

TECHNICAL SUMMARY

INVESTIGATION OF CRACKS IN
CYLINDRICAL SPUN-CAST CONCRETE
PILES IN A MARINE ENVIRONMENT

Summary of Report Number 320

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Introduction

Louisiana uses 54-inch cylindrical piles post-tensioned in the southern part of the state on relatively long bridges above swamps and coastal waters. Typical examples include the US 90 bridge over Wax Lake Outlet, I-10 on the east and west approaches to New Orleans, US 11 east of New Orleans, and I-55 north of New Orleans. DOTD bridge inspectors have reported that many of these piles exhibit vertical hairline cracks over the post-tensioning ducts.

Louisiana has thousands of these piles in service and typical remediation work for this problem has proven to be very costly. Therefore, before the problem of cracks in these piles reaches a critical repair state, it is imperative to set up a systematic monitoring procedure and determine accurately the level of damage in the inventory of these piles. As a follow-up, guidelines need to be set up for future underwater inspections.

Objectives

The objectives of this project were:

- Evaluate the extent of cracks in 54-inch cylindrical spun-cast concrete piles in Louisiana
- Identify the piles exhibiting the worst cracking
- Evaluate the in-situ condition of the most severely cracked piles by non-destructive evaluation (NDE) methods
- Identify possible causes of these cracks
- Develop guidelines for future inspections of these piles.

Approach

All 19 coastal states were contacted regarding their experience with cylindrical spun-cast piles. Each state was asked the following three questions:

1. Are cylindrical spun-cast piles being used?
2. If so, have there been problems with cracks?
3. What has been done to address these problems?

A visit was made to a manufacturer of these piles to gather additional information to help determine the cause of the cracking.

In an effort to catalog the level of damage in DOTD piles, DOTD maintenance databases and drawings were reviewed and appropriate DOTD personnel were interviewed

DOTD inspections reports revealed no discernable correlation between pile cracking and age, pile manufacturer, or location. Interviews with district personnel did however identify piles that seemed to have the most damage. These piles became the focus for a level I above water survey.

Several weeks were spent on a small boat conducting a drive-by inspection of all piles at Twin Spans, Bonnet Carre Spillway, I-10 Between Ramah and Whiskey Bay, and Reserve Relief. The cracking was sporadic and most cracks were only of hairline thickness, so there was no call for a rating scheme. Instead, records were kept of all piles with hairline cracks. Few piles with cracks wider than hairline were noted and identified for a more in-depth investigation.

A level III survey, including an underwater investigation of the piles with wider than hairline cracks, was conducted. With the assistance of the Federal Highway Administration (FHWA), underwater pictures and video were taken of the most severely damaged piles. In addition to this, half-cell potential tests were conducted on three of these piles.

Conclusions and Recommendations

The investigators recommend that no immediate repair actions be taken at this time for the following reasons:

- The vast majority of cracks found in 54-inch cylindrical spun-cast piles were only hairline width
- Even the most severe cracks were minor and do not warrant immediate repair
- These cracks are confined to a few bents
- The cracks in the DOTD piles are not caused by the same factors as the cracks in piles from the Lake Pontchartrain Causeway Bridge
- The non-destructive testing (NDT) results for corrosion, using half-cell potential, were 3.2 above water and 5.5 under water. Both these results are on the borderline of corrosion beginning to occur
- The DOTD conducts underwater bridge inspections at five-year intervals. It is recommended that the following special protocol be set up for future underwater inspections of the 54-inch spun-cast piles:
 1. A permanent numbering system should be established so that specific bents can be identified from inspection to inspection.
 2. A series of crack width gauges should be installed on piles in the Rama to Whiskey Bay section and the Reserve Relief Canal section. The gauges should be placed over the larger cracks and distributed over the entire section. They should be attached in a manner that insures a degree of permanency so that readings can be taken on successive inspections.
 3. The specifications for future underwater inspections should include taking gauge readings and comparing to previous readings.
 4. Future contracts should also include half-cell potential measurements. It is recommended that ten be taken in each of the two sections.
 5. If the half-cell potential measurements indicate increased corrosive activity, then consideration should be given to chloride sampling tests and rate of corrosion tests.

6. In future underwater inspections, it is recommended that a level III inspection be conducted on every 30th bent and that the same bents be inspected in subsequent inspections. The cracking patterns (including hairline) should be measured and mapped on these bents and compared to previous inspections.

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