Inferring strength and deformation properties of hot mix asphalt layers from the GPR signal: recent advances

Tosti, Fabio ORCID: https://orcid.org/0000-0003-0291-9937, Benedetto, Andrea, Bianchini Ciampoli, Luca, Adabi, Saba and Pajewski, Lara (2015) Inferring strength and deformation properties of hot mix asphalt layers from the GPR signal: recent advances. In: EGU General Assembly 2015, 12-17 April 2015, Vienna, Austria.

Geophysical Research Abstracts
Vol. 17, EGU2015-12822-2, 2015
EGU General Assembly 2015

Inferring strength and deformation properties of hot mix asphalt layers from the GPR signal: recent advances

Fabio Tosti, Andrea Benedetto, Luca Bianchini Ciampoli, Saba Adabi, and Lara Pajewski

Roma Tre University, Department of Engineering, Rome, Italy (tosti.fabio@uniroma3.it; andrea.benedetto@uniroma3.it; bianchini.ciampoli@gmail.com; saba.adabi@gmail.com; lara.pajewski@uniroma3.it)

The great flexibility of ground-penetrating radar has led to consider worldwide this instrument as an effective and efficient geophysical tool in several fields of application. As far as pavement engineering is concerned, ground-penetrating radar is employed in a wide range of applications, including physical and geometrical evaluation of road pavements. Conversely, the mechanical characterization of pavements is generally inferred through traditional (e.g., plate bearing test method) or advanced non-destructive techniques (e.g., falling weight deflectometer). Nevertheless, measurements performed using these methods, inevitably turn out to be both much more time-consuming and low-significant whether compared with ground-penetrating radar's potentials. In such a framework, a mechanical evaluation directly coming from electromagnetic inspections could represent a real breakthrough in the field of road assets management. With this purpose, a ground-penetrating radar system with 600 MHz and 1600 MHz center frequencies of investigation and ground-coupled antennas was employed to survey a 4m×30m flexible pavement test site. The test area was marked by a regular grid mesh of 836 nodes, respectively spaced by a distance of 0.40 m alongside the horizontal and vertical axes. At each node, the elastic modulus was measured using a light falling weight deflectometer. Data processing has provided to reconstruct a 3-D matrix of amplitudes for the surveyed area, considering a depth of around 300 mm, in accord to the influence domain of the light falling weight deflectometer. On the other hand, deflectometric data were employed for both calibration and validation of a semi-empirical model by relating the amplitude of signal reflections through the media along fixed depths within the depth domain considered, and the Young's modulus of the pavement at the evaluated point. This statistically-based model is aimed at continuously taking into account alongside the depth of investigation, of both the different strength provision of each layer composing the hot mix asphalt pavement structure, and of the attenuation occurring to electromagnetic waves during their in-depth propagation. Promising results are achieved by matching modelled and measured elastic modulus data. This continuous statistically-based model enables to consider the whole set of information related to each single depth, in order to provide a more comprehensive prediction of the strength and deformation behavior of such a complex multi-layered medium. Amongst some further developments to be tackled in the near future, a model improvement could be reached through laboratory activities under controlled conditions and by adopting several frequency bandwidths suited for purposes. In addition, the perspective to compare electromagnetic data with mechanical measurements retrieved continuously, i.e. by means of specifically equipped lorries, could pave the way to considerable enhancements in this field of research.

Acknowledgements - This work has benefited from networking activities carried out within the EU funded COST Action TU1208 "Civil Engineering Applications of Ground Penetrating Radar".