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Integration of GPR and FWD methods for the assessment of airfield aprons

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Airport apron relates to an airfield area dedicated to the parking, loading/unloading, refueling and boarding of aircrafts. The standard conventional pavement solution in apron areas is a concrete rigid pavement with jointed concrete slabs, which is due to two main reasons. First, use of concrete technology helps to prevent the potential viscous behaviour of the hot-mixed asphalt solution. This is caused by long-term and permanent loads, especially at high temperatures. Secondly, use of concrete blocks avoids the decay of the wearing course due to the contact with fuel.

Although it is relatively easy to design the working features of hardened concrete for apron surfacing purposes (i.e., following the requirements of pavement quality standards), great attention must be paid to the laying stages and construction process. This is to ensure that the laid concrete attains all the designed properties and no premature decays occur. Decays include, inter alia, uncontrolled cracking throughout the concrete slabs. To that effect, role and magnitude of concrete cracking in affecting strength and durability of a rigid pavement subject to external loads is still under debate.

Monitoring and assessment of concrete cracking is a complex task, and several theoretical and experimental models have been developed over the past years. To this purpose, ground-truth information were collected using destructive (e.g., concrete sampling) and non-destructive testing (NDT) methods. In this regard, ultrasonic testing (UT) has been widely used for quality control of concrete and damage detection purposes. On the other hand, the falling weight deflectometer (FWD) technology is commonly used for the assessment of stiffness-related parameters of pavement structures. To this effect, mechanical properties of pavements are usually estimated in combination with the geometric information (i.e., thickness of layers/slabs) collected by the ground-penetrating radar (GPR) NDT method.

In this study, a demonstration of the potential of integrating ground-penetrating radar (GPR) and falling weight deflectometer (FWD) non-destructive testing (NDT) methods for the assessment of an airfield apron has been given. The main objective was to provide an effective methodology capable to combine multi-source information from FWD, light falling weight deflectometer (LFWD), GPR, pavement construction stages and development of decay over time (available from the airport maintenance company) in order to assess the mechanical properties of an airfield apron affected by early-stage and widespread cracking. The structure of the apron was a rigid pavement with jointed concrete slabs

To this purpose, an airport apron area with dimensions of 190 m $\times$ 90 m, paved by a grid of squared concrete slabs with a side length of 7.5 m, was investigated. FWD, LFWD and a ground-coupled multi-frequency GPR system with 600 MHz and 1600 MHz central frequency antennas were used for testing purposes. The results from the integrated application of the above NDTs demonstrated significant potential for the interpretation of distinctive features of the concrete slabs, including cracking, that may affect the mechanical behavior of the pavement.

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