Abstracts of the presentations at the

7th European FWD User Group Meeting,

Trondheim, 2013.

Structural pavement monitoring with non-destructive measuring devices - Experience from a pilot project in Germany.

Rolf Rabe, BASt

The presentation addresses the comparative GPR, FWD and TSD measurements in Germany, also discussed at the BCRRA conference. Some more information will be given about dynamic wheel load measurements.

EUROFWD13

(7th European FWD User's Group Meeting)

24 June 2013, Trondheim

Summary of presentation

Can we robustly define a dynamic plate test device?

By Peter Langdale and Brian Ferne, Transport Research Laboratory, UK

There are now many types of in-service road pavement dynamic plate test devices (DPTs) including those commonly called Falling Weight Deflectometers (FWDs) or Lightweight Deflectometers (LWDs) and many manufacturers of these devices. The FWD is used for many purposes but in almost all cases the measurements are used to make important decisions that have financial implications. This maybe deciding on whether or not a pavement layer needs replacing, whether a strengthening overlay is 40mm or 150mm thick or it may be deciding whether a new foundation is adequate. However, in all cases the accuracy and consistency of the measurements is vital if the correct and robust decision is to be reached. If the method of interpretation of the FWD results is empirically calibrated with the device being used then consistency is more important than absolute accuracy.

In the early days of FWD usage the above was not an issue as commercially manufactured machines were fairly consistent with each other but there were 'home-built' devices that differed significantly in the measurements. The COST336 Action therefore developed correlation procedures, using the mean of the assessed fleet as the reference. COST336 also considered alternative more fundamental solutions, such as developing a 'golden' FWD to be kept as the absolute long-term reference. This was to try and avoid a long term drift in the fleet results. However, it was concluded that this was not economically and realistically viable. COST336 also considered a more fundamental examination of the variability between machines using visco-elastic modelling but this work was inconclusive.

In the UK we were fortunate that initially only one manufacturer supplied FWD's to UK operators. that enabled us to use the COST336 correlation trial approach with tighter limits to maintain a good level of consistency for some years. When the manufacturer introduced the Heavyweight FWD or HWD this initially introduced more variability but the addition of a 'magic' filter seemed to maintain consistency.

In the USA, the SHRP(1) studies developed rather different calibration procedures using checks of the geophone and load cell measuring accuracy on one concrete structure against calibrated reference sensors. When a US manufacturer tried to introduce a SHRP calibrated machine to the UK it failed the UK trials, although it was consistent with UK machines on a rigid concrete pavement. This highlighted the different approaches in the two countries.

Currently two manufacturers offer machines in the UK in both FWD and HWD formats and these generally meet the requirements of the UK trials.

In the UK, and elsewhere, FWD's were initially primarily used to assist in the assessment of pavement condition and maintenance design. More recently they have been used to assess the adequacy of new construction, in particular the foundation layers. In view of the lower loading test pressures required, lightweight versions of the FWD have been developed, the LWD, with some inevitable differences from their heavier cousins. Thus the resultant deflection responses can be somewhat different even with the same peak loads. As a consequence in the UK we still use a local site calibration to the FWD before employing the results from a LWD as the acceptance tool for a new foundation. This is particularly necessary at present as no robust calibration or correlation tests have been developed for such machines in the UK.

Another development, for use on airfield pavements, was the heavyweight FWD or HWD, and very recently the Super Heavyweight or SHWD enabling more realistic loads to be applied on the stronger structures required by the latest larger aeroplanes. However, this type of equipment is inevitably heavier than a basic FWD with a heavier dead-load. Is this important in the measured response particularly when such machines could be used at load levels comparable to an LWD?

Thus we have machines applying peak loads ranging from 5 to 250 kN(?) or more that can apparently be used interchangeably is this really satisfactory or do we need

better definitions of what devices are acceptable for the different roles within pavement construction and maintenance? How then should we calibrate such machines for accuracy and consistency?

We therefore propose the following issues concerning specification and calibration of DPTs for discussion:

- Can we define a specification for a standard DPT for each main purpose?
- If we use the fleet mean as the reference, how many machines are needed to provide an adequate reference and should there be a balanced mix of machine types?
- How do we prevent a steady change in the mean of the fleet?
- Is calibration of the individual components adequate or do we need to check the whole system?
- Since ultimately we are using DPT measurements to predict the structural condition of the pavement, and its response to rolling wheel loads, should we therefore also be referencing all measurements to pavement responses under a standardised rolling wheel load?

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The role of the FWD in the “SOFICO” campaign in Wallonia, Belgium.

Pierre Nigro, Walloon Road Directorate (SPW)
Carl Van Geem, Belgian Road Research Centre (BRRC)

The motorways and main national roads in Wallonia are managed by SOFICO and the Walloon Road Directorate. They have a plan for investment in road works on the network but lacked information on the structural quality of these roads. In order to take the current structural performance of the roads into account during the management phase, a measurement campaign was started up in the summer of 2012. In the mean while several hundreds of kilometres were measured with the FWD. The presentation will give an overview of the aims of the campaign and its approach. As an illustration, a particular case will be presented in which the back calculation module of the software “Qualidim” was used.

Structural Analysis of Deflection Measurement Asphalt Roads (STRADA)

Christ van Gurp

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Abstract

The CROW study committee 'Structural Analysis of Deflection Measurements Asphalt Roads (STRADA)' is in the process of updating the testing and analysis approach presented in CROW-publication 92 'Deflection bowl not a pitfall anymore'. The current approach is based on deflection data collected between the wheel paths. This analysis approach requires input of historic traffic data. The new approach must facilitate this approach (but in a more accurate way) but should also open the way for analysis of deflection data measured in the nearside wheel path without having historic traffic data available.

Road widening and transfer of management of roads from a national roadway authority to a lower roadway authority or vice versa lead to situations where data bases are not accessible anymore or at least to situation s where data has been lost.

The presentation will address the latest results of the STRADA study committee

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1 Final Asphalt Design Based on Measured Moduli of Unbound Layers

Susanne Baltzer, Danish Road Directorate
Per Ullidtz, Consultant

For more than 30 years the Danish Road Institute has based the final design of the asphalt layers on the measured moduli of the completed unbound pavement layers. In this way the design is modified to the actual construction, instead of only being based on the assumptions taken during the design phase. On the finished surface of the granular base course, static plate bearing tests have been carried out with plates of three different diameters. From the measured deflections the moduli of the subgrade, subbase and base course are backcalculated using Odemark-Boussinesq' approach. These moduli are then used with the Danish method for pavement design to determine the final thickness of the asphalt layers.
In a project the possibilities of substituting the static plate bearing tests by Falling Weight Deflectometer (FWD) tests have been evaluated. Comparative measurements using static plate loading tests and FWD tests on several sections were carried out in 2009 and have been supplemented by different FWD test procedures in 2011 and 2012.
The paper will explain the method used, the problems encountered during the project and the recommendations resulting from the experiments.

EuroFWD 2013

Proposed abstract

Railway substructure evaluation using FWD

By Simona Fontul

LNEC, Lisbon, Portugal

Some results of experimental work carried out on a deactivated rail stretch, used as an experimental site are presented. FWD tests were performed together with plate load and Handy Falling Weight tests. The load tests were performed before removing the railway superstructure and also on the four different rehabilitation solutions studied for the reinforcement of the substructure.

In old lines it is often observed a layer of fouled ballast on the top of the foundation soil. During the renewal there are some technical, economic and environmental advantages in maintaining the fouled ballast layer under the new reinforcement layers. These advantages are related to the high stiffness of that layer and to the reduction in supply, deposit and transportation of materials. This study was performed in order to assess the feasibility of some structural solutions, using reinforcement layers built with unbound granular materials (UGM) and cement bound granular mixtures (CBGM).

The results obtained and the main difficulties regarding the use of FWD for the evaluation of this type of structures and materials are presented herein.

7th European FWD Users Group Meeting

24 June 2013 – Trondheim, Norway

Trackbed Evaluation and Design Using FWD Deflections as Performance Indicators

Dr Bachar Hakim[1]

Abstract

Trackbed quality deteriorates with time due to train axle loading and environmental variations. Defining and maintaining acceptable trackbed quality is a key to reliable railway infrastructure and users satisfaction. Recent research proposed the Falling Weight Deflectomter (FWD) deflections to indicate track quality for different rail categories. This paper describes the use of FWD deflections for assessment of track quality, to plan maintenance and rehabilitation requirements as well as for trackbed reconstruction and new design.

The trackbed and foundation layer materials are modeled using multilayered elastic system and deflections under FWD loading are calculated to optimize the trackbed design thickness, by limiting deflections to those expected for the specified rail category. Additionally, the subgrade shear stresses under train axle load are calculated and compared with the design shear strength for the proposed trackbed structure in order to control shear failure and deformation.

Case studies using alternative materials such as Geoweb, stabilization and asphalt sub-ballast to improve and design trackbed over poor ground are presented.

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