | Truck Percent | IRI (m/km) | RUTTING (in) |
|---|---|---|---|---|---|---|---|---|
| I-35W | SB | 566 | 1989 | | | | | |
| I-35W | SB | 566 | 1991 | | | | 1.59 | |
| I-35W | SB | 566 | 1993 | | | | 0.76 | |
| I-35W | SB | 566 | 1994 | | | | 1.07 | |
| I-35W | SB | 566 | 1996 | 100768 | 1188077 | | 0.95 | |
| I-35W | SB | 566 | 1998 | 109827 | 1063910 | 6.5 | 0.74 | |
| I-35W | SB | 566 | 2000 | 109877 | 1140130 | 6.7 | 0.83 | |
| I-35W | SB | 566 | 2001 | 114272 | 1203284 | 6.7 | 0.93 | 0.19 |
| I-35W | SB | 566 | 2002 | 109584 | 1245269 | 7.2 | 1.07 | 0.15 |
| I-35W | SB | 566 | 2003 | 111557 | 1279751 | 7.1 | 1.08 | 0.2 |
| I-35W | SB | 566 | 2004 | 110257 | 1373439 | 7.6 | 1.09 | 0.19 |
| I-35W | SB | 566 | 2005 | 111359 | 1397606 | 7.6 | 0.9 | 0.21 |
| I-35W | SB | 566 | 2006 | 109201 | 1364885 | 7.5 | 0.88 | 0.14 |
| I-35W | SB | 566 | 2007 | 109201 | 1407760 | 7.6 | 1 | 0.14 |
| I-35W | SB | 566 | 2008 | | | | 1.04 | 0.16 |

| ROAD | Direction | Sec. num. | Year | AADT | ESAL | Truck Percent | IRI (m/km) | RUTTING (in) |
|---|---|---|---|---|---|---|---|---|
| I-35W | SB | 567 | 1991 | | | | 1.8 | |
| I-35W | SB | 567 | 1993 | | | | 0.81 | |
| I-35W | SB | 567 | 1994 | | | | 1.13 | |
| I-35W | SB | 567 | 1996 | 100768 | 1188077 | 8.1 | 1.2 | |
| I-35W | SB | 567 | 1998 | 109827 | 1063910 | 6.5 | 0.82 | |
| I-35W | SB | 567 | 2000 | 109877 | 1140130 | 6.7 | 0.91 | |
| I-35W | SB | 567 | 2001 | 114272 | 1203284 | 6.7 | 1.15 | 0.16 |
| I-35W | SB | 567 | 2002 | 109584 | 1245269 | 7.2 | 1.27 | 0.14 |
| I-35W | SB | 567 | 2003 | 111557 | 1279751 | 7.1 | 1.36 | 0.18 |
| I-35W | SB | 567 | 2004 | 110257 | 1373439 | 7.6 | 1.28 | 0.14 |
| I-35W | SB | 567 | 2005 | 111359 | 1397606 | 7.6 | 0.96 | 0.2 |
| I-35W | SB | 567 | 2006 | 109201 | 1364885 | 7.5 | 0.99 | 0.14 |
| I-35W | SB | 567 | 2007 | 109201 | 1407760 | 7.6 | 1.09 | 0.13 |
| I-35W | SB | 567 | 2008 | | | | 1.22 | 0.15 |

| ROAD | Direction | Sec. num. | Year | AADT | ESAL | Truck Percent | IRI (m/km) | RUTTING (in) |
|---|---|---|---|---|---|---|---|---|
| I-94 | WB | 1442 | 1991 | | | | 1.2 | |
| I-94 | WB | 1442 | 1995 | | | | 1.26 | |
| I-94 | WB | 1442 | 1996 | 60000 | 1176475 | 11 | | |
| I-94 | WB | 1442 | 1997 | 62580 | 1239611 | 11 | 1.45 | |
| I-94 | WB | 1442 | 1998 | 69000 | 1149750 | 9.1 | | |
| I-94 | WB | 1442 | 1999 | 70794 | 1191477 | 9.1 | 1.45 | |
| I-94 | WB | 1442 | 2000 | 77000 | 1535738 | 10.7 | | |
| I-94 | WB | 1442 | 2001 | 80080 | 1612826 | 10.7 | 1.89 | |
| I-94 | WB | 1442 | 2002 | 79000 | 1303926 | 8.7 | 1.82 | |
| I-94 | WB | 1442 | 2003 | 80422 | 1367244 | 8.9 | 2.02 | |
| I-94 | WB | 1442 | 2004 | 89000 | 1505041 | 8.7 | 2.25 | |
| I-94 | WB | 1442 | 2005 | 89890 | 1529003 | 8.7 | 2.29 | |
| I-94 | WB | 1442 | 2006 | 93000 | 1602423 | 8.7 | 1.69 | |
| I-94 | WB | 1442 | 2007 | 93000 | 1889987 | 10.2 | 1.77 | 0.13 |
| I-94 | WB | 1442 | 2008 | | | | 1.6 | 0.17 |

| ROAD | Direction | Sec. num. | Year | AADT | ESAL | Truck Percent | IRI (m/km) | RUTTING (in) |
|---|---|---|---|---|---|---|---|---|
| I-394 | EB | 1804 | 1991 | | | | | |
| I-394 | EB | 1804 | 1993 | | | | 1.74 | |
| I-394 | EB | 1804 | 1995 | | | | 1.61 | |
| I-394 | EB | 1804 | 1996 | 135000 | 630337 | 3.2 | | |
| I-394 | EB | 1804 | 1997 | 140805 | 667784 | 3.2 | 1.32 | |
| I-394 | EB | 1804 | 1998 | 143000 | 687551 | 3.2 | | |
| I-394 | EB | 1804 | 1999 | 146718 | 716254 | 3.2 | 1.34 | |
| I-394 | EB | 1804 | 2000 | 145000 | 736264 | 3.3 | | |
| I-394 | EB | 1804 | 2001 | 150800 | 777023 | 3.3 | 1.65 | 0.06 |
| I-394 | EB | 1804 | 2002 | 150000 | 672432 | 2.8 | 1.62 | 0.03 |
| I-394 | EB | 1804 | 2003 | 152700 | 745489 | 3 | 1.64 | 0.05 |
| I-394 | EB | 1804 | 2004 | 151000 | 1044192 | 4.2 | 1.44 | 0.16 |
| I-394 | EB | 1804 | 2005 | 152510 | 1050521 | 4.2 | 1.18 | 0.18 |
| I-394 | EB | 1804 | 2006 | 148000 | 1090164 | 4.4 | 1.16 | 0.09 |
| I-394 | EB | 1804 | 2007 | 148000 | 872774 | 3.5 | 1.29 | 0.14 |
| I-394 | EB | 1804 | 2008 | | | | 1.47 | 0.14 |

| ROAD | Direction | Sec. num. | Year | AADT | ESAL | Truck Percent | IRI (m/km) | RUTTING (in) |
|---|---|---|---|---|---|---|---|---|
| I-394 | WB | 1792 | 1991 | | | | | |
| I-394 | WB | 1792 | 1993 | | | | 1.55 | |
| I-394 | WB | 1792 | 1995 | | | | 1.58 | |
| I-394 | WB | 1792 | 1996 | 135000 | 630337 | 3.2 | | |
| I-394 | WB | 1792 | 1997 | 140805 | 667784 | 3.2 | 1.24 | |
| I-394 | WB | 1792 | 1998 | 143000 | 687551 | 3.2 | | |
| I-394 | WB | 1792 | 1999 | 146718 | 716254 | 3.2 | 1.05 | |
| I-394 | WB | 1792 | 2000 | 145000 | 736264 | 3.3 | | |
| I-394 | WB | 1792 | 2001 | 150800 | 777023 | 3.3 | 1.13 | 0.1 |
| I-394 | WB | 1792 | 2002 | 150000 | 672432 | 2.8 | 1.22 | 0.08 |
| I-394 | WB | 1792 | 2003 | 152700 | 745489 | 3 | 1.22 | 0.12 |
| I-394 | WB | 1792 | 2004 | 151000 | 1044192 | 4.2 | 1.11 | 0.06 |
| I-394 | WB | 1792 | 2005 | 152510 | 1050521 | 4.2 | 0.99 | 0.1 |
| I-394 | WB | 1792 | 2006 | 148000 | 1090164 | 4.4 | 0.92 | 0.11 |
| I-394 | WB | 1792 | 2007 | 148000 | 872774 | 3.5 | 1.08 | 0.11 |
| I-394 | WB | 1792 | 2008 | | | | 1.16 | 0.1 |

| ROAD | Direction | Sec. num. | Year | AADT | ESAL | Truck Percent | IRI (m/km) | RUTTING (in) |
|---|---|---|---|---|---|---|---|---|
| MNTH-55 | WB | 11541 | 1991 | | | | 1.8 | |
| MNTH-55 | WB | 11541 | 1992 | | | | 2.5 | |
| MNTH-55 | WB | 11541 | 1993 | | | | 1.57 | |
| MNTH-55 | WB | 11541 | 1995 | | | | 1.67 | |
| MNTH-55 | WB | 11541 | 1996 | 32037 | 296908 | 7.3 | | |
| MNTH-55 | WB | 11541 | 1997 | 32517 | 304812 | 7.3 | 0.8 | |
| MNTH-55 | WB | 11541 | 1998 | 34857 | 305711 | 6.8 | | |
| MNTH-55 | WB | 11541 | 1999 | 35903 | 318443 | 6.8 | 0.94 | |
| MNTH-55 | WB | 11541 | 2000 | 35134 | 325172 | 7 | | |
| MNTH-55 | WB | 11541 | 2001 | 36539 | 341857 | 7 | 1.04 | 0.14 |
| MNTH-55 | WB | 11541 | 2002 | 36902 | 118488 | 2.7 | 1.16 | 0.13 |
| MNTH-55 | WB | 11541 | 2003 | 37567 | 121674 | 2.7 | 1.5 | 0.17 |
| MNTH-55 | WB | 11541 | 2004 | 36136 | 121375 | 2.8 | 1.11 | 0.11 |
| MNTH-55 | WB | 11541 | 2005 | 36498 | 123743 | 2.8 | 1.22 | 0.26 |
| MNTH-55 | WB | 11541 | 2006 | 34414 | 118670 | 2.8 | 1.03 | 0.13 |
| MNTH-55 | WB | 11541 | 2007 | 34414 | 131313 | 3 | 1.07 | 0.16 |
| MNTH-55 | WB | 11541 | 2008 | | | | 1.11 | 0.17 |

| ROAD | Direction | Sec. num. | Year | AADT | ESAL | Truck Percent | IRI (m/km) | RUTTING (in) |
|---|---|---|---|---|---|---|---|---|
| MNTH-55 | WB | 11542 | 1991 | | | | 1.81 | |
| MNTH-55 | WB | 11542 | 1992 | | | | 2.91 | |
| MNTH-55 | WB | 11542 | 1993 | | | | 1.73 | |
| MNTH-55 | WB | 11542 | 1995 | | | | 1.99 | |
| MNTH-55 | WB | 11542 | 1996 | 32037 | 296908 | 7.3 | | |
| MNTH-55 | WB | 11542 | 1997 | 32517 | 304812 | 7.3 | 0.58 | |
| MNTH-55 | WB | 11542 | 1998 | 34857 | 305711 | 6.8 | | |
| MNTH-55 | WB | 11542 | 1999 | 35903 | 318443 | 6.8 | 0.67 | |
| MNTH-55 | WB | 11542 | 2000 | 35134 | 325172 | 7 | | |
| MNTH-55 | WB | 11542 | 2001 | 36539 | 341857 | 7 | 0.83 | 0.15 |
| MNTH-55 | WB | 11542 | 2002 | 36902 | 118488 | 2.7 | 0.92 | 0.17 |
| MNTH-55 | WB | 11542 | 2003 | 37567 | 121674 | 2.7 | 1.01 | 0.2 |
| MNTH-55 | WB | 11542 | 2004 | 36136 | 121375 | 2.8 | 0.97 | 0.09 |
| MNTH-55 | WB | 11542 | 2005 | 36498 | 123743 | 2.8 | 1.07 | 0.26 |
| MNTH-55 | WB | 11542 | 2006 | 34414 | 118670 | 2.8 | 1.04 | 0.15 |
| MNTH-55 | WB | 11542 | 2007 | 34414 | 131313 | 3 | 1.03 | 0.16 |
| MNTH-55 | WB | 11542 | 2008 | | | | 1.07 | 0.16 |