Geophysical Research Abstracts
Vol. 19, EGU2017-16548-2, 2017
EGU General Assembly 2017
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Assessment of the underground construction details of a road pavement using GPR antenna systems with different frequencies

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The assessment of the underground construction details of a road infrastructure is a problem of great concern in highway engineering. The case becomes complicated especially when damages reoccur after carrying out remedial surface maintenance and repair works over the life cycle of the infrastructure. The challenge will be exacerbated at the presence of underground watercourses, such that the geotechnical stability of the entire road structure could be threatened.
In this respect, ground-penetrating radar (GPR) has been recognised and accepted as one of the most effective non-destructive testing (NDT) techniques that could be employed in identifying the cause/s of such problems. The recent advancements and developments made in the field of GPR hardware as well as the current level of understanding of the applications and processing techniques of the GPR data have immensely added to the reliability in the utilisation of this tool in variety of subsurface investigation projects.
In view of this, the work presented in here focuses on the assessment of the underground construction details of a road pavement using different frequency GPR antenna systems. In addition to this, the possible presence and location of an underground watercourse was investigated in this work. The existence of the latter problem was perceived due to reoccurrence of longitudinal and traversal road surface cracking as well as subsidence at a particular location of the road. Reoccurrence of this damage was interpreted and related to the possible existence of an underground watercourse. The original design and the construction of the road were as such to prevent this movement. Therefore it seemed necessary to perform a GPR survey to investigate and confirm the underground construction details of the road. To this purpose, the identified area was surveyed using high to low frequency antennas with 2000 MHz, 900 MHz, 600 MHz and 200 MHz central frequencies of investigation. Scans were performed at 1m intervals in the direction of the road started from the reference (first) transversal axis located 5m behind the drain at the side of the road.
The results obtained using the 2000 MHz antenna showed that the road construction consisted of an asphalt layer of 10 cm thickness overlaying a reinforced concrete block with two layers of rebar mesh. In addition, significant moisture damage and evidence of subsidence within the road were identified. The 900 MHz frequency antenna confirmed the above results as well as suggesting the existence of subsidence at the lower areas of the road foundation. Furthermore, results revealed the existence of an unidentified object at the deeper depth. This was not detected by the higher frequency antenna. The maximum depth of penetration was achieved by using the 600 MHz and the 200 MHz antennas (maximum of 3 m). To that effect this investigation did not identify or confirm the existence of any underground watercourse.

Acknowledgement

The authors acknowledge the COST Action TU1208 “Civil Engineering Applications of Ground Penetrating Radar” for providing networking and discussion opportunities throughout its activity and operation as well as facilitating prospect for publishing research outputs.