Dynatest®

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Application Note:

New method for in-situ Accelerated Pavement Testing.

There are several options for full-scale APT testing, including full-scale test tracks or mobile simulators such as the HVS. While these testing methods offer a precise and thorough test, a more economic and flexible method could facilitate higher innovation into the finding of new asphalt mixtures.

Accelerated Pavement Testing (APT) has since the beginning of the 20th century helped to create innovation and understanding of pavements during accelerated testing and is one of the valuable tools that can be used to predict and validate performance. Accelerated Pavement Testing is defined as the controlled application of wheel loading to pavement structures for the purpose of simulating the effects of long-term in-service loading condition in a compressed time period.

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Still today, research is being carried out into new asphalt mixtures, for example in the use of recycled material with used car tires or glass. Here it is important to measure how the mixture reacts over long-term serviceability and therefore APT would be a recommended method to test the road condition under stress in a compressed timeframe.

Today, there are several technological approaches in use around the world for conducting full-scale APT tests which can be categorized into two main types: 1) fixed base test tracks and 2) mobile testing devices. Examples of fixed-based tracks include the AASHTO Road Test, CEDEX in Spain, French Université Gustave Eiffel, Nantes Campus (previous LCPC) and the National Center for Asphalt Technology at Auburn University at Auburn Alabama, USA.

The most widely used mobile device is the Heavy Vehicle Simulator (HVS). This one is the Dynatest Titan 2022.

The most widely used mobile device is the Heavy Vehicle Simulator (HVS), which was developed by the Council for Scientific and Industrial Research in Pretoria, South Africa starting in the late 1970s. It is important for a mobile device that it can work 24 hours per day, seven days per week, so the test can be conducted in a matter of months rather than years.

There are several advantages of using a mobile device versus a fixed track alternative. A mobile device can be operated 24/7, whereby fixed tracks typically require the use of trucks to traffic the pavement surface, which also implies the employment of truck drivers. The mobile device can be moved around when testing in-service pavements. The facility and staff requirements are much less for a mobile device as compared to a fixed-track option.

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There are times, however, when a smaller, more compact testing device might be desirable, either to test smaller pavement sections or to address budget or staffing limitations. However, due to the need of continuous testing, no other testing equipment have been suitable for this task until now.

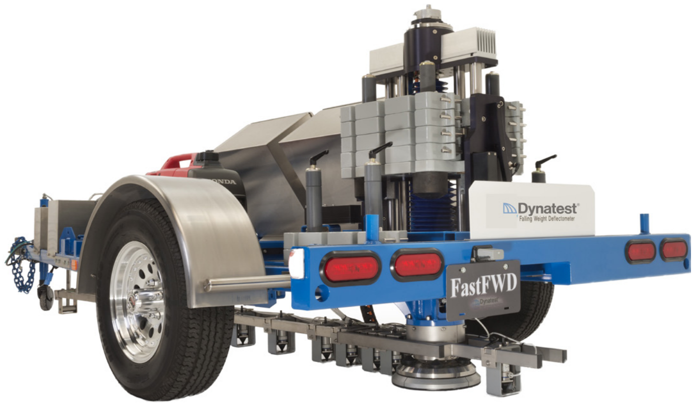
The first Falling Weight Deflectometer (FWD) was developed in the late 70s and has given the opportunity to calculate the in-situ modulus and critical stress/strains considered the most important input for the mechanistic part of the mechanistic-empirical (M-E) pavement design method.

The first Falling Weight Deflectometer (FWD) was developed in the late 70s and has given the opportunity to calculate the in-situ modulus and critical stress/strains.

In 2015, the Fast Falling Weight Deflectometer (FastFWD) was introduced speeding up testing procedures and overall productivity reaching a loading rate from 5 to 7.5 times faster than any existing FWD device. As it is possible to note from the production data, the more the drops, the higher is the percentage of improvement.

Deflection data from a FastFWD is indistinguishable from a conventional FWD while the loading capabilities and characteristics (pulse shape, rise time, peak load) are identical. The FastFWD has passed correlation trials in the UK, Netherlands and in the US, the FastFWD shadowed a conventional FWD to collect deflection data on a number of LTPP sites. This data was submitted to, and reviewed by, the Federal Highway Administration in November 2014. It has also been demonstrated to pass the AASHTO R32-20 calibration process.

The load lifting system in the FastFWD has been changed. The hydraulically driven components of the conventional FWD have been replaced with a powerful DC electric motor. For the operators this results in a saving of time, hence more technical and economic resources. Absence of hydraulic systems significantly reduces the maintenance requirements of the apparatus and the noise. This aspect is very beneficial for those who lead deflections measurements for structural diagnosis for maintenance purposes, but what makes the FastFWD an innovative machine is the ability to use it in research.



In 2015, the Fast Falling Weight Deflectometer (FastFWD) was introduced speeding up testing procedures and overall productivity reaching a loading rate from 5 to 7.5 times faster than any existing FWD device.

Given the productivity improvements of the FastFWD it is natural to study the possibility of using the device for in-situ Accelerated Pavement Testing (iAPT) in order to predict pavement deterioration. The method would potentially shorten the gap between the Heavy Vehicle Simulator (HVS) and small-scale laboratory test methods.

The drops speed of execution allows the study of the behavior and the pavement response subjected to a similar cycle loads to the one that would face over its design life. In a recent experiment 1.5 million drops were reached to simulate the pavement deterioration until its failure in less than a month (impossible with standard FWD).

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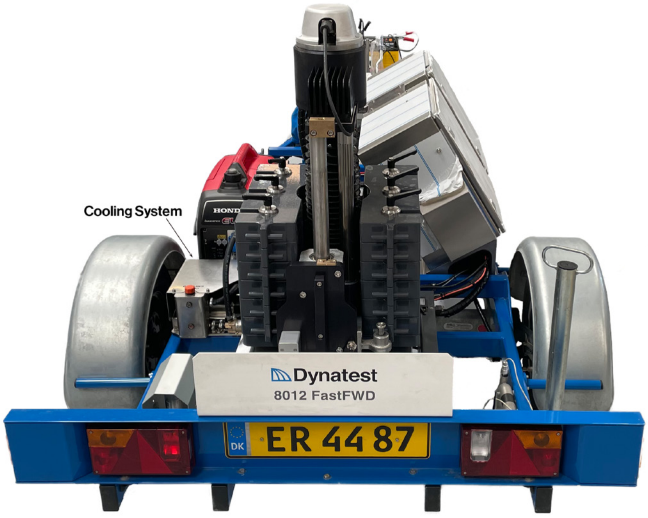
However, in order to use the FastFWD for in-situ Accelerated Pavement Testing, it was identified that some modifications were needed to the make the FastFWD fully suitable for the scope.

For standard deflectometer applications the deflectometer will only perform a limited amount of drop applications and then drive to the next point. In this case, the motor has time to cool down and the motor will never be overheated.

However, in Accelerated Pavement Testing applications, the FastFWD will be placed in the same spot for as long as the testing demands and just drop until the end of the experiment without resting. In this situation the deflectometer would need to have some pauses every about 100 drops, because the motor will get too warm. The length of the pause will depend on the ambient temperature. It can go from 5 minutes to 8 minutes, and this would significantly slower the testing process, also due to the thixotropic proprieties of bitumen that would let the material recover part of their formal stiffness.

Therefore, the design of an APT application package has been needed and this includes a cooling system to ensure that the motor temperature remain below the warning temperature of 100 degrees Celsius while operating continuously at maximal load. It has also been identified that the AC-24V charging system needed to be replaced with two Mean Well chargers to ensure that the FastFWD batteries are always charged while operating.



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As additional required amendments are a beam to measure the height profile as reference, and a remote-control system to check performance and data from the test remotely.

The FastFWD has proven to be able to be used as an intermediate tool, between the small-scale laboratory tests (bending beam, shear, and triaxial tests) and full scale accelerated pavement tests. Several tests have been conducted with great success and a number of iAPT FastFWDs have been built for customers interested in its use as accelerated pavement testing device.

www.dynatest.com

Dynatest A/S, HQ
Tempovej 27-29
2750 Ballerup
Denmark

Dynatest US, Inc.
576 NE 23RD AVE
Gainesville, FL 32609, USA

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