Florida Department of Transportation

I-295/SR9A Joints Evaluation

FDOT Office
State Materials Office

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Introduction

This project is in the northbound lanes of I-295 (SR9A) in southeast Jacksonville, Florida. The first test area this report focuses on, is composed of two sections, namely, FL 1-3 and FL 1-CA located at the southern end of the project approximately 1.2 miles north of State Highway 1/Phillips Highway (Figure 1). These two sections were built between 1997 and 1998.

Figure 1. Test area location

Background

Transverse joints in jointed plain concrete pavement (JPCP) are typically created by making an initial sawcut to force controlled cracking, followed by a second, wider sawcut to produce a reservoir for the joint sealant material. This traditional approach of sawing and sealing transverse contraction joints is estimated to account for between 2 and 7 percent of the initial construction cost of a JPCP. Moreover, these sealed transverse joints require resealing one or more times over the service life of the pavement, leading to additional costs in terms of labor, materials, operations, and lane closures.

State departments of transportation (DOTs) have been questioning conventional transverse joint sawing and sealing practices. These agencies contend that the benefits derived from sealing do not offset the costs associated with the placement and continued upkeep of the sealant over the life of the pavement. As a result, they have been experimenting with different sawing and sealing alternatives, for example:

- Narrow unsealed joints, consisting of single saw cuts that are left unsealed.
- Narrow filled joints, consisting of single saw cuts that are filled with sealant that adheres to the sides and bottom of the sawcut.
- Narrow sealed joints, consisting of single saw cuts that contain a narrow backer rod and sealant material.

In 1993, the Federal Highway Administration's (FHWA's) Research Office at Turner-Fairbank Highway Research Center sponsored a study to collect and examine field performance data from a wide variety of in-service concrete pavement joint sealing experiments across 11 states, including Florida. The study was conducted as part of the Concrete Pavement Technology Program Task 65 product implementation activity under contact No. DTFH61-03-C-00102 entitled "Effectiveness of Sealing Transverse Contraction Joints in Concrete Pavements." The study was initiated in February 1993, with data collection completed in May 2006. There was no final report but a Tech Brief which was published in 2009 (1).

The original Florida test site in the FHWA study included two test areas on northbound I-295 (SR 9A) in southeast Jacksonville. The first test area (sections FL 1-3 and first control section FL 1-CA) was located on the southern end of the project. The second test area (FL 1-1, FL 1-2, and second control FL 1-CB) was located between the on-ramp from Deerwood Gate Parkway and J.T. Butler Boulevard. On-going construction has obliterated the second test area, which resulted in second test area being excluded from this evaluation.

Therefore, the evaluation area included the remaining two adjacent 608-ft sections in the northbound truck lane, namely, FL 1-3, and FL 1-CA (control). A 1-inch contraction joint separates the two sections identified by a 6-inch white paint mark across the travel lane.

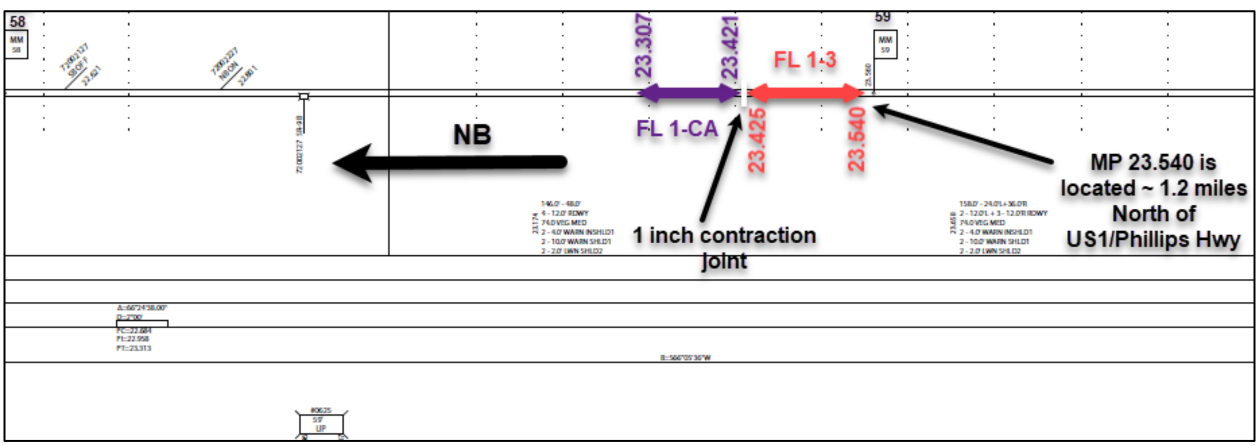

Figure 2 FL 1-3 and FL 1-CA test sections

Objective

The objective of this evaluation is to compare the long-term performance of a JPCP test section with single cut 1/8- inch joints (FL 1-3) to a similar section with double cut 3/8- inch joints (FL 1-CA). The joints in both sections were silicone sealed. Performance evaluation is based on Faulting in the right wheelpath, roughness based on average International Roughness Index (IRI) of both wheelpaths, and noise including both OBSI as well as inside the survey vehicle cabin.

Project Description

FL 1-3 and FL 1-CA were constructed in 1997 with a typical cross-section consisting of 12.5-inch JPCP on a stabilized subgrade layer. The joints in both sections have 1 ¼ -inch diameter dowels, perpendicular to the centerline, uniformly spaced at 16-ft intervals, silicone sealed, with a transverse tinning texture. The joints in FL 1-3 were sawcut once and were not widened whereas the FL 1-CA section contained conventional double-cut joints and used as the control section. The effective test length was 608 feet in each section, which corresponds to 38 to 39 transverse joints per section.

Faulting

Faulting in the right wheel-path was calculated from the right wheelpath profile trace using the FDOT Automated Faulting Program (AFP). From the 2017 data, the AFP detected 42% of the joints (16 out of 38) in FL 1-3, and 74% of the joints (28 out of 38) in FL 1-CA; from the 2018 data, AFP detected 50% of the joints (19 out of 38) in FL 1-3, and 71 % of the joints (27out of 38) in FL 1-CA. As illustrated in Figure 3, faulting was low in both years, averaging 0.04 inch in both sections. The low faulting magnitude agrees with the relatively low transverse joint detection

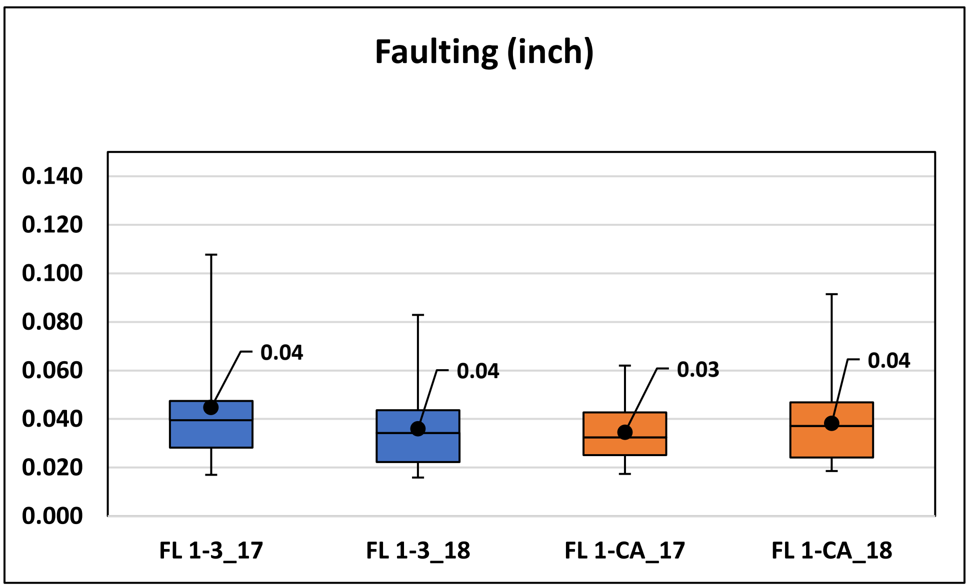

Figure 3 2017 and 2018 Faulting including joints

Roughness

Profile testing was conducted in October 2017 and March 2018 by the same operator. Due to the on-going construction, the profiler operator had to straddle both lanes with the survey vehicle to avoid driving over the asphalt surface covering the outside portion of the outside lane (L2). Thus, data collection in the left wheel path was conducted in the inside lane (L1), while right wheelpath data collection was conducted in the outside lane (L2). As shown in Figure 4, the average IRI for FL 1-3 for 2017 and 2018 was almost double that of FL 1-CA. This is opposite to what is normally expected given that FL 1-CA has the wider joints.

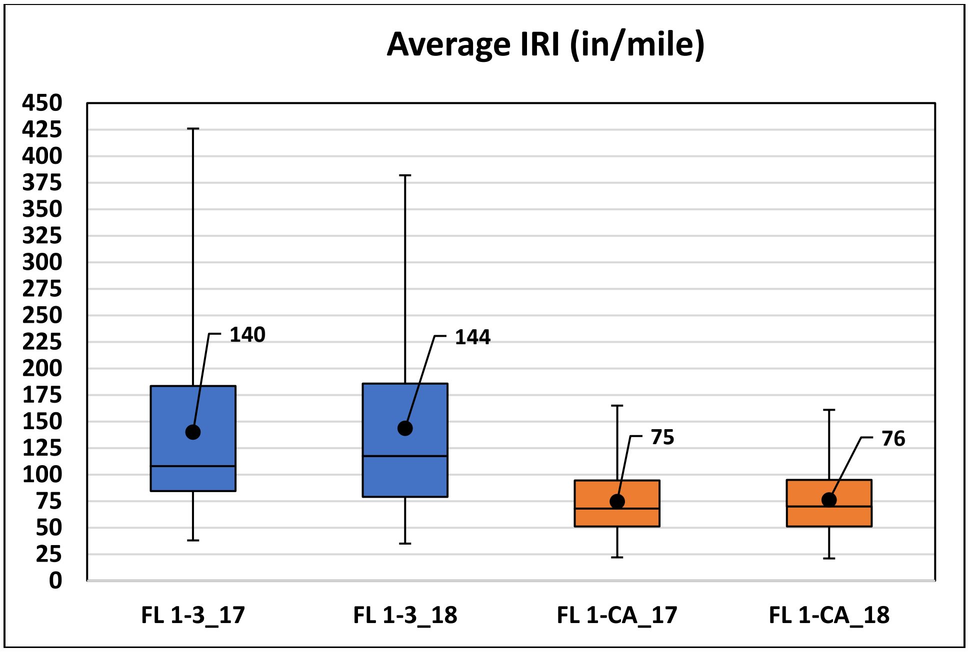

Figure 4. 2017 and 2018 roughness

The profiles were again processed but this time excluding profile data at the detected transverse joints. Although the resulting average IRI dropped in both sections, it did not change significantly as illustrated in Figure 5. This indicates that the contribution of the detected transverse joints to overall roughness is not significant. This is consistent with field observations during data collection noted by the absence of "joint slap", notable difference in "seat-of-the-pant" roughness, and faulting.

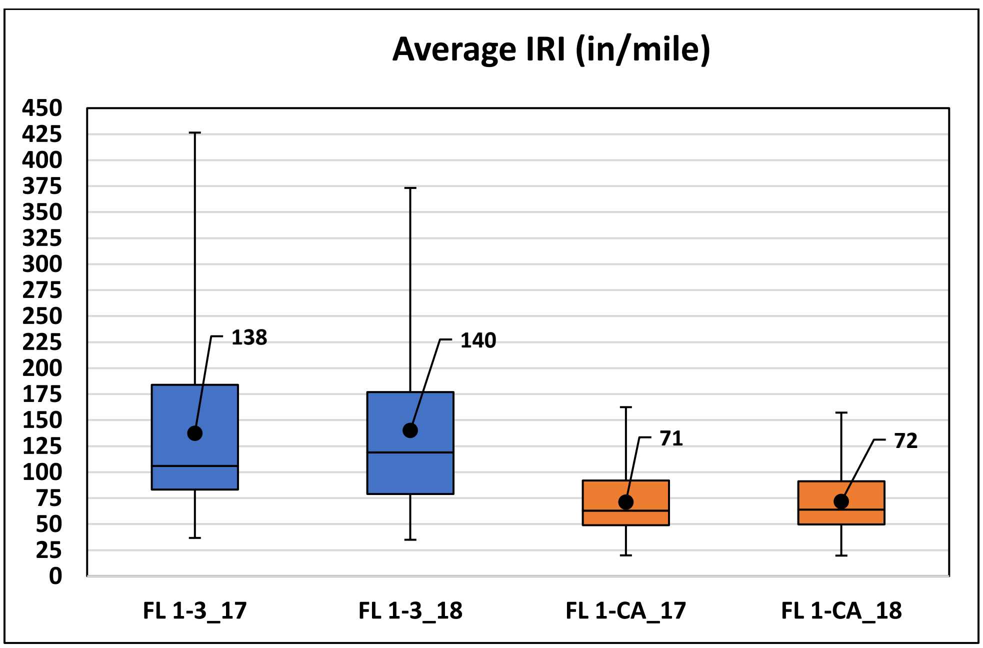

Figure 5. 2017 and 2018 roughness excluding joints

Power Spectral Density (PSD) plots were generated for each wheelpath profile trace using ProVAL 3.61 Software to further investigate the difference in average IRI between the two sections. The PSD function of road profiles is a statistical representation of the importance of various wave numbers (or wave lengths) (2). The PSD plots in Figure 6 and Figure 7 clearly show a relatively high frequency of 55 ft wave length content in FL 1-3 illustrated by a spike at that frequency, for the Left Wheelpath (LWP) and Right Wheelpath (RWP) profile, respectively, which is a major contributor to the relatively large IRI in this section.

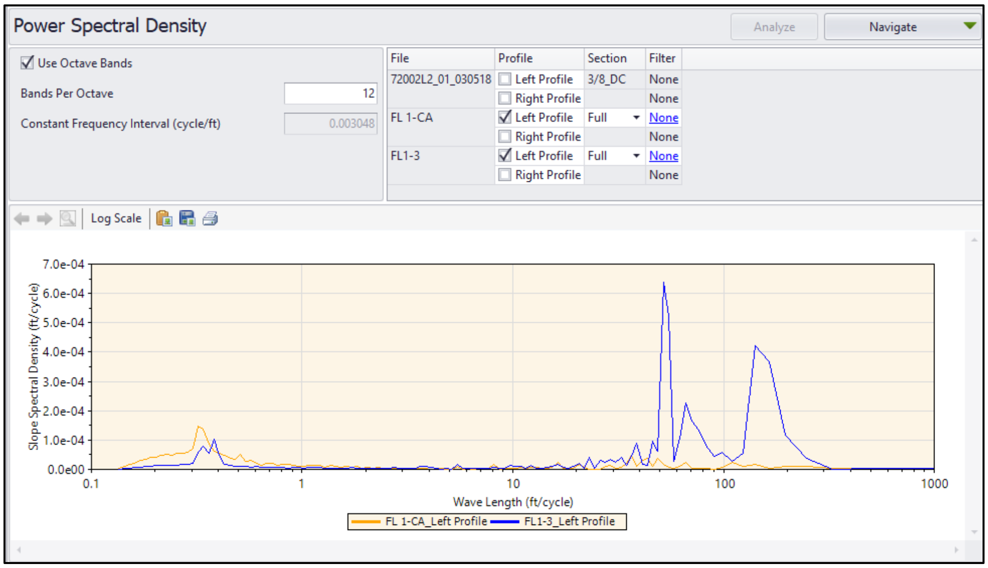

Figure 6. PSD for LWP profile

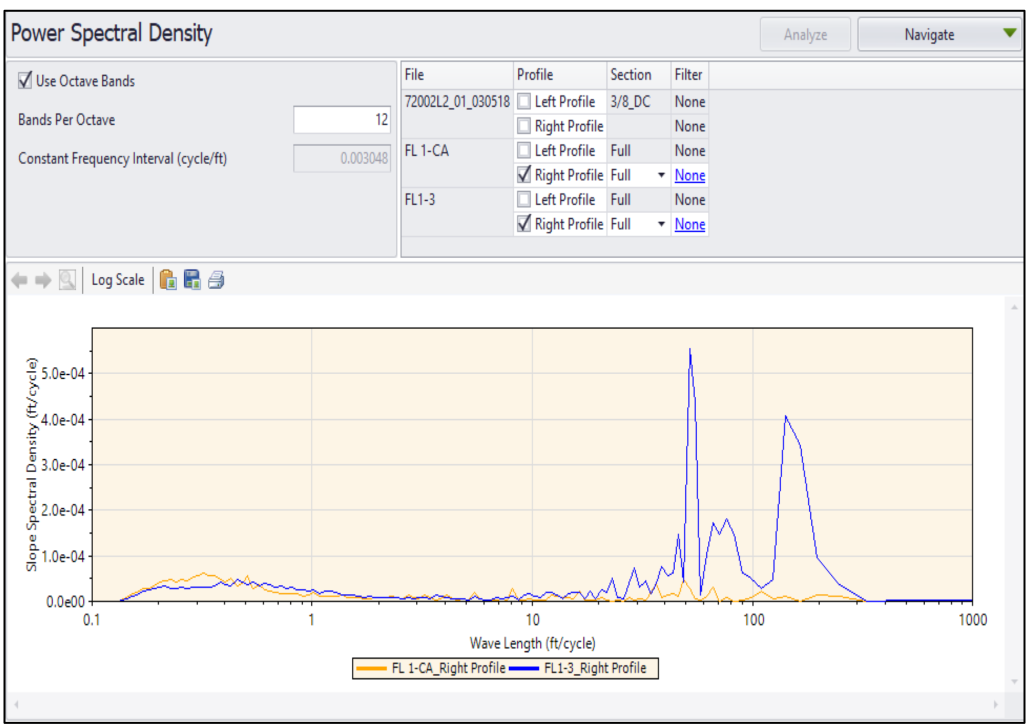

Figure 7 PSD for RWP profile

The original profiles were also filtered using a Butterworth filter set at 100 ft cutoff. The resulting filtered profile clearly shows a relatively high-profile pattern for FL 1-3 in the LWP (Figure 8) and in the RWP (Figure 9) when compared to FL 1-CA.

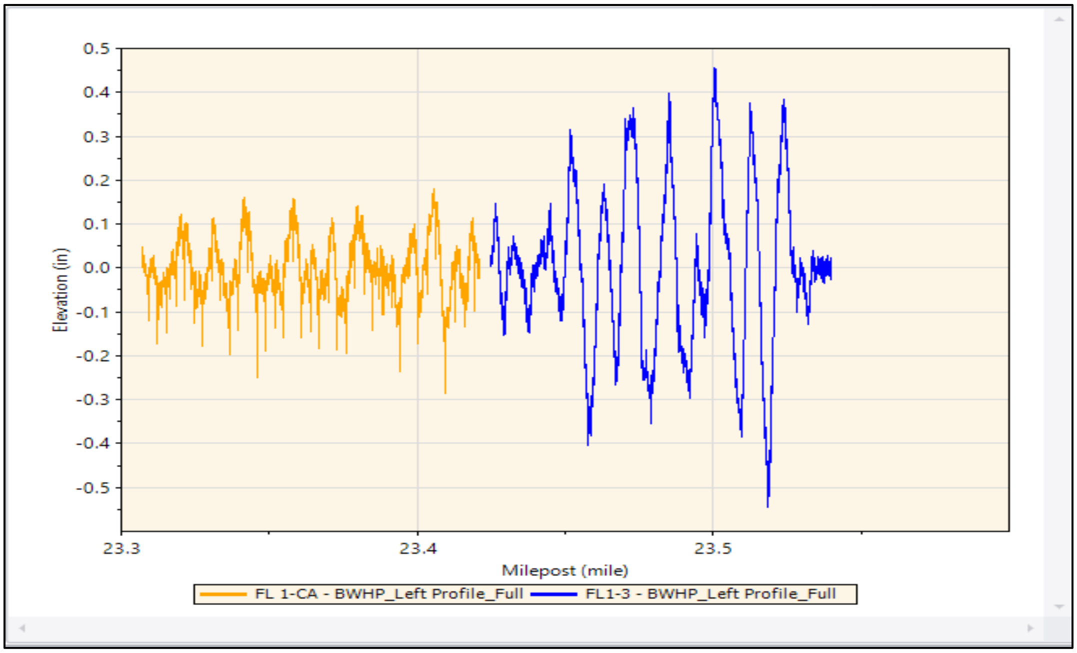

Figure 8 LWP Profile with Butterworth Filter @ 100 ft cutoff

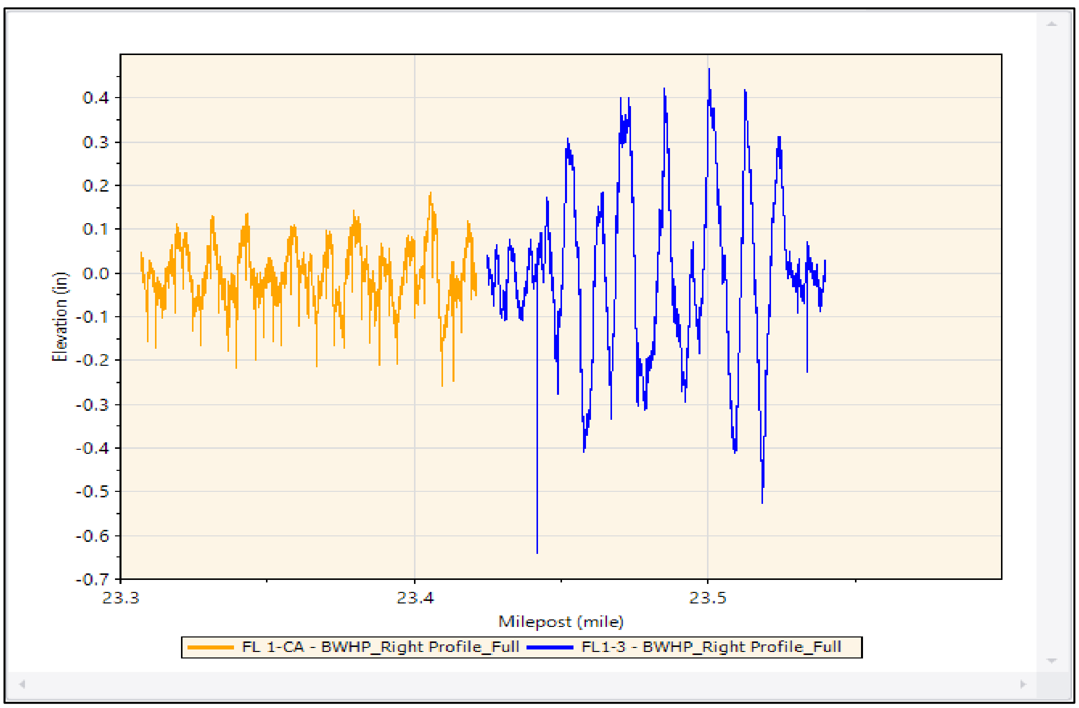

Figure 9 RWP Profile with Butterworth Filter @ 100 ft cutoff

As observed from the plots in Figure 10, FL 1-3 left and right profiles show a similar pattern, which indicates this is very likely due to a construction issue. One plausible theory is that it may have been caused by a sag in the paving string-line, survey error(s) in setting string-line elevations, or a combination of both.

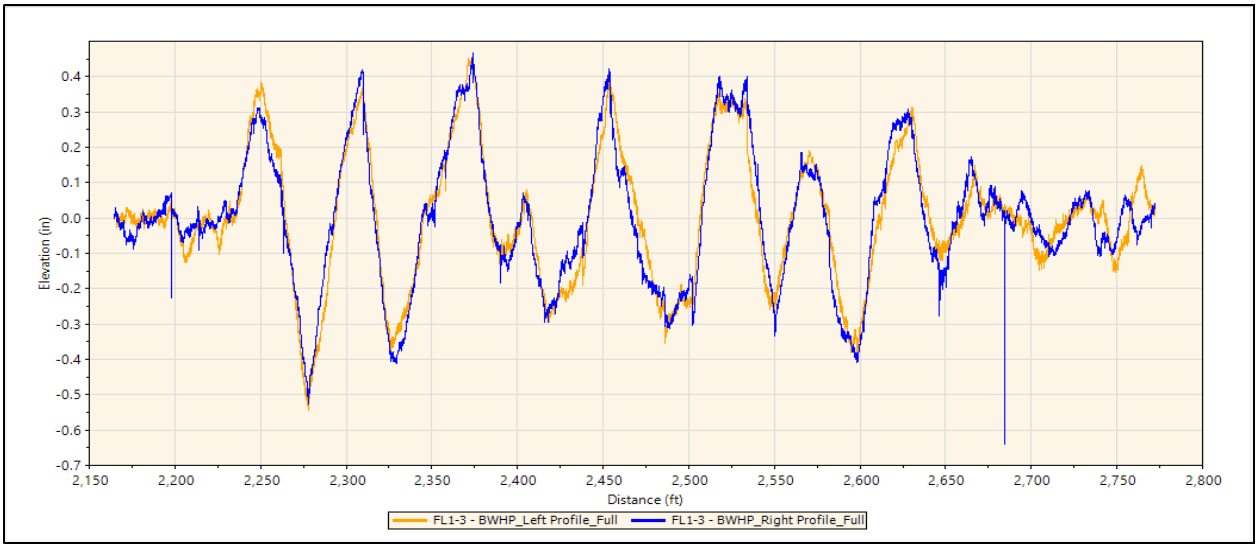

Figure 10 FL 1-3 LWP and RWP profile with Butterworth Filter @100 ft cutoff

Noise

Noise data was collected in the inside travel lane (L1) and recorded OBSI as well as noise inside cabin of survey vehicle. Data was collected at 60 mph and recorded for 5 seconds in each section. Repeat measurements were conducted in each section, three for OBSI and two for inside cabin noise. The results in Figure 11 show no significant difference between the 1/8- inch (FL 1_3) and the 3/8-inch (FL 1_CA) joint sections.

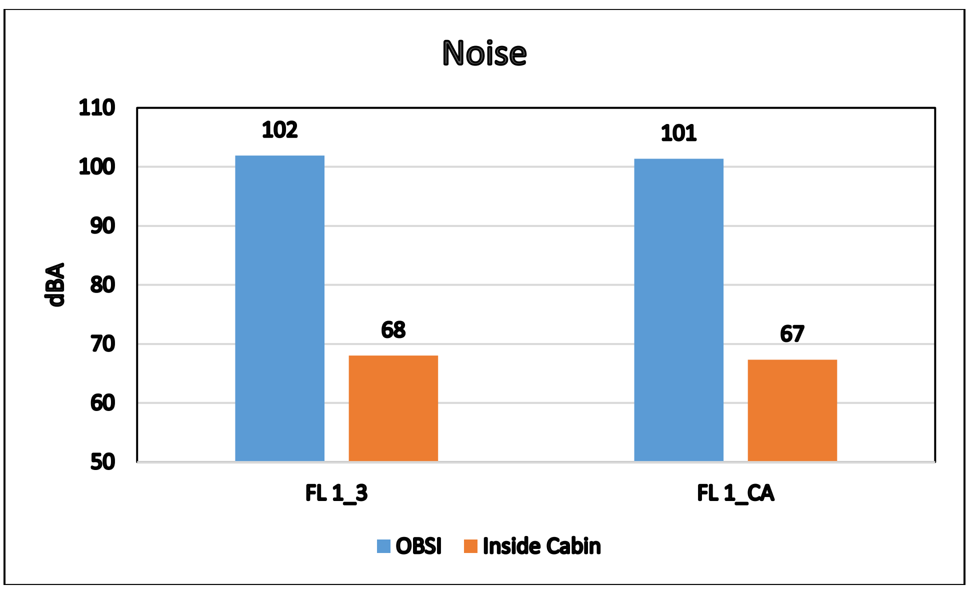

Figure 11 Noise in FL 1_3 and FL 1_CA

Summary

Two JPCP test sections on SR 9A (I-295) were evaluated for performance, namely, FL 1-3 with 1/8-inch single cut joints, and FL 1-CA with traditional 3/8-inch double cut joints. Overall, both sections appear to be in good condition after 16 years of service with no significant signs of distress. Faulting was low averaging 0.04 inch in both sections. Average IRI in the 1/8-inch single cut joints section (FL 1-3) was almost twice the IRI in the 3/8-inch joints Section (FL 1-CA). The relatively large IRI in FL 1-3 may be due to a construction issue. Noise level was similar in both sections, with OBSI averaging 102 dBA and 101 dBA, while inside cabin noise averaged 68 dBA and 67 dBA, for FL 1_3 and FL 1_CA, respectively.

Reference(s)

1. Hall, K., Performance of Sealed and Unsealed Concrete Pavement Joints, 2009, CPTP Tech Brief FHWA Concrete Pavement Technology Program Task 65, FHWA-HIF-09-013.

2. Transtec Group, Pro VAL 3.6 User's Guide, Austin, Texas, 2016.