Louisiana Transportation Research Center

Technical Assistance Report 14-02TA-B

Evaluation of Rutting Distresses on I-20 Near Minden, LA

by

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16. Abstract

Noticeable rutting issues have been a problem for many years on a corridor of I-20, in both eastbound and westbound lanes, located near Minden, LA and near the Webster-Bienville parish line. At the request of the DOTD designers and District 04 engineers, the Louisiana Transportation Research Center (LTRC) asphalt research group performed a small scale forensic evaluation in December 2014. The request was made because a reconstruction project is planned and scheduled in an attempt to remediate the rutting issues observed.

Evaluation of the site and asphalt cores retrieved showed considerable deterioration of the binder course due to its moisture susceptibility and due to inadequate moisture drainage. The support structure of the road was damaged and settling occurred on the surface layers causing severe rut issues. Based on these findings, full depth rehabilitation of the asphalt pavement is recommended. Additional breaking of the original JCRP pavement should be performed in various areas of the old test sections. In addition, it is recommend that the current underdrain system be removed and replaced.

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ABSTRACT

Noticeable rutting issues have been a problem for many years on a corridor of I-20, in both eastbound and westbound lanes, located near Minden, LA and near the Webster-Bienville parish line. At the request of the DOTD designers and District 04 engineers, the Louisiana Transportation Research Center (LTRC) asphalt research group performed a small-scale forensic evaluation in December 2014. The request was made because a reconstruction project is planned and scheduled in an attempt to remediate the rutting issues observed.

An evaluation of the site and asphalt cores retrieved showed considerable deterioration of the binder course due to its moisture susceptibility and due to inadequate moisture drainage. The support structure of the road was damaged and settling occurred on the surface layers causing severe rut issues. Based on these findings, a full depth rehabilitation of the asphalt pavement is recommended. Additional breaking of the original pavement should be performed in various areas of the old test sections. In addition, it is recommend that the current underdrain system be removed and replaced.

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INTRODUCTION

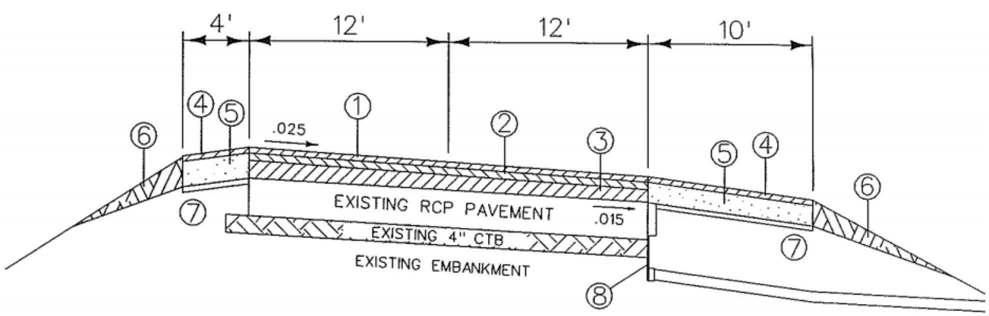
Noticeable rutting has been an issue for many years on a corridor of I-20, in both eastbound and westbound lanes, located near Minden, LA, and near the Webster-Bienville parish line. At the request of the DOTD designers and District 04 engineers, the Louisiana Transportation Research Center (LTRC) asphalt research group performed a small scale forensic evaluation in December 2014. The request was made because a reconstruction project is planned and scheduled in an attempt to remediate the rutting issues observed. Also, the district recently milled approximately five miles of the westbound outside lane to alleviate a surface drainage issue and also had to close the eastbound outside lane due to severe rutting. Figure 1 shows the milled section on the west bound lane. Figure 2 shows severe rutting on the eastbound lane.

This portion of Interstate 20 was part of a previously rehabilitated project that was constructed from December 1990 to March 1994. This project (State Project No. 451-03-0040), shown in Figure 3, consisted of a 10-mile section of the I-20 corridor from the Webster-Bienville Parish line (log mile: 16.63) to Dixie Inn (log mile: 6.40). The existing 10 in. of Portland Cement Concrete (PCC) used the Break and Seat rehab technique and overlaid with Marshall Mix designed asphaltic concrete. According to Figure 4, the layers include a 3-in. minimum (Type 5A) asphalt concrete base course, a 2.5-in. (Type 3) asphalt concrete binder course, and a 1.5-in. (Type 8) asphalt concrete wearing course. The westbound road cross section was slope corrected from 1.5% to the current typical 2.5% drainage slope on the travel lanes. Water drained from inside travel lane all the way to the outside shoulder. Travel lanes were a standard 12 ft. in width with a 10-ft. outside shoulder.

Figure 1
I-20 westbound milled outside lane

Figure 2
I-20 eastbound lane rutting

Figure 3
State Project No. 451-03-0040 location



TYPICAL ROADWAY SECTION

1	1½" Asphalt Concrete Wearing Course (Type 8)
2	2½" Asphalt Concrete Binder Course (Type 3)
3	3" Min. Asphaltic Concrete Base Course (Type 5A)
4	1½" Asphaltic Concrete Wearing Course (Shoulder Mix)
5	Asphaltic Concrete Base Course (Type 5B) (Thickness Varies)
6	Borrow
7	Existing Embankment and Shoulder
8	12" Deep Geocomposite Underdrain System

Figure 4
Typical roadway section of I-20

LTRC was involved in a research study focused on the original project to evaluate the Break, Seat, and Overlay technique in an effort to determine the break pattern necessary to mitigate reflective cracking. The research consisted of evaluating eight different test sections,

including one control section where nothing was done to the existing pavement. The main break pattern for the remainder of the project outside the test areas was 12 in. LTRC Final Report 287, describing the technique and results, can be found on LTRC's website.
Three asphalt overlay projects were performed on this section of I-20 since the rehabilitation project in 1990. An overlay project (State Project No. 451-03-0052) was performed in the same 10-mile section as the previous project and was completed from July to November 1997. This project covered both eastbound and westbound lanes.

The next overlay project (State Project No. 451-03-0057) was performed from October to December 2003 where existing surface layers were milled and overlaid with new Stone Mastic Asphalt (SMA) wearing course. This project started near the Jack Martin Rd. bridge (log mile: 13.06) and ended at the Webster-Bienville Parish line (log mile: 16.06). This project was only performed on the westbound lane.

From October 2011 to March 2012 the district milled 10 miles from the same I-20 locations (State Project No. 451-03-0070) from the Webster-Bienville Parish line (log mile: 16.02) to Dixie Inn (log mile: 6.20) and placed a level 2F Superpave wearing course on the westbound inside lane with a 4.5-ft. overlap onto the outside lane. This overlay can be seen in Figure 1 where the 4.5-ft. overlap into the outside lane is noticeable.

From previous experience, the LTRC research team anticipated that the presence of moisture in the pavement structure was possibly the major contributor to the premature rutting. Moisture can enter the pavement through joints, cracks, pores, and through movement by subsurface water *[1]*. Excessive moisture in a pavement structure can cause faulting and associated pumping in rigid pavements. It may reduce strength, strip-off asphalt from the mixture, and develop extensive cracking from loss of subgrade support in flexible pavement. Since the beginning of asphaltic pavements, drainage of water has been given a very important consideration, as many premature pavement failures are found to be tied to inadequate subsurface drainage systems *[2]*.

OBJECTIVE AND SCOPE

The objective of this study was assist the DOTD designers with a solution to overcome the rutting issues that have plagued this area since the earlier rehab construction project. LTRC chose to conduct a forensic evaluation of the aforementioned I-20 corridor, where excessive premature rutting was noticed.

To meet the objectives, six full-depth roadway cores were obtained and examined from the westbound outside travel lane. Locations of the cores were determined using station numbers from a median cable barrier installation project (State Project H.010675). From the station numbers, the authors determined the exact distance from permanent markers in the area and determined approximate log mile data.

METHODOLOGY

A total of six roadway cores were drilled from the westbound travel lanes where the milling had taken place; three cores drilled from the inside lane and three from the outside lane. A recent median cable barrier project (State Project No. H.010675) provided station numbers on the side of the highway, which were used for marking core locations. The location of coring was near the Webster-Bienville parish line located at Sta. 1615+64. A guardrail located in the median protecting eastbound traffic was at Sta. 1612+64. Coring would occur approximately 700 ft. west of the guardrail. Table 1 shows the station and correlating log mile locations of the coring site in control section 451-03 (Webster Parish). From the inside lane, two cores were taken at station 1605+33; core #1 on the left wheel path and core #2 at the center of the lane. Core #3 was taken at station 1600+00 on the center of the lane. Core #1 was not fully retrieved while the last two were 100% retrieval. The outside lane was taken in a similar fashion with two cores taken from 1605+33; core #4 at the right wheel path and core #5 on the right wheel path. Core #6 was obtained from 1602+66. Cores #4 and #5 were 100% retrieved, but core #6 was lost due to it being stuck in the drill bit.

The makeup of the roadway cores were also observed on the field. Job Mix Formulas (JMF) of the 1990 state project (State Project No. 451-03-0040) were provided by the area engineer.

Table 1
Location of roadway cores (control section 451-03)

Core #	Station Location	Log Mile Location	Location of Core	Notes
1	Sta. 1605+33	15.972	LWP	Base course not retrieved
2	Sta. 1605+33	15.972	CL	100% retrieval
3	Sta. 1600+00	15.871	CL	100% retrieval
4	Sta. 1605+33	15.972	RWP	100% retrieval
5	Sta. 1602+66	15.921	RWP	100% retrieval
6	Sta. 1602+66	15.921	CL	Stuck in drill bit, not retrievable

DISCUSSION OF RESULTS

During coring operations, a Stone Mastic Asphalt (SMA) surface layer was observed as the wearing course on both the inside and outside lanes. This lift apparently was placed directly over the old wearing course. This was noticeable of all the cores obtained, as there was difficulty keeping them intact during drilling operations. Each core came out in two or three pieces. Figure 5a shows the typical core obtained from the field. At the locations where cores were taken, the bottom and thickest layer (approx. 4 in.) was the Type 5A base course placed in 1991. The next two lifts were the Type 3 binder (approx. 3 in.) and Type 8 wearing (approx. 2 in.) courses placed in 1991. The original wearing course was covered in a layer of clay/sands due to the drilling process, which is believed to have come from the deteriorated binder course. The top surface was the SMA wearing course, added in 2003. The SMA layer was easily distinguishable by observing the large aggregates in the mix. Damage was not observed in any of the SMA layers obtained. Although some stripping has occurred in the base course, the binder course exhibited excessive stripping throughout the layer, as seen in Figure 5b, and shows a loss of asphalt coverage on the aggregate. A considerable amount of clay, sand, and gravel was found all around the drilling site after taking the core.

District 04 was able to supply LTRC with the JMFs from the original project. An extensive evaluation of the JMFs were conducted for the base and binder courses. Mix procedures and specifications were properly followed. It was reported that the main aggregate source was obtained from a sand/clay/gravel source, readily found in the northern region of the state. A large percentage of the mixture included both the coarse and fine aggregate structure from this blend source. Gravel was used in the Type 3 binder, Type 5A base, and Type 8 wearing courses. Gravel aggregate may have shale mixed in. When crushed, the shale can break down, reverting to clay and getting into the mixture. Clay tends to expand in the presence of water, and the expanded clay can lift the asphalt off the surface of the aggregate. If this is combined with the action of traffic, the clay will emulsify the asphalt in the mix and cause severe stripping. This is why it is critical that clay not be allowed in the mix. In some cases, clay is generated in the crushing process *[3]*. Sand has properties of being too rounded, promoting lack of interlocking properties. The use of natural sand materials decreased the stability and strength characteristics of the asphalt concrete mixture *[4]*.

In a review of the original construction proposal, edge underdrains were required to relieve moisture from accumulating underneath the pavement structure. Construction documents indicate that the installed underdrain system was a thin geocomposite underdrain type system. Most states, including Louisiana, have determined the geocomposite underdrain system to be inferior to the traditional trench underdrain system, which is the current practice used by the DOTD.

(a) **(b)**

Figure 5
Roadway core #4

CONCLUSIONS AND RECOMMENDATIONS

Evaluation of the site and asphalt cores retrieved showed considerable deterioration of the binder course due to its moisture susceptibility and due to inadequate moisture drainage. The "pooling" and pumping of water in the underlying layers caused the loss of adhesion between the asphalt binder and aggregates. Subsequently the support structure of the road was damaged and settling occurred on the surface layers. The water was introduced from the underlying layers and forced upwards to the asphalt layers. However, the mix designs which followed the allowable specifications during the time of construction would not pass current design specifications.

Based on these findings, the authors recommend a full-depth rehabilitation of the asphalt base, binder and wearing courses. This should ensure the removal of substandard materials that were used on the original rehab project. Once the old pavement is removed, it is further recommended that additional breaking of the original JRCP pavement be conducted in areas where reflective cracking is visible at the top surface, and/or in the areas of the old test sections where the break pattern or other rehab technique was greater than 18 in. In addition, it is extremely important that the deficiencies of the underdrain system are corrected. It is recommended that the current geocomposite underdrain system be removed and replaced with the latest design for underdrain systems similar to the one shown in the Appendix.

ACRONYMS, ABBREVIATIONS, AND SYMBOLS

DOTD	Department of Transportation and Development
EB	Eastbound
HMA	Hot Mix Asphalt
JMF	Job Mix Formula
JRCP	Joint Reinforced Concrete Pavement
LTRC	Louisiana Transportation Research Center
PCC	Portland Cement Concrete
SMA	Stone Mastic Asphalt
WB	Westbound

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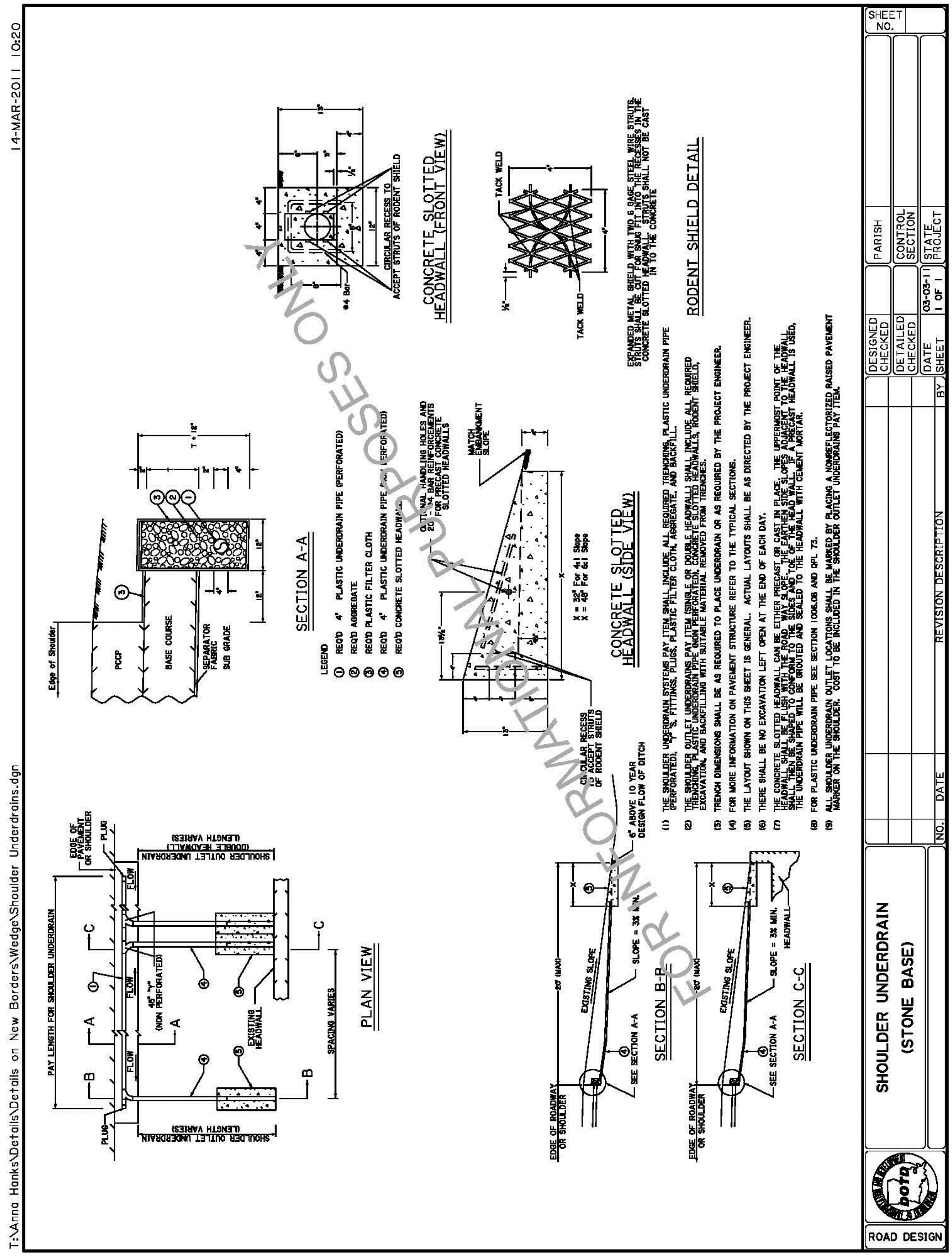
APPENDIX

DOTD Standard Drainage Details



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