**BERTHA W. HENRY,** County Administrator
115 S. Andrews Avenue, Room 409 • Fort Lauderdale, Florida 33301 • 954-357-7362 • FAX 954-357-7360

March 1, 2010

TO: Mayor and Board of County Commissioners

FROM: Bertha Henry
County Administrator

SUBJECT: Noise Reduction Study for the SW 4th/7th Avenue Bridge

At the April 14, 2009 Commission meeting (Item #83), the Board directed staff to investigate solutions to reduce noise on the SW 4th Street/7th Avenue Bridge (Marshall Point Bridge). To that end, Public Works Department staff engaged a consultant engineering firm to perform the study. The conclusions of the study are attached to this memorandum. The complete study report consists primarily of detailed structural and mechanical calculations and preliminary design drawings. Interested parties may contact Tony Hui to review a copy of the report.

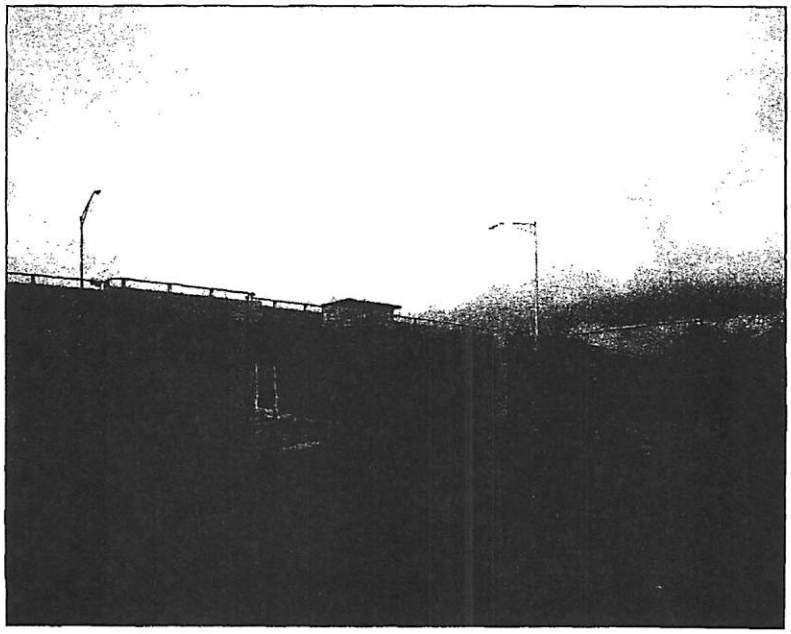
Public Works Department Staff will incorporate the cost of this improvement (budgetary capital cost - $380,000) into the FY2011 Budget Process. The priority of this project will be reviewed and discussed with the Board.

CC: Thomas Hutka, Director, Public Works Department
Anthony Hui, Deputy Director, Public Works Department
Kayla Olsen, Director, Office of Management and Budget
Anh Ton, Interim Director, Highway/Bridge Maintenance Division
Sam Sohal, Project Manager IV, Highway/Bridge Maintenance Division
Richard Tornese, Director, Highway Construction and Engineering Division

# STRUCTURAL NOISE REDUCTION STUDY
# SW 4th/7th AVENUE DRAW BRIDGE OVER NEW RIVER
# FORT LAUDERDALE, FL

## BROWARD COUNTY PROJECT No. 5380

*December 2009*



**Submitted By:**

HARDESTY & HANOVER, LLP
ENGINEERING

**Sunrise, Florida**

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ENGINEERING

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## INTRODUCTION

Broward County Department of Public Works Highway and Bridge Maintenance Division has retained Hardesty & Hanover, LLP of Sunrise, Florida to perform Professional Engineering Services to study Structural Noise Reduction to the SW 4th/7th Avenue Drawbridge over the New River in Fort Lauderdale, Florida. (Broward County Project No. 5380.)

There are typically three types of noise generated by draw bridges; tire noise from the grating, vibration of structural members and impact noises. All three types of noise are caused by vehicular traffic passing over the draw span. The most dominant source of noise is that which is generated by tire contact with the steel grating elements. This type of noise is transferred to the supporting structural steel.

The noise associated with the SW 4th/7th Avenue Bridge predominantly originates from vehicles crossing over the open grating roadway deck on the draw span due to tire noise. Vibration of structural members and impact are not prevalent on this structure. Therefore, any effort to mitigate noise must be associated with the roadway grating.

Roadway noise reduction (approximately 10% in decibel levels) has been accomplished on several bascule span bridges owned by the Florida Department of Transportation with the use of concrete fill placed in the grating located along the vehicular wheel paths of the roadway. There are no other known methods to mitigate the noise resonating from open roadway grating other than filling the steel roadway grating with concrete other than replacing the deck with a solid concrete, orthotropic, or FRP deck system. However a solid deck system would overstress the structural and/or mechanical capability of the bridge and therefore would also require replacement.

The Florida Department of Transportation has in recent times (since 1993) have received complaints from local residents in the proximity of the bridge of the excessive noise emitting from the open gratings of many draw bridges in south Florida. It has been the policy of the FDOT to provide concrete wheel paths on those draw bridges near residential areas where feasible, in regard to the capacity of the structural and mechanical systems of the draw span.

The following FDOT bridges in south Florida have been provided with concrete wheel paths in an effort to mitigate roadway noise:

a. 14th Street Bridge, Pompano, FL (Figure 1)
b. PGA Blvd Bridge, Palm Beach Gardens, FL
c. Hollywood Blvd Bridge, Hollywood, FL (Figure 2)
d. Oakland Park Blvd, Fort Lauderdale FL
e. Sunrise Blvd Bridge, Ft. Lauderdale, FL
f. Las Olas Blvd Bridge, Ft. Lauderdale, FL
g. Spanish River Bridge, Boca Raton, FL

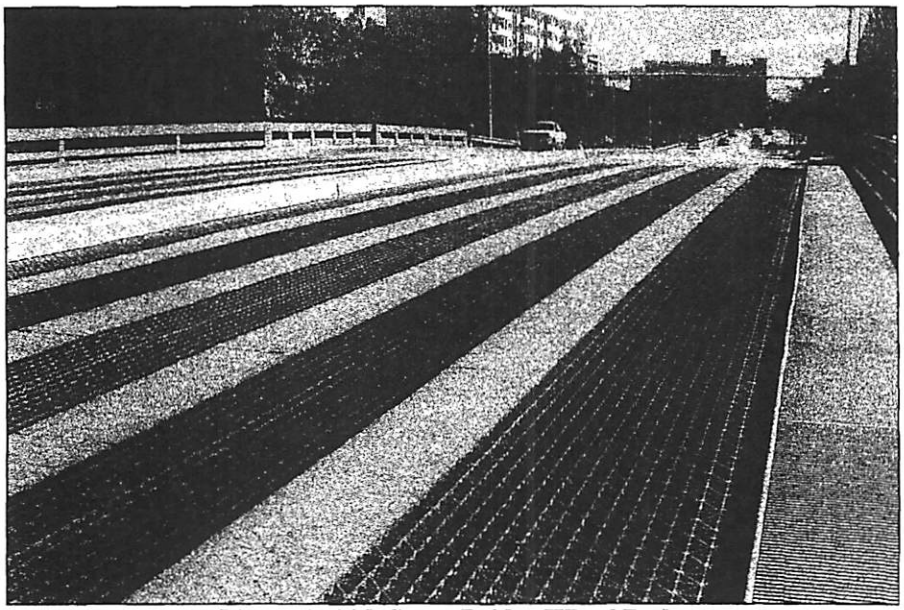

**Figure 1: 14th Street Bridge Wheel Paths**

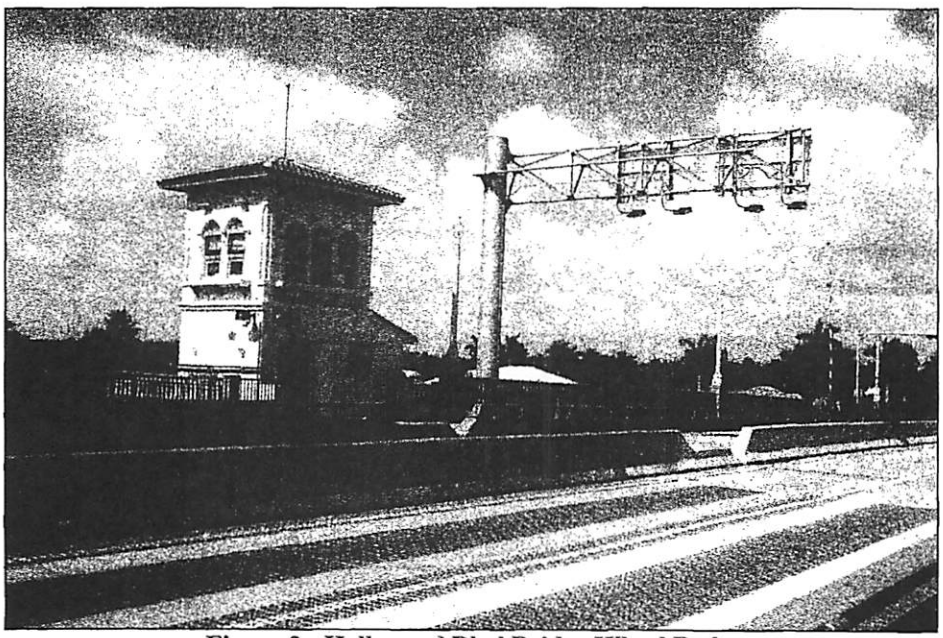

**Figure 2: Hollywood Blvd Bridge Wheel Paths**

In addition it has been the policy of the FDOT since 1995 that new bascule span bridges be constructed with solid deck systems for better ridability and noise mitigation. Examples of draw bridges in Broward County with solid deck systems (concrete filled gratings) are the 17th Street Causeway Bridge in Ft. Lauderdale and the Hallandale Beach Blvd. Bridge in Hallandale.

## ANALYSIS

The scope of work of this study is to determine the feasibility of installing concrete wheel paths on the SW 4th/7th Ave Drawbridge in order to mitigate the tire noise emitting from the bridge. The following is our Scope of Work:

a. Determine if the lift girders, floorbeams and stringers of the draw span have adequate capacity for the additional dead load of the concrete wheel paths and additional counterweight ballast.
b. Determine if the existing machinery capacity is not exceeded with the additional weight of the wheel paths and the additional wind resistance due to the solid deck areas from the concrete paths.
c. Determine if there is adequate space for the additional counterweight blocks needed to balance the draw span due to the additional weight of the concrete wheel paths.
d. Provide a cost estimate of the work required to install the wheel paths and re-balance the draw span.

### A. Structural Capacity

The 4th/7th Ave Bridge consists of 2 lanes of traffic in each direction requiring a total of eight concrete wheel paths across the draw span placed in the open steel grating. Typically light weight concrete (116lb/ft3) is used to minimize the dead load added to the leaf and minimize the ballast placed in the counterweight to re-balance the span so that the machinery is operating the leaves in a balanced condition, and therefore minimizing the horsepower required to open the span.

As shown by calculation (in the appendix) there is enough reserve capacity in the structural members to support the additional weight afforded by the concrete wheel paths. The wheel paths were assumed to be 24 inches wide. This will require an additional 24,000 pounds of ballast to be placed in each of the counterweights to balance the span.

### B. Operating Machinery Capacity

The addition of the wheel paths add additional wind resistance when opening or closing the draw span, and therefore additional power is required to operate the span. An analysis of the existing machinery on the bridge as per AASHTO for Movable Bridges (1988 edition) indicates the horse power requirements for the draw span is adequate for the wheel paths added to the draw span. The existing 20 horse power motor that move each leaf are adequately sized for the additional wind load. The bridge electrical system was last rehabilitated 15 years ago, and typically have a 20

year life. Setting aside funding for a capital expenditure (approximately $1,200,000) to replace the electrical system would be prudent.

### C. Counterweight Pocket Capacity

The counterweight pockets for both leaves are presently empty and have excess capacity for additional ballast as needed. In addition, both leaves have ballast mounted to the toe floorbeam of the leaf to provide a toe heavy condition. With the addition of the wheel paths these weights can be removed.

### D. Cost

The cost of the providing concrete wheel paths on the draw span will be approximately **$360,000** including the installation of the counterweight ballast. The cost can be reduced with the reduction of the wheel paths width. We do not recommend a wheel path width less than 18 inches as they lose their effectiveness. Assuming the bridge will be closed to traffic for the time required for the installation of the wheel paths. This would be beneficial to the setting of the concrete so that vibrations from vehicular traffic does not induce cracks into the (plastic) concrete.

Construction inspection and support would require an additional $20,000 for a grand total of **$380,000.**

### E. Construction

Installation will require the following steps:

1. Obtain permission from the United States Coast Guard to close the span to navigation for an extended period (1 day). A night closure may be required. Planning of navigation closure in coordination with the below procedure is required.
2. Close bridge to vehicular traffic. (7-14 days) For Step 3 (installation of steel pans) lane closures can be utilized in lieu of complete closure of the bridge.
3. Weld steel pans to roadway grating in required locations of the wheel paths. Lane closures can be used during the installation of the pans. Locations of the wheel paths are shown in the Drawings located in the Appendix.
4. Weld studs to the bottom of the pans.
5. Close bridge to navigation (bascule span set in closed position for concrete placement and setting time approximately 24 hours).
6. Place lightweight concrete in the pans. Let concrete set and cure.
7. Collect concrete test cylinders for each truck. Have cylinders tested for strength and dry weight.
8. Place ballast in the counterweight to balance the span.
9. Test draw span for balance. Adjust ballast as necessary.
10. Open bridge to vehicular traffic.