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Examples of the use of GPR for research at airports

Abstract: The GPR tests were carried out for the needs of the expansion of the "Fryderyk Chopin" airport in Okęcie in Warsaw. There were old and new surfaces at the airport. GPR profiling was conducted on selected lines. For the purposes of the research, core drillings and ground core drillings were performed in the airport pavements. The geological interpretation of the GPR data was made on the basis of drilling data. 6 GPR models were developed for the tested airport pavements. The results of each GPR cross-sectional line were compared with the results of the HWD study. It was found that the use of the non-destructive GPR method for monitoring airport pavements causes: reduction of the number of drilling in pavements, minimization of interruptions in aircraft traffic, quick and effective monitoring of the condition of airport pavements.

Keywords: GPR; Airport surfaces

The GPR method is used to monitor the surface at airports: runways, taxiways, turning pads, aircraft parking pads (APRONS- aircraft parking pads). Methodical, GPR research was carried out for the needs of the expansion of the "Fryderyk Chopin" airport in Okęcie in Warsaw. GPR tests using the linear profiling method were performed to a depth of 2.5 m with the use of RAMAC/GPR with shielded 250 MHz antennas.

1. RAMAC/GPR equipment with 250 MHz shielded antennas

The following tasks were set:

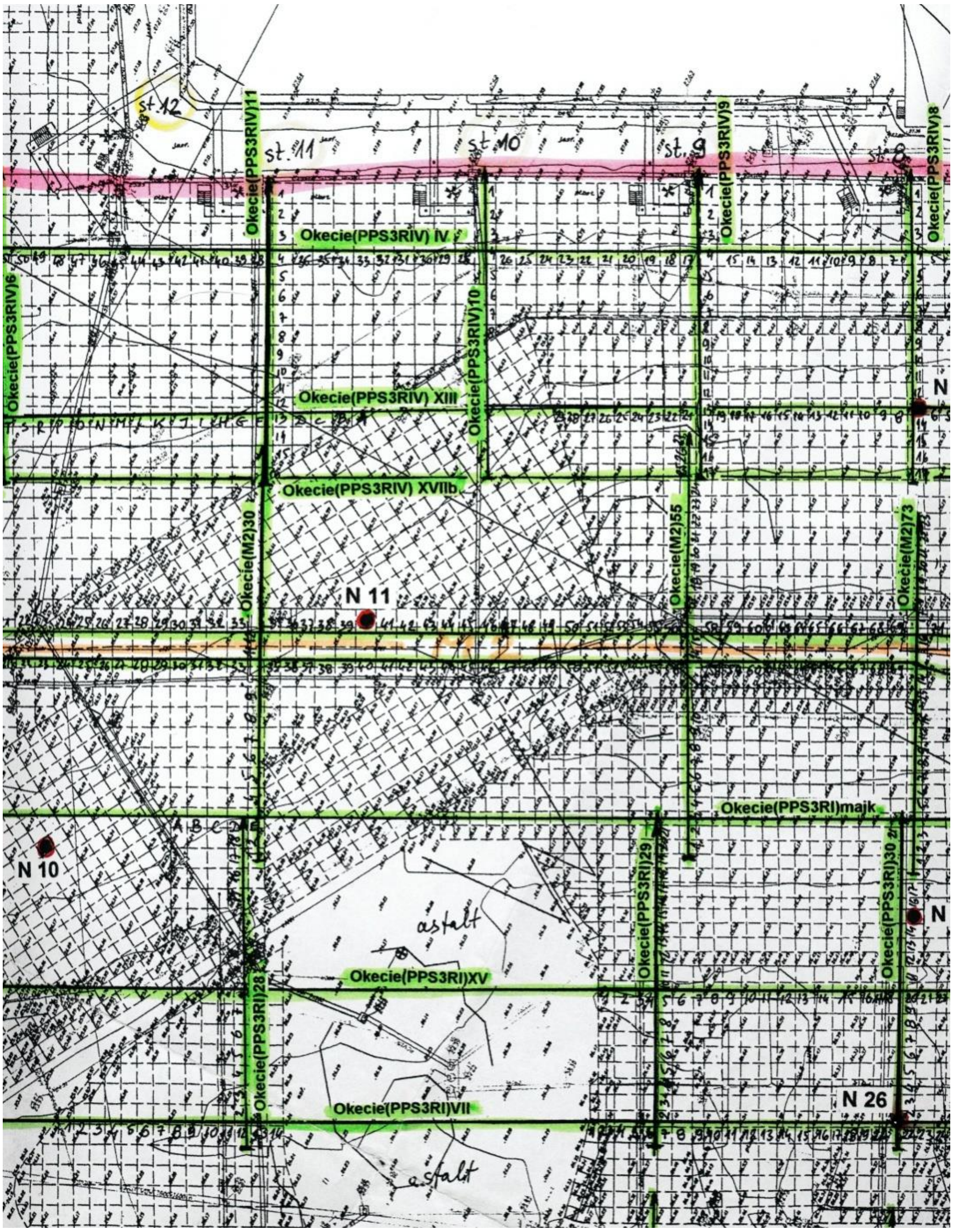
I. - showing the structure of selected fragments of the airport pavement,
II. - showing the condition of the plates and their destruction,
III. - showing if there are any old, unknown structures under the surfaces.

The following requirements were imposed on the GPR Team research: 1) not to interrupt work at the airport and in the airport, 2) GPR teamwork should be performed only at night (21:30 -5: 30) when traffic at the airport is minimal, 3) constant radio contact with the tower air traffic control. The research area was limited to the area in front of the former Terminal 1 and at the site of the planned new (current) terminal. For the purposes of the research, 24 drillings (cored) were made on the surface of the airport and 4 drillings (cored) in the ground (up to a depth of 4-6 m).

For over 50 years of the airport's operation, the pavements were rebuilt. There were old and new surfaces at the airport. Drilling has shown that old surfaces are usually one layer of concrete on the so-called base, which was made of a layer of gravel bonded with cement. The new surfaces had two concrete layers lying on a thin layer of asphalt, under which there was a base layer (gravel bonded with cement). The pavements of the taxiways were constructed differently. Most often, the surface layer was made of a layer of asphalt, underneath it there were one or two layers of concrete lying on the base (a layer of gravel bonded with cement).

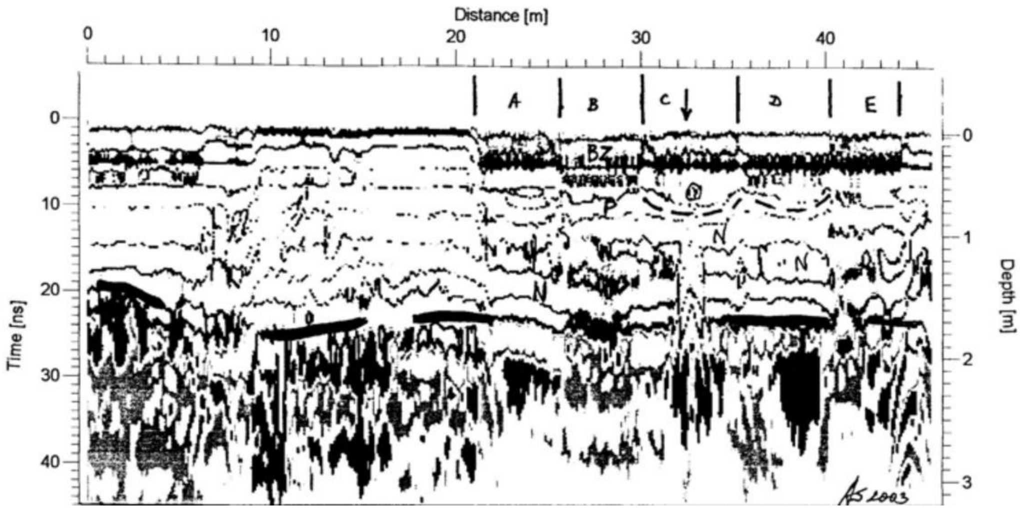
2. Examples of cores from drilling in pavements: 9 - core from the new pavement, 10, 24 cores from old pavement

3. Examples of cores from drilling in the Taxiway DK-A4 surface

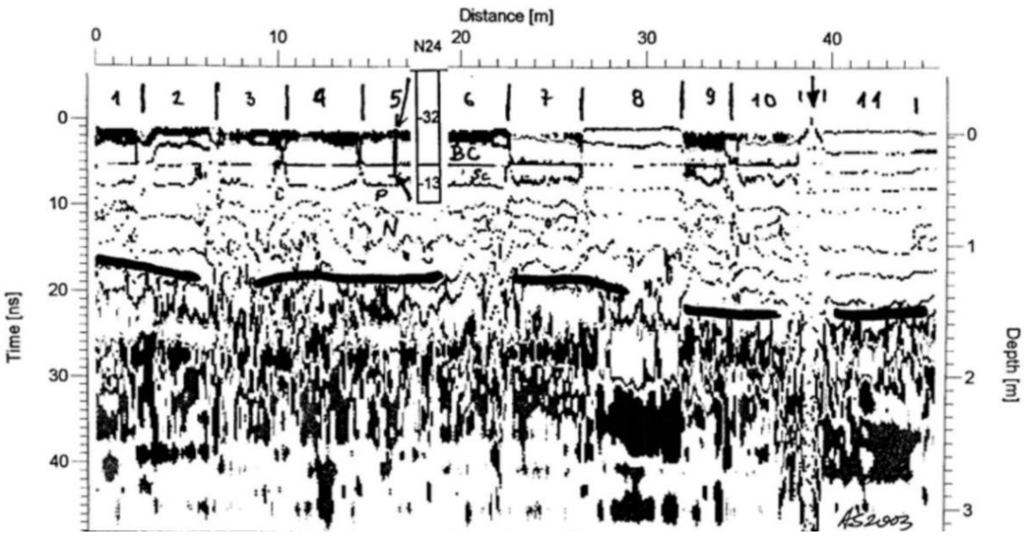


4. Location of selected GPR cross-section lines (green line) and selected pavement drillings

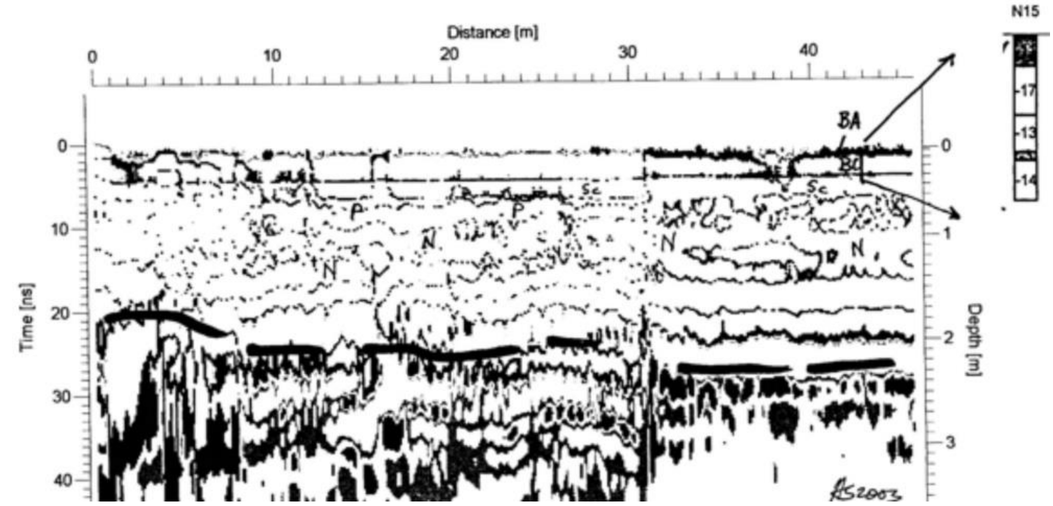
GPR profiling was conducted on selected lines. During two weeks of work, two operators completed a total of 30 km of cross-sectional lines. The geological interpretation of the GPR data was made on the basis of drilling data. GPR models of the airport pavement were developed:



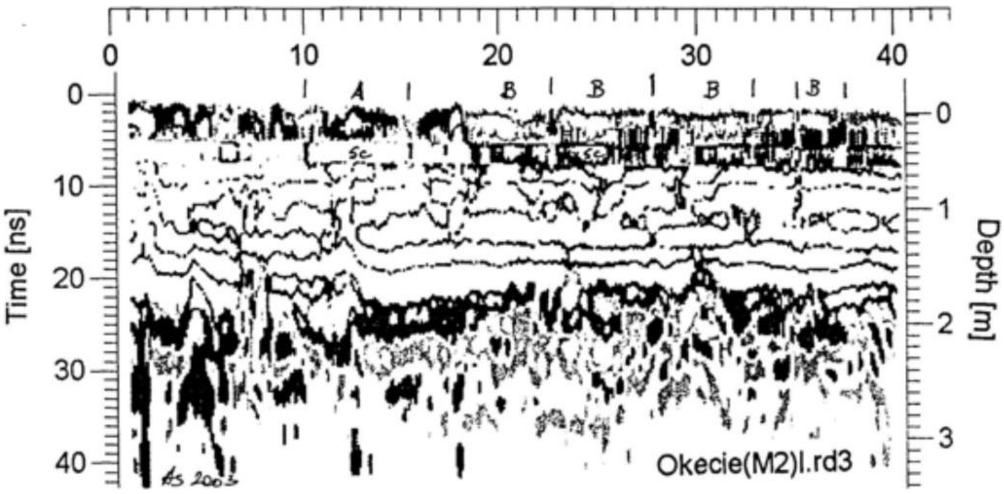
5. Model 1 - a slab made of reinforced concrete (slabs: A, B, C, D, E);



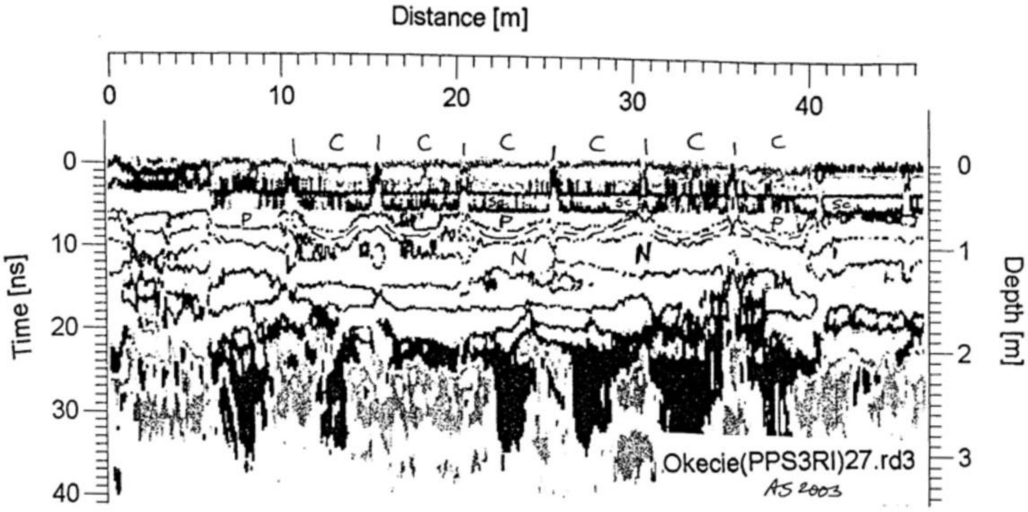
6. Model 2 - a slab made of: asphalt layers (black pavement), concrete layers (BC), base layers (Sc);



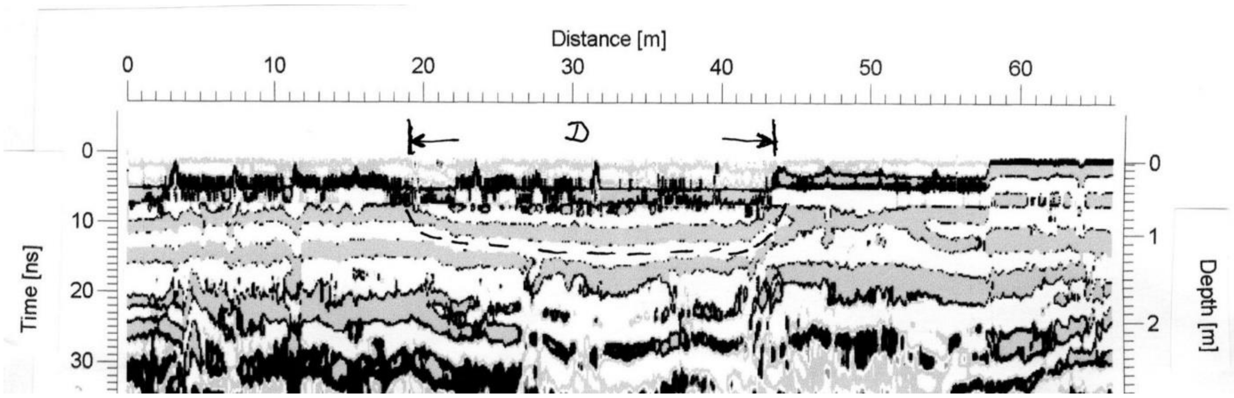
7. Model 3 - slab made of: asphalt layer (BA), two concrete layers (BC, 17 + 13), and below: asphalt layer (BC, 5 cm) and a base layer (Sc, cement-bonded gravel); N15 - core from drilling in the surface



8. Model 4 - base under the plate (Sc): good condition (A), bad condition, cracked (B)

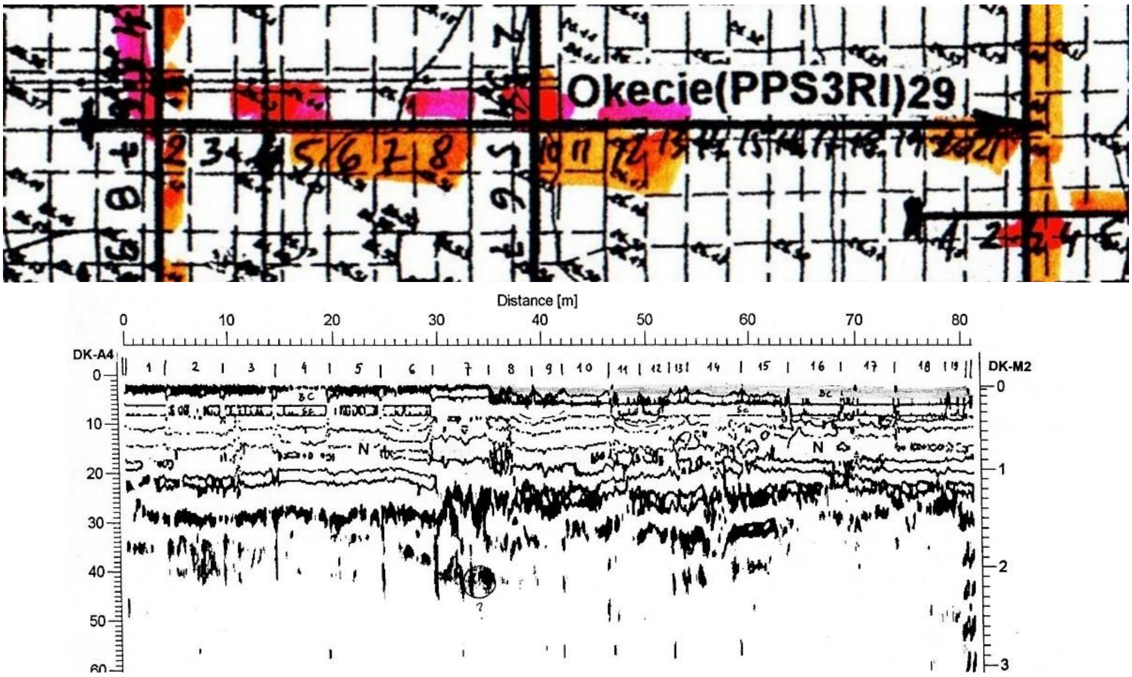


9. Model 5 - plates (C) pressed into the sub-base (P) and into the natural substrate (N),



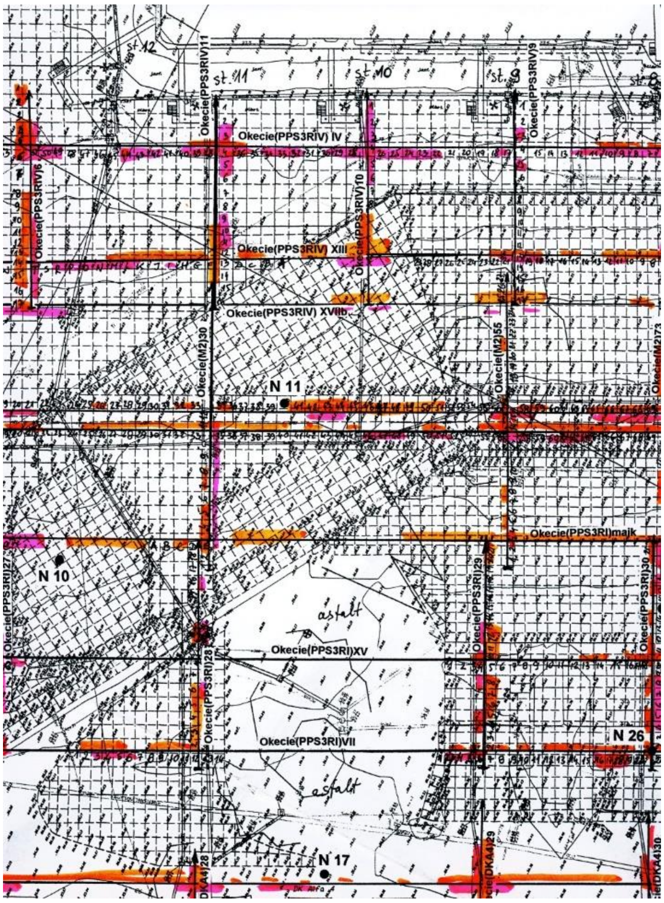
10. Model 6 - plate group (D) pressed into the natural substrate

On the map showing the airport pavement, the test results for each plate are marked on the GPR section line (Figures **11**, **12**).



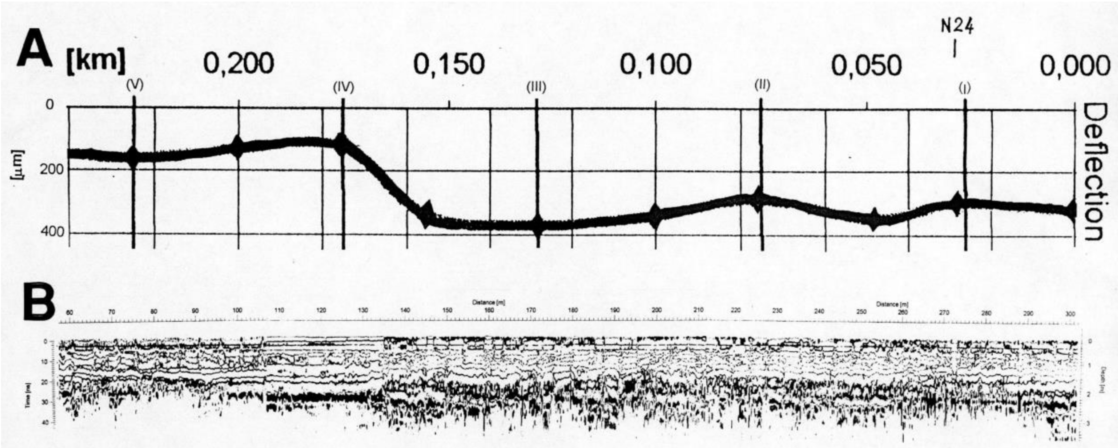
11. GPR (PPS3RI) 29 section , from DK-A4 to DK-M2.

The plates are numbered, and their condition is marked on the map (at the top): good - white plate (e.g. 3), cracked and pressed (e.g. 6), bad condition (e.g. 8, 12).



12. Fragment of the map with GPR test results: crushed base under the plates - purple color, plates pressed into the subbase - brown color

The results of each GPR cross-sectional line were compared with the results of the HWD tests carried out by the Airport Construction Department of the Military Institute of Aviation Technology in Warsaw (example in Figure **13**).



13. Comparison of the results of the HWD (A) tests and the results of the GPR (B) tests on the same cross-sectional section (I-V - control points)

The comparison shows the convergence of the research results. From 0.000 - 0.170 km, HWD shows that the plates are in very bad condition (cracked). Comparable section GPR (135-300 m) also shows that the plates are in very bad condition, but the picture of each plate is more accurate..

Summary

The use of the non-destructive GPR method for monitoring airport pavements causes:

1. Reduction of the number of drillings in pavements (time-consuming and very expensive).
2. Minimizes interruptions in aircraft traffic (the airport works continuously).
3. Quick and effective monitoring of the condition of airfield surfaces.