Non-destructive testing maintains pavement integrity and provides in-situ data collection

A greater number of passengers and more freight than ever are travelling by aircraft, requiring increases in available flights and new large aircraft to accommodate demand. As airport traffic and aircraft loads continue to expand, the FAA remains committed to minimizing runway closures and maximizing pavement performance by understanding and anticipating maintenance and rehabilitation needs.

Non-destructive testing (NDT) techniques offer efficient and cost-effective solutions to meet a variety of airport pavement evaluation demands, from pavement condition to layer moduli evaluations to quality control during construction.

NDT techniques can be used to evaluate a pavement’s structural life (applications include pavement layer evaluation and acceptance of new construction) or its functional life (including measurement of rehabilitation triggers such as roughness and cracking). The available collection methods evaluate in situ conditions, which can allow for quicker, less costly, and more complete testing of a pavement than destructive alternatives.

All NDT applications rely on accurate and comprehensive data acquisition, processing, and dissemination in order to advise aviation stakeholders in important rehabilitation decisions. Automation of these functions is increasingly important as practitioners strive to cover more area in less time and improve overall pavement performance. Continued advancements are ultimately expected to help monitor pavement behavior and improve pavement management systems and databases.

ATR’s NDT program is identifying non-destructive devices, techniques, and methodologies and establishing specifications for these technologies by evaluating device performance and applicability.
Structural Evaluation using NDT

Structural evaluations examine the makeup and integrity of a pavement’s layers in order to support the management of its structural life. The following non-destructive testing (NDT) methods measure relevant structural qualities:

- The **Light Weight falling Deflectometer** (LWD), pictured above, is used to complete quality assurance and quality control (QA/QC) procedures during pavement construction. This method provides an inexpensive and quick estimation of the resilient modulus, which can also be used for airport pavement design and analysis.

- The **Ground Penetrating Radar** (GPR) uses a high-frequency radio signal in order to characterize pavement layers. Applications include determination of pavement layer thickness, delamination, and identification of any potential voids.

- **Heavy Weight Deflectometer** (HWD) testing measures pavement surface deflection upon application of a predefined impulse load at set distance from the load. Deflection analyses are used to determine subgrade and pavement layer moduli. HWD results are also used to monitor the structural integrity of airfield pavements.

- **Software** plays two critical roles in the use of NDT. First, software from manufacturers or developers controls the NDT equipment when collecting data. Once a NDT tool or vehicle has been used to collect pavement data, the FAA uses its suite of pavement evaluation software, which is developed, maintained, and updated by ATR, to process and analyze it. For example, backcalculation is performed on HWD data using FAA’s BAKFAA software to determine in situ layer moduli using various models.

- The **Portable Seismic Pavement Analyzer** (PSPA) provides a non-destructive means for determining in-situ layer properties and an alternative to time consuming and expensive coring. PSPA is being used as a basis for the development of new pavement acceptance criteria.

Visit the ATR Website at [www.airporttech.tc.faa.gov](http://www.airporttech.tc.faa.gov)

Functional Evaluation using NDT

Distress surveys and functional analysis using NDT allow airport pavement practitioners to determine and manage a pavement’s functional life, or how long it will perform considering the impacts of environmental triggers:

- **Pavement Condition Index (PCI)** is the pavement industry’s dominant index for surface condition evaluation. While the required visual survey is typically time consuming, maturing NDT technologies such as FAA’s mobile NDT vehicle, pictured above, can significantly reduce the labor required. The NDT van can acquire 2D and 3D images, day or night, with 4 meter-wide coverage. It has been used for pavement evaluation during Construction Cycles at the National Airport Pavement Test Facility and remotely, acquiring data to support FAA’s Extended Airport Pavement life project. The van is also being used as a test bed to evaluate new image capturing technologies.

- Undesirable runway pavement surface profile changes, or roughness, can inflict stress on aircraft components, obstruct braking action, and inhibit aircraft safety. So, the FAA developed the Boeing Bump Index to validate in-service pavement roughness. The FAA’s ProFAA software is used together with equipment such as the NDT van and profile measurement tools to measure acceptability using this index. A next generation index is being developed to expand current capabilities.

- **Grooving** increases pavement surface texture so that surface water on runways can escape from under aircraft tires. This decreases hydroplaning during wet weather events. NDT such as profile measurement devices allow operators to collect 100% of groove dimension measurements along a runway. That data can be processed through FAA’s ProGroove evaluation software to compare a runway’s distribution of groove geometry with the allowed groove serviceability levels.

- **Macrotexture** is an important element of pavement safety performance characterized by aggregate gradation, size, and shape. It influences splash, spray, and pavement friction in wet weather conditions. 2D and 3D NDT imaging can collect a true texture profile to calculate macrotexture profile depth.