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16. Abstract

This technical assistance report documents the investigation conducted by the Louisiana Transportation Research Center (LTRC) of the cored concrete from girders of the US 90 Bayou Ramos Bridge near Morgan City, LA. The unit weights of the cores were determined to be within the generally accepted range of portland cement concrete unit weight. The modulus of elasticity and compressive strengths were generally acceptable. The modulus of elasticity results were all within the general range of 4 to 6 million psi. The compressive strengths were acceptable with one core exhibiting low strength due to premature failure during the modulus test. The cores showed no visible signs of distress.

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Evaluation of Girder Cores from the US 90 Bayou Ramos Bridge

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Louisiana Transportation Research Center

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ABSTRACT

This technical assistance report documents the investigation conducted by the Louisiana Transportation Research Center (LTRC) of the cored concrete from girders of the US 90 Bayou Ramos Bridge near Morgan City, LA. The unit weights of the cores were determined to be within the generally accepted range of portland cement concrete unit weight. The modulus of elasticity and compressive strengths were generally acceptable. The modulus of elasticity results were all within the general range of 4 to 6 million psi. The compressive strengths were acceptable, with one core exhibiting low strength due to premature failure during the modulus test. The cores showed no visible signs of distress.

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INTRODUCTION

This report will detail the condition, compressive strength, and modulus of cores obtained from girders of the US 90 Bayou Ramos Bridge near Morgan City, LA. The cores were being tested due to signs of distress noted during routine bridge inspection. The Senior Structures Research Engineer at Louisiana Transportation Research Center (LTRC), along with the bridge design and construction sections of the Louisiana Department of Transportation and Development (LADOTD) contacted the author about determining the strength and modulus of cored girder samples shown in Figure 1. Note the mixture contains gravel as was commonly used at the time this bridge was constructed.

Figure 1
Girder cores from the US 90 Bayou Ramos Bridge

OBJECTIVE AND SCOPE

The objective of the study was to determine the modulus of elasticity and compressive strength of cores obtained from girders of the US 90 Bayou Ramos Bridge located near Morgan City, LA. To meet the objective, nine girder cores and one deck core were tested. Note that this report is limited to the unit weight, modulus of elasticity, and compressive strength of the girder and deck concrete, and makes no reference to the potential presence of other deleterious substances or reaction products. The author has been informed that separate samples were sent to an outside consultant for petrographic analysis.

METHODOLOGY

LTRC Concrete Research Laboratory personnel took possession of the cores on April 19, 2012, and started processing them on April 20, 2012.The cores were photographed as shown in Figure 1 and then the samples were measured and weighed to determine their unit weight. The samples ends were then ground to planeness and the samples were first tested for modulus of elasticity according to ASTM C469 and then compressive strength according to ASTM C39.

DISCUSSION OF RESULTS

This section will first detail the results of the investigation with unit weights, modulus of elasticity values, and then compressive strengths.

Unit Weight

The cores were measured three times and averaged for the length and the diameter. The samples were weighted and the unit weight was calculated for each specimen. The unit weight of the cored girders ranges from 139.1 to 143.8 pounds per cubic foot (pcf). These values are well within the generally accepted values for precast or cast-in-place concrete. The results are shown in Table 1.

Modulus of Elasticity

The modulus of elasticity was determined according to ASTM C469. Note that the end neoprene bearing caps that are generally used for this test were not used due to insufficient length of the cores. Note that when the end caps were used, premature failure of the specimens tended to occur and necessitated the discontinuation of their use. Table 2 shows the modulus of elasticity results for the cores. Note that the values obtained are within the accepted values of 4-6 million psi for portland cement concrete.

Compressive Strength

The compressive strengths were determined according to ASTM C 39 with ground ends. The average compressive strength for the girders was 6722 psi with a low of 3761, as shown in Table 2. Note that the low compressive strength is due to partial premature failure while conducting the modulus of elasticity test with the unbounded caps. The unbounded caps used were for 4 inch diameter cylinders or cores and the girder cores about 3.7 inches in diameter. The reduction in diameter leads to radial forces when using an unbounded cap, thus leading to spalling around the edges while testing. The compressive strength of the deck core was determined to be 7716 psi. Note that all of these compressive strengths can be estimated to be about 20 percent higher than what is reported due to sample disturbance and micro fracturing that occurs while coring a concrete sample.

Table 1

Unit weight results for girder cores from the US 90 Bayou Ramos Bridge

Sample ID	Length (in)	Average Length (in)	Diameter (in)	Average Diameter (in)	Weight (lbs)	Unit Weight (pcf)
WB G3 S88	7.204 7.220 7.239	7.221	3.694 3.705 3.707	3.702	6.333	140.8
WB G2 S40	7.317 7.330 7.304	7.317	3.690 3.688 3.691	3.690	6.369	140.7
WB G2 S41	7.385 7.360 7.322	7.356	3.691 3.689 3.691	3.690	6.334	139.1
WB G2 S78	7.236 7.230 7.234	7.233	3.689 3.698 3.699	3.695	6.456	143.8
WB G2 S79	7.109 7.140 7.105	7.118	3.701 3.700 3.704	3.702	6.327	142.7
EB G5 S39	7.394 7.386 7.400	7.393	3.698 3.706 3.698	3.701	6.569	142.7
EB G5 S40	7.460 7.442 7.478	7.460	3.698 3.706 3.698	3.701	6.616	142.5
EB G5 S80	7.368 7.340 7.341	7.350	3.699 3.709 3.716	3.708	6.553	142.7
EB G5 S81	7.265 7.224 7.228	7.239	3.691 3.692 3.705	3.696	6.450	143.5
WB Span 39 Deck	7.670 7.671 7.684	7.675	3.686 3.698 3.686	3.690	6.675	140.5

Table 2

Individual modulus of elasticity and compressive strength results

Sample ID	Modulus (psi)	Compressive Strength (psi)
WB G3 S88	5200000	--
WB G2 S40	4450000	3761
WB G2 S41	4200000	6318
WB G2 S78	--	7646
WB G2 S79	--	4793
EB G5 S39	5650000	8009
EB G5 S40	5800000	6721
EB G5 S80	5400000	7416
EB G5 S81	4950000	9114
WB Span 39 Deck	--	7716

CONCLUSIONS

The condition of the cores was as one would expect from a bridge girder in use of that age. The unit weight, modulus of elasticity, and compressive strengths were in the expected range. The cores showed no visible signs of distress.