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Long-Term Monitoring of the HPC Charenton Canal Bridge

INTRODUCTION

In 1997, the Louisiana Department of Transportation and Development (LADOTD) began to design the Charenton Canal Bridge using HPC for both the superstructure and the substructure. As a part of the project, a research contract was awarded to assist LADOTD in the implementation of high performance concrete in the Charenton Canal Bridge. After the bridge was built, the PI and a graduate student semi-annually collected data for several years, and then data collection was interrupted. A final report titled "Implementation of High Performance Concrete in Louisiana" was then published and distributed. The report recommended the continuation of the long-term monitor of the bridge.

As a result, this study was titled "Long-Term Monitoring of the HPC Charenton Canal Bridge" was initiated. The monitoring of the bridge was set to ten years, assumed from day 1091 (11/15/2001) to day 4055 (4/6/2010).

OBJECTIVE AND SCOPE

The objective of this particular study was to carry out the long-term data collection and analysis for the instrumented Charenton Canal that was first initiated in a previous LTRC study (Final Report 310). The long-term monitoring consisted of collecting data from embedded strain gauges in the deck and four girders of Span 3 of the five-span structure.

METHODOLOGY

Since this project is of long-term monitoring type and not a new research project, work done consisted of the following:

1. Site visits were performed to collect data (temperature and strains) from the four instrumented girders and deck of Span 3 of the structure, and the deflection/camber of those girders were measured
2. From strain data collected, (1) deck strains were analyzed, and (2) prestress losses in instrumented girders were calculated.
3. Reserachers performed an analysis for long-term prestress losses, i.e., losses due to thermal and steel relaxation, elastic shortening, and creep and shrinkage.
4. Conclusions, recommendations, and implementation statements were provided.

LTRC Report 473

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CONCLUSIONS

Long-Term Prestress Losses

1. Prestress losses due to thermal and steel relaxation took place prior to casting and will not change as a result of long-term monitoring.
2. Prestress losses due to elastic shortening did not experience any additional change. This is due to the fact that those losses are not time-dependent. The elastic shortening prestress losses remained at 13,606 psi, 15,374 psi, 13,880, and 14469 psi for Girders 3A, 3B, 3C, and 3D, respectively. Those losses were computed with vibrating wire strain gauges immediately after strand release.
3. Prestress losses due to creep and shrinkage (time-dependent) that were measured from vibrating wire strain gauges continued to increase from 18,313 psi to 18,745 psi for girder 3A (2.4% increase); 22,385 psi to 22,676 psi for Girder 3B (1.3% increase); 19,102 psi to 19,491 psi for Girder 3C (2.0% increase); and 19,831 psi to 20,236 psi for Girder 3D (2.0% increase), respectively.
4. Prestress losses due to steel relaxation (time-dependent) that were measured from vibrating wire strain gauges continued to increase from 1,565 psi to 1,646 psi for girder 3A (5.2 % increase); 1,293 psi to 1,330 psi for Girder 3B (2.89 % increase); 1,544 psi to 1,616 psi for Girder 3C (4.7 % increase); and 1,482 psi to 1,544 psi for Girder 3D (4.8 % increase), respectively.

Camber and Deflection

Camber and deflection measurements from the time the girders were removed from the casting bed the last visit in 2010, i.e., after 4155 days, it was found that:

1. The measured final camber/deflections for Girders 3A, 3B, 3C, and 3D were 1.53 in., 1.81 in., 1.55 in., and 1.59 in., respectively.
2. The predicted final camber/deflection for the prestressed girders was 1.89 in.

From previous values, the measured final camber/deflection values are less than the predicted value.

RECOMMENDATIONS

The data analyzed in this report strongly supports the decision of LADOTD to build more bridges with HPC members. No additional recommendation could be added to the original recommendations that can be found in Final Report 310 published by LTRC.

IMPLEMENTATION

Short term data collected and analyzed after the bridge was built were very promising. As a result of the successful performance of this bridge, HPC was used in the design and construction of several additional bridges over the last 10 years:

- The Rigolets Pass Bridge was constructed using HPC 72-in. bulb-tee girders in some of its spans.
- An implementation assessment of the use of HPC girders in the I-10 Twin-Span Bridges was performed. The use of HPC resulted in a savings of 25,920 linear feet of girders, which resulted in a savings of $14.6 million dollars.

The long-term monitoring of the Charenton Canal Bridge not only supports LADOTD's decision to continue building HPC bridges with confidence, but also provides the necessary information to maintain current HPC bridges and assist in future bridge design decisions.