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Summary of presentation

Different loads and load pulses make comparisons between LWD, FWD, HWD and SHWD difficult

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There are now many types of Falling Weight Deflectometers and many manufacturers. 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(?) 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?

I therefore propose the following issues concerning specification and calibration of 'FWD's' for discussion:

- Can we define a specification for a standard FWD 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 FWD 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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