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16. Abstract
This technical assistance report documents the investigation conducted by the Louisiana Transportation Research Center (LTRC) of the LA 1 Bridge located at the flood control structure near Morganza, LA. The in-place condition of the bridge deck showed signs of wear in terms of exposed aggregate and cracking. The depths of the cracks generally did not extend to the reinforcement steel and the condition of the steel showed little to no corrosion in the full and partial depth cores. No delamination was found when the site was visited. The tensile and compressive strengths proved adequate and the pull-off test strengths showed that an epoxy type overlay will be very well suited as a rehabilitation technique.

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Evaluation of the LA 1 Bridge at the Morganza Flood Control Structure

by

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ABSTRACT

This technical assistance report documents the investigation conducted by the Louisiana Transportation Research Center (LTRC) of the LA 1 Bridge located at the flood control structure near Morganza, LA. The in-place condition of the bridge deck showed signs of wear in terms of exposed aggregate and cracking. The depths of the cracks generally did not extend to the reinforcement steel and the condition of the steel showed little to no corrosion in the full and partial depth cores. No delamination was found when the site was visited. The tensile and compressive strengths proved adequate and the pull-off test strengths showed that an epoxy type overlay will be very well suited as a rehabilitation technique.

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INTRODUCTION

This report will concentrate on the LA 1 bridge deck at the Morganza flood control structure. On March 9, 2010, the Louisiana Department of Transportation and Development (LADOTD) bridge design section contacted the author regarding a specific cracking pattern on the LA 1 Bridge at Morganza, LA. The cracking pattern can be seen at the bottom of Figure 1. Bridge design's concern dealt with the extent of the deck damage, whether the cracking was due to corrosion of reinforcing steel, and any possible concrete delamination.

Figure 1
Span 99 looking west (Northbound lane is closest)

OBJECTIVE AND SCOPE

The objective of the study was to determine the extent of deck cracking and to determine the condition of the reinforcing steel. To meet the objective, a site visit was conducted to examine the condition of the existing deck. Note that this report is limited to the condition of the deck and reinforcing steel and makes no reference to the condition of any joints, beams, railings, or substructure elements.

METHODOLOGY

LTRC personnel began gathering bridge deck samples on Tuesday, July 20, 2010, between the hours of 9:15 am and 12:30 pm. A total of 11 cores were removed from the structure. The cores were drilled to an approximate depth of 8 inches over a girder to ensure a full depth representative sample of the deck was obtained; from here on, this report will refer to these cores as full depth cores. Three full depth cores were removed from the southbound lane and eight full depth cores were removed from the northbound lane. Full depth cores were tested for pull-off direct tension strength, compressive strength, and tensile strength. In addition to full depth cores, partial depth cores were also taken to visually observe the extent of steel corrosion, and a soundness test using a chain drag was also conducted on several spans to assess delamination.

DISCUSSION OF RESULTS

This section will first detail the results of the investigation with tensile strengths, direct tension pull off, and compressive strengths. The field results will then be presented.

Full depth samples were removed from Northbound (NB) Span Numbers 5, 16, 28, 65, 68, and 99. Full depth samples were removed from Southbound (SB) Span Numbers 104, 105, and 113. Note that span numbers 104 and 105 were fire damaged. Partial depth cores were taken on Spans 3, 14, 25, and 65 Northbound.

Tensile Strength

The tensile strength was determined using ASTM C 496. The average tensile strength for cores 65 NB and 99 NB was 466 psi.

Direct Tension Pull-Off

The direct tension pull-off tests were conducted according to ACI 503. Two tests were conducted on full depth 4-inch diameter cores from Spans 28 and 68, both northbound. The strength of the first test from Span 28 was 48 psi and the specimen failed at the steel interface about 2 inches below the deck surface. The second specimen, Span 68, failed at 27 psi, but the sample failed in the epoxy layer.

Compressive Strength

The compressive strengths were determined according to ASTM C 39 using unbonded caps with ground ends. The average compressive strength for the remaining samples was 3882 psi. Table 1 shows the individual results for each core. Note the low outlier strengths for 105 SB, 5 NB, and 113 SB. The author believes these low strengths are due to damage to the concrete from coring operations, and they should be noted in that context.

Table 1
Individual compressive strength results

Sample No.	105 SB	5 NB (1)	5 NB (2)	104 SB	113 SB
Average Length	4.072	3.603	4.453	3.443	6.301
Average Diameter	2.288	2.296	2.298	2.290	2.307
Area (π x D² / 4)	4.112	4.139	4.148	4.119	4.181
(L/D)	1.780	1.569	1.938	1.503	2.731
Correction Factor	0.98	0.97	0.99	0.96	1.01
Load Rate (psi/sec)	35	35	35	35	35
Load Rate (lbs/min)	8636	8691	8711	8649	8780
Load at Failure (lbs)	3742	6637	10210	18241	6339
Compressive Strength (psi)	**892**	**1556**	**2436**	**4252**	**1531**
Type Break	4	3	3	1	2
Sample No.	**68 NB**	**16 A (1)**	**16 A (2)**	**16 B (1)**	**16 B (2)**
Average Length	7.215	2.786	3.526	2.715	3.469
Average Diameter	3.773	2.287	2.289	2.293	2.298
Area (π x D² / 4)	11.179	4.107	4.115	4.130	4.146
(L/D)	1.912	1.218	1.540	1.184	1.510
Correction Factor	0.99	0.92	0.96	0.92	0.96
Load Rate (psi/sec)	35	35	35	35	35
Load Rate (lbs/min)	23475	8625	8642	8673	8706
Load at Failure (lbs)	58814	19975	20849	14992	11218
Compressive Strength (psi)	**5208**	**4474**	**4863**	**3340**	**2598**
Type Break	3	2	2	3	1

Field Results

This section will detail the deck condition, delamination assessment, and in-place steel condition. The deck condition as noted on July 20, 2010, was typical of a deck that has undergone many years of wear. The deck surface had exposed gravel aggregate and many spans exhibited the cracking pattern shown in Figure 2. The cracks were observed to generally occur above reinforcing steel but were usually limited to a depth less than 1.5 inches. Figure 3 gives an indication of crack depth in one of the most affected spans where the crack depth was about 2.5 inches. The author was asked to investigate the effect of fire on the deck surface. A fire had occurred sometime in the past five years on spans 104 and 105 southbound. The fire-affected spans (104 and 105 southbound) did exhibit a noticeably different surface texture and color shown in Figure 4. The field investigation team noted that the fire-affected spans had been repaired with a cementitious based surface treatment in the past. Based on laboratory results, the author believes this is surface damage due to the fire and not structural.

Figure 2
Exposed aggregate and crack pattern (Note the crack pattern is approximately 4 – 6 inches square)

Figure 3
Cracked deck in span 99 northbound (Note the crack depth here was about 2.5 inches)

Figure 4
Surface texture and color in span 105 southbound, a fire affected span

Chain Drag Delamination Assessment

A chain drag assessment was conducted on Northbound Spans 2–29. The finding showed that there are little to no areas exhibiting delamination at the time of measurement. It was noted that the sound of the chain drag did change in the middle of the lane, but it was determined that this was due to the integral girder being located directly below the center of the lane.

In-place Steel Condition

The in-place steel condition was much better than expected for the author. The in-place steel showed little to no signs of corrosion either in the partial depth cores or in the full depth retrievals. Figure 5 and Figure 6 illustrate the state of the reinforcing steel as encountered on July 20, 2010. The condition of the steel and noted crack depths led the team to reduce the number of core samples by about one third.

Figure 5
Full depth core showing no steel corrosion

Figure 6
Partial depth core showing little steel corrosion

CONCLUSIONS

The in-place condition of the bridge deck showed signs of wear in terms of exposed aggregate and cracking. The depths of the cracks generally did not extend to the reinforcement steel. The condition of the reinforcing steel showed little to no corrosion in the full depth and partial depth cores. No delamination was found when the site was visited. The tensile and compressive strengths proved adequate and the pull-off test strengths showed that an epoxy type overlay will be very well suited as a rehabilitation technique.

ACRONYMS, ABBREVIATIONS, AND SYMBOLS

LADOTD	Louisiana Department of Transportation and Development
LTRC	Louisiana Transportation Research Center
NB	northbound
SB	southbound
ASTM	American Standard for Testing and Materials
ACI	American Concrete Institute
psi	pounds per square inch