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Assessment of an Impulse GPR Antenna Abilities in Investigation of Transversal Cracks of the Bituminous Pavement

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Ground Penetrating Radar (GPR) technique is commonly used for detection of internal singularities of construction structure. The method is particularly efficient in the case of linear horizontal objects when profile scanning is being performed in the direction perpendicular to object elongation and polarization of the electric field is parallel to the elongation. Then the singular object manifests itself in the echogram as a scattering hyperbola. Similar response is generated by an object having shape close to a vertical half plane with horizontal edge, when the edge acts like the scattering linear object. The use of GPR technique for investigation of transversal cracks in the bituminous pavement would seem to be promising, but numerous paradoxes occur just at the beginning tests. Even well visible cracks of more than ten millimeters thickness doesn't generate noticeable GPR response, while thinner ones sometimes can produce strong response but in the deeper interior of the pavement. Thus arise a more general question: what the GPR technique can tell us about the cracks?
Trying to study this problem some laboratory tests were performed to estimate efficiency of signal generation by structures simulating idealized cracks' shapes. Next long-term (several years) visual observation and repeated GPR scanning was performed on the three road sections (each one of several hundred meters length) with heavy traffic, where ongoing cracking process occurs. The preliminary measurements were directed to obtain the proper way of scanning. The main aim of the analysis was to find GPR characteristics of cracks that can be noticed on echograms. It was performed by detailed correlation of the visually observed cracks position with echograms using decimeter precision. These efforts provided a list of diagnostic GPR characteristics of cracks and some provisional scale of their intensity. In several cases the cracks were probed by drillings to recognize structures responsible for signal generation or to explain reasons of lacking signal. The three field cases represent different types of bituminous pavement and different degrees of cracking process progress, what showed first of all a large diversity GPR responses types and existence of specific masking effect related possibly to large-size granulation of the asphalt mixture. These examples show that the strong signals are frequently related to advanced deterioration in lower, older layers and confirm difficulty of cracks detection in a new cover. But on other hand long term observation showed that numerous new cracks appear on the surface in places, where some structural singularities were noticed earlier inside the new construction.