ROAD PAVEMENT FORENSICS

GPR for subsurface road conditions

This custom Noggin configuration is capable of carrying multiple GPR sensors in a ground couple fashion at highway speeds on a legally-licensed platform.

Overview

Subsurface structural failures generate gradual degradation in the pavement structure that works its way up to the surface. GPR pavement forensics surveys can detect unusual subsurface conditions prior to a surface failure. A survey of a multi-lane highway constructed with asphalt over concrete shows growing surface failures directly above joints in the underlying concrete.

Problem

The challenge is to identify zones of incipient failure to plan remedial action. Firefighting emergency repairs are costly and disrupt maintenance budgets. Technology is needed that can define subsurface conditions rapidly and inexpensively at highway speeds without road closure.

GPR Contribution to Solution

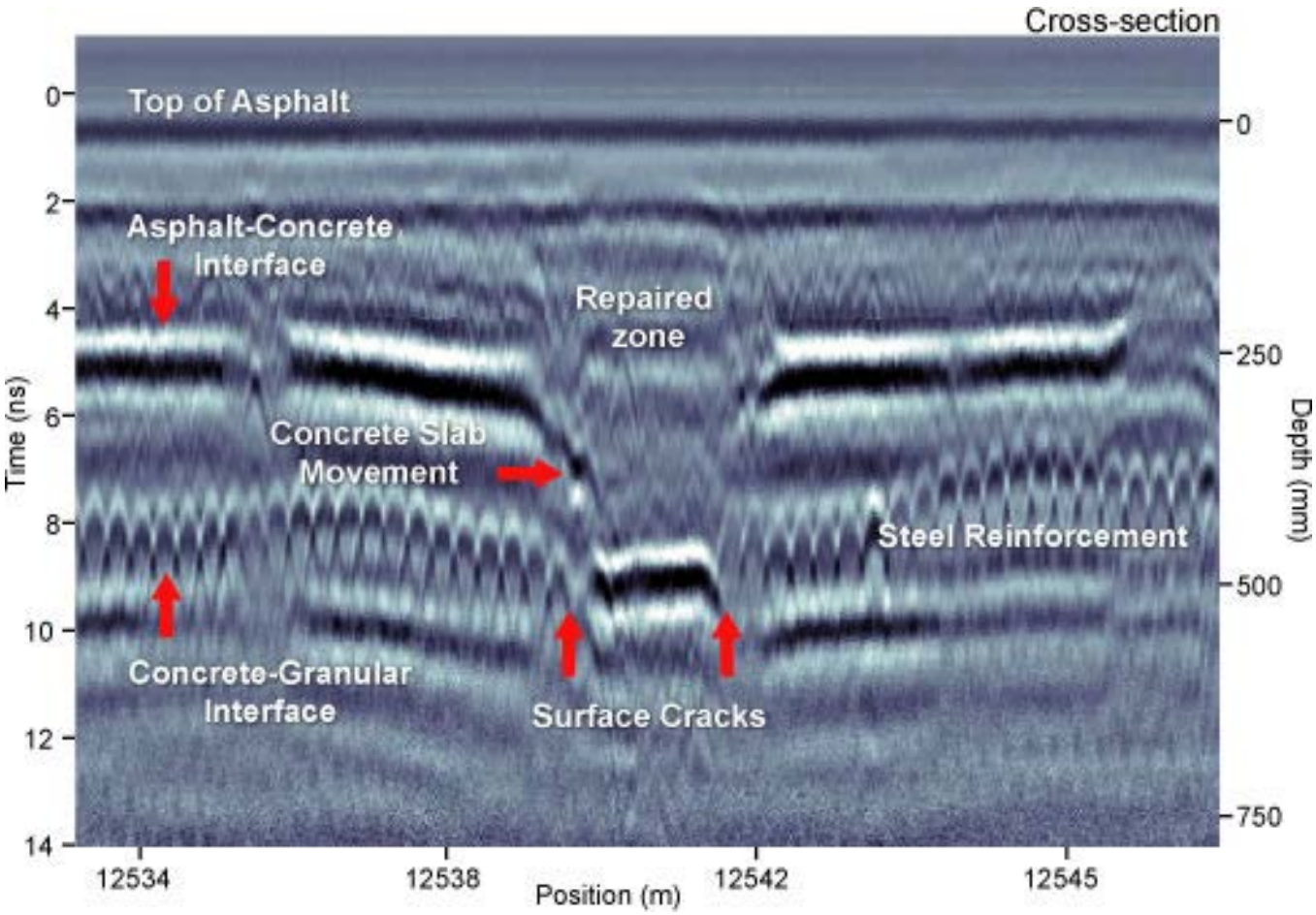
Surveys for undocumented and non-visible repair zones were conducted on Highway 401 in Toronto, Canada to plan maintenance and road upgrades. The highway in this area is 40 years old and has seen many upgrades and repairs. Two sites of surface degradation are marked on the Google Earth map, below.

RoadMap uses Noggin GPR systems to acquire precisely, geo-referenced GPR. Data are collected concurrently from multiple GPR sensors with differing frequencies and/or different path alignments. Synchronized video augments the GPR data, and all data are digitally recorded for later review and analysis.

The location of sites mapped with the RoadMap system

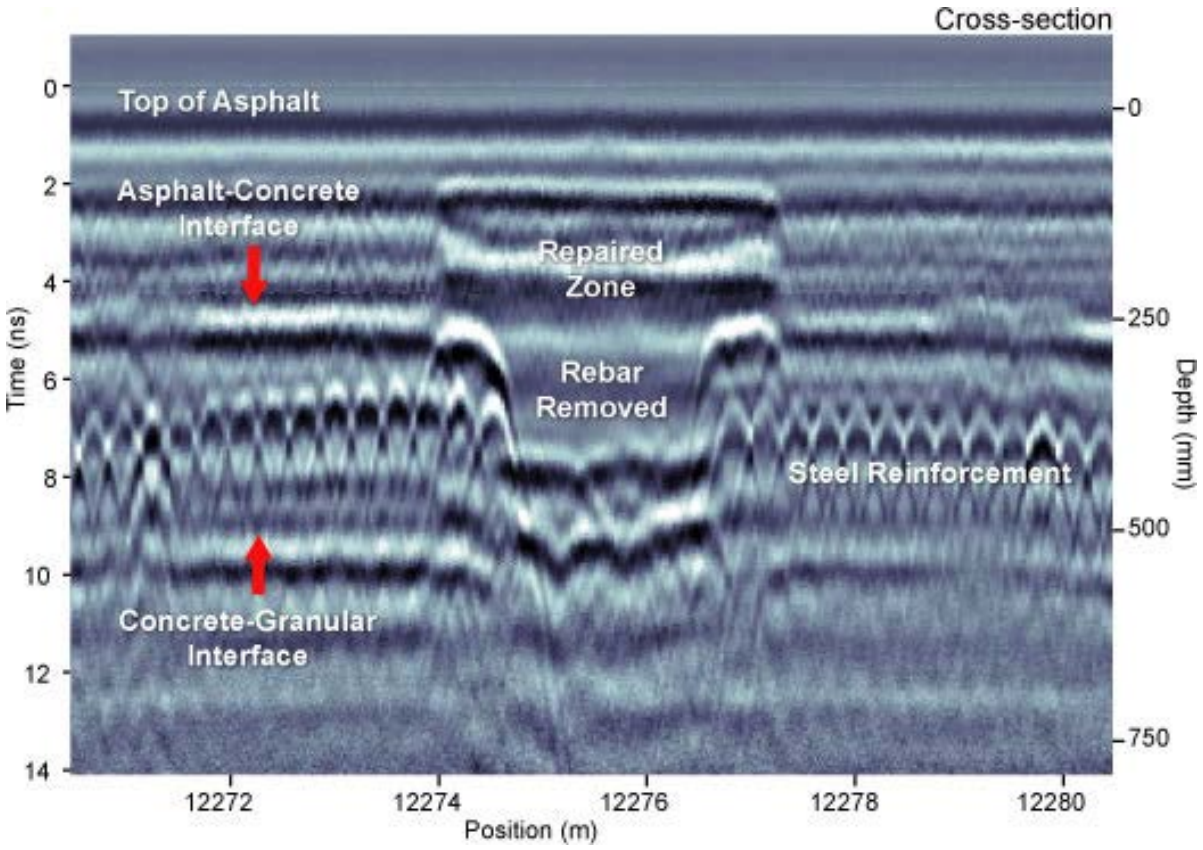
The road construction in the area consists of a 200 to 250 mm layer of asphalt pavement overlying concrete slab which in turn overlies granular material. Multiple passes over several lanes over a distance of about 14 km indentified numerous zones of past repairs and structural issues which were neither on record nor visible from the surface.

"Site 1" shows a prior repair zone where part of the entire concrete slab has been removed The concrete slab to the immediate left is also tilted.



At "Site 1" a previous repair and tilting concrete slab to the left of the repair are clearly visible in this GPR section. Visible surface cracks bracket the repair.

"Site 2' indicates a different construction repair character. There were no clear surface expressions of the repair at the time of the survey.



Another repair zone on Hwy. 401 - "Site 2". In the repaired section, the steel reinforcing and possibly the concrete slab have been removed.

In both instances, the RoadMap data were acquired at 0.01 m step size. Depths were determined from the localized point scattering diffractions and validated against subsequent core sampling.

Results & Benefits

The GPR road and pavement forensics investigation demonstrates the power of GPR for detecting and characterizing subsurface road conditions. Some key benefits are:

- GPR can detect a wide range of changes in road material conditions
- Exploration to depths in excess of 1m are practical
- Operation of ground-coupled systems at highway speeds is practical

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