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Moisture map of pavement by GPR. An informative case study.

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Ground penetrating radar (GPR) in road engineering applications include not only structural layer thickness evaluation, but also locating in situ anomalies within the road substructure like stripping and segregation or delamination and reinforcement corrosion detection in bridge decks (Berthelot et al, 2010). According to Saarenketo (2006) moisture it is another aspect that can be evaluated through GPR and this paper deals with a successful informative case study in this field.

This case study is a recent constructed road pavement, 600m long, where surface's longitudinal and transversal roughness took place during in less than one year. This roughness (evenness) affect moving vehicle dynamics by steppingup the wearing on the components of a vehicle and, hence, becomes effective mainly on vehicle operating costs and safety and on comfort and cruise speed dominantly.

To investigate these premature pavement deterioration non-destructive tests were the only feasible tools since the huge use of the pavement during day and night.

The first approach to investigate the problem was a survey with a falling weight deflectometer (FWD) test (65 kN), along 4 parallel lanes, with one test for each 100m segment, together with laser sensors to evaluate longitudinal roughness (International Roughness Index).

In a second survey, test segment was shorten (25m) to enhance the possibilities to detect a pattern and understand the problem. Furthermore, the load of FWD tests has been increased (100 kN) to mobilize deeper layers of the pavement, that may contribute to the problem. This second survey included also ground penetrating radar (GPR) evaluation, together with longitudinal roughness evaluation (IRI). GPR survey, have been carried out along the same FWD and IRI lanes, with horn air launched antennas of 1GHz and 2GHz central frequencies.

Data analyses of test results achieved through different methods allow to conclude about possible correlations between test results on the pavement anomalous zones, contributing to understand singularities that each method individually identify.

In fact, overlapping test results suggested the relationship between the areas with higher IRI values and those with bigger deflection amplitude (FWD), and as well as, those areas with higher GPR amplitude reflection along granular base/soil cement interface.

It should be stressed that GPR detected heterogeneous amplitude reflection values in the interface granular base / soil cement that can be attributed to local structural deficiencies or heterogeneous moisture. A complementary site investigation with two inspection pits clarify that the differences of the amplitude reflection values were associated to the saturation level of material, allowing a moisture mapping associated with distinct hydraulic conditions in pavement structure and foundation.

Despite the correlation between the test results GPR has a decisive contribution to identify the problem contributing to the understanding of the reasons for the premature pavement deterioration.

References

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