Implementation of Advanced Fiber Optic and Piezoelectric Sensors in Smart Bridges

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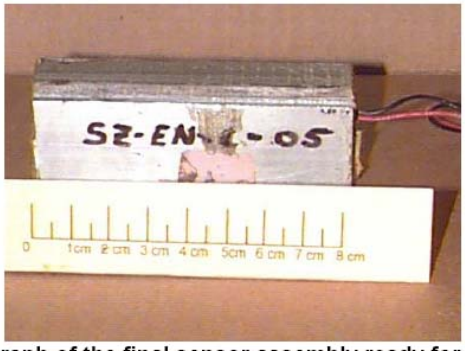
Piezoelectric sensors are being tested for collecting traffic data, including weigh-in-motion, measuring vehicle speeds, classifying vehicles by category and counting axles etc. There are two types of these sensors – polymer and ceramic. Currently WIM systems use a piezoelectric polymer sensor that produces a voltage proportional to an applied pressure or load. The polymer sensors are usually in the form of a long tape or cable embedded within a long block of elastomeric material. These blocks are installed into grooves, which are cut into roads perpendicular to the traffic flow. The biggest disadvantage of polymer sensors is that the piezoelectric output is not uniform with temperature and time, thus leading to large uncertainty in the data collected. Piezoelectric ceramic materials have a much more stable response over a large temperature range. However, they are not used for traffic data sensors because of their inherent brittleness. Piezoelectric ceramic/polymer composites are made with an active piezoelectric ceramic embedded in a flexible non-active epoxy polymer. They hold a lot of promise for WIM applications because of their flexibility and excellent piezoelectric properties similar to that observed in bulk ceramics.



Photograph of the final sensor assembly ready for loading tests.

In this research project, ceramic/polymer composite strips have been fabricated for use as piezoelectric sensors for measuring large loads. After encapsulating the polymer and composite sensors in elastomeric blocks in aluminum channels, the voltage outputs for different loads, loading rates and temperature conditions have been determined. Also, the composite and polymer sensor assemblies are being installed on a test road in order to perform actual measurements.

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