GROUND INSTRUMENTATION FOR TRAFFIC SPEED DEFLECTOMETER (TSD)

Developing a comprehensive understanding of TSD deflection data by installing ground instrumentation in two Western Australian validation sites

The structural capacities of pavements are traditionally measured using non-destructive deflection testing devices, such as the falling-weight deflectometer (FWD). The FWD measures the response of the pavement surface from a static impulse load. However, traffic speed deflectometer (TSD), measures near continuous pavement surface deflection under a rolling wheel load at traffic speed (40-80 km/hr). ARRB commissioned two ground-truth instrumentation sites near Perth to investigate deflection bowls derived from the FWD and TSD.

Background

In 2018, the project team (Main Roads, ARRB and SLR Consulting) designed and completed the installation of two ground-truth instrumentation sites near Perth. The instrumentation sites (array of geophones, accelerometers and temperature sensors embedded near the pavement surface) were used to monitor the 'true' surface response when the deflection testing devices travel over the sensor array. The primary objectives of the project were to:

- allow comparison of deflections made by the FWD and the TSD;
- provide an independent tool to assess the reported deflections from FWD and TSD; and
- acquire a better understanding of TSD deflection data, to improve confidence in the adoption of the technology.

Approach

- Design, calibrate, install sensor arrays
- Conduct FWD and TSD testing
- Analyse deflection bowls
- Knowledge transfer

Sensor Preparation and Installation

Each unit is custom-made to improve the reliability and longevity of the sensors. The "off-the-shelf" accelerometers and geophones require waterproofing, strengthening and pavement anchorage before they can be embedded in the pavement (Figure 1).

FIGURE 1 GEOPHONE WITH PROTECTIVE CAP IN PLACE AND ANCHOR COLD-WELDED

Source: ARRB 2018.

Results

- Figure 2 presents the deflection bowls measured using the TSD and FWD. For the Kwinana Freeway site, there was a good match in the front end of the deflection bowl (0 to 600 mm). For the Leach Highway site, the deflection in the front end of the deflection bowl also had a good match between 0 to 900 mm offset. It was observed that the deflection profiles and correlation relationship varies with pavement type.

FIGURE 2 COMPARISON OF SELECTED DEFLECTION BOWLS FROM TSD AND FWD

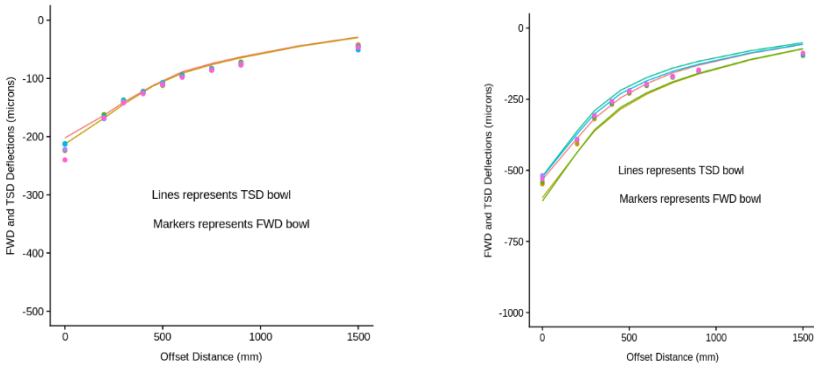
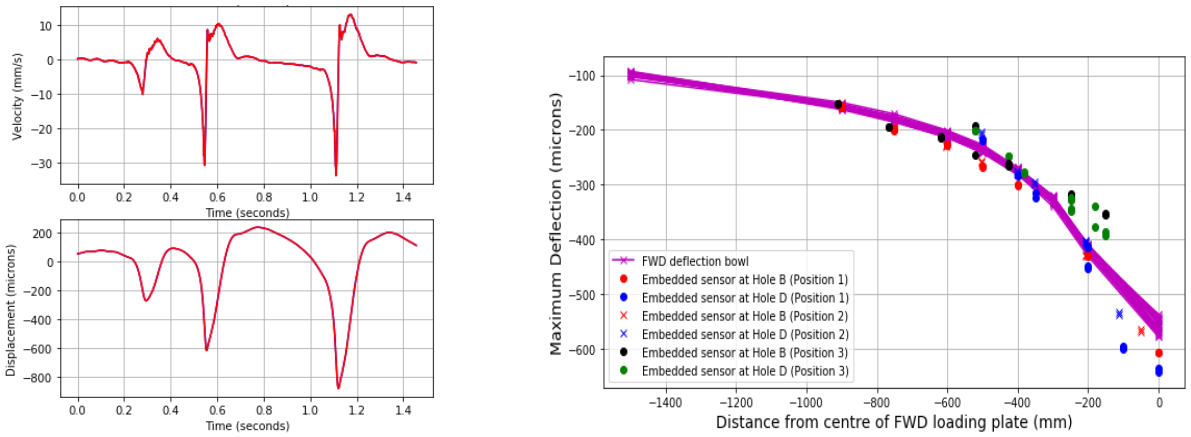


FIGURE 3 TIME RECORD OF TSD AND COMPARISON OF FWD BOWL AGAINST SENSOR ARRAYS



Recommendations for Future Research

- Improve sensor housing design and travel path tracking system for future installation works.
- Establish additional instrumentation sites to increase the coverage for other pavement types, e.g. sprayed seal over granular basecourse.
- Extended project works to monitor the pavement surface response for a range of standard vehicular loadings.

Conduct similar ground instrumentation trials for different pavement types.

Continue to monitor national and international developments on this topic.