

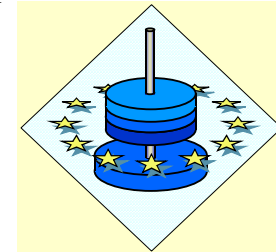


Can we robustly define a dynamic plate test device?

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EUROFWD10

(7th European FWD User's Group Meeting)



**NTNU, Trondheim
24 June 2013**

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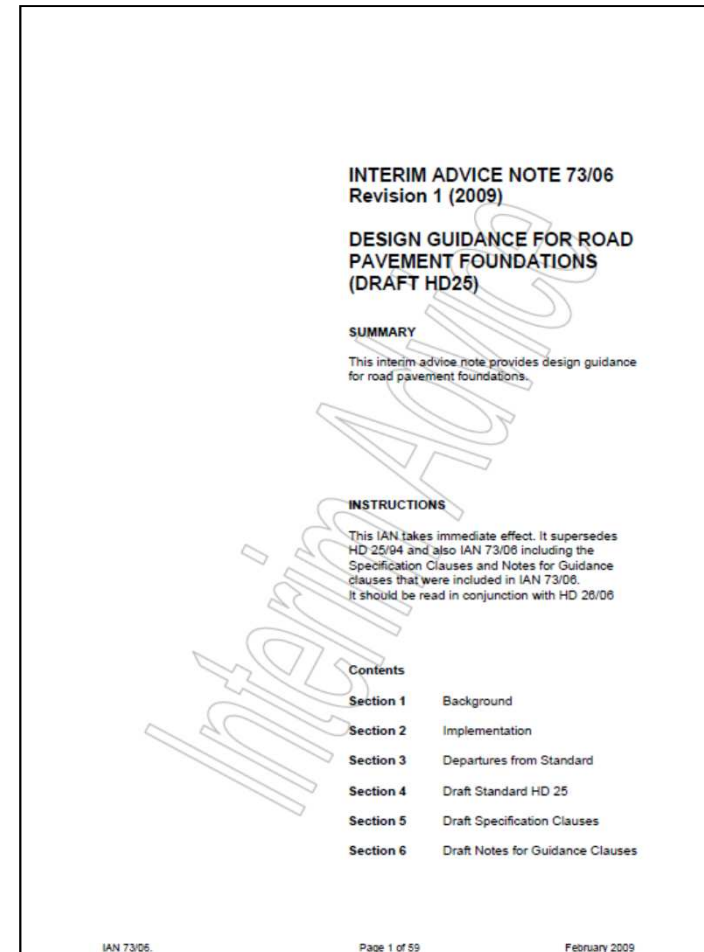


INTERIM ADVICE NOTE 73/06 Rev 1 (“IAN73”) Design guidance for road pavement foundations

“Surface Modulus testing must be carried out using a **Dynamic Plate Test device**, which has been calibrated to the manufacturer’s specification. Regular checking and calibration of the load cell and deflection sensors must be carried out as recommended by the manufacturer”.

“If a lightweight test device is used, it must be correlated to an FWD which will remain the reference test method.”

But what is an FWD?!



Examples of DPTs

LWD (Light Weight Deflectometer)

Peak load = 1 to 15 kN

FWD (Falling Weight Deflectometer)

Peak load = 30 to 120 kN

HWD (Heavy Weight Deflectometer)

Peak load = 30 to 240 kN

SHWD (Super Heavy Weight Deflectometer)

Peak load = 30 to 300 kN



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Why carry out Accreditation and Quality assurance?

- Contractor
 - Accreditation checks that the equipment is working correctly
 - and then QA checks that it continues to work correctly
 - Confidence in data – repeat business
- Road operator
 - Increases consistency across the survey fleet (and operators)
 - Risk mitigation against poor condition data being delivered
 - Correct valuation of asset
 - Correctly targeted maintenance programme
 - Value for money
- Road user
 - Common assessment of condition across different networks

Review of HA accreditation and QA processes

- Examined the need for accreditation and QA from a business and technical point of view
 - Involved consultation with the survey contractors
- Findings:
 - The HA has a dependence on good quality survey data throughout the business.
 - The money spent on Accreditation and QA is insignificant in the overall context of their business.
 - Reaffirmed the importance of accreditation but emphasised the need for ongoing QA between accreditations
 - Annual accreditation trials should continue
 - Central funding
 - Future change should be considered....
 - QA regime should be expanded
 - 1st and 3rd party

Technical issues – Existing Accreditation of FWDs

Accreditation		
	Strengths	Weaknesses
FWD	<ul style="list-style-type: none"> + Machines are accredited on a number of different pavements with varying deflections. + Machines are accredited together to avoid variations in measurement not caused by the machines. + Accreditation carried out on test track where pavements are comparatively un-trafficked meaning they do not deteriorate as fast as a real network site. 	<ul style="list-style-type: none"> – No formal specification for accreditation trial. – No completely independent reference data (uses fleet mean) – Different weight classifications of machines not taken into account – Pavement used for test is not fully representative of network. – New devices do not get more rigorous tests – No test of repeatability – No test on temperature – No test of location referencing



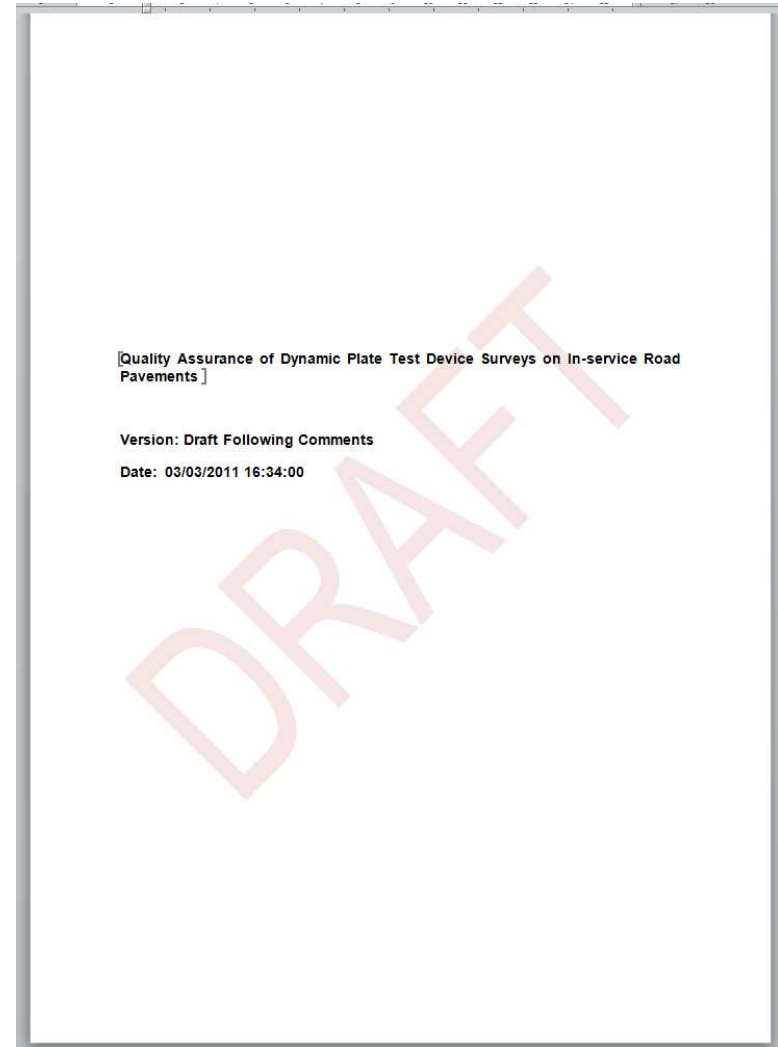
Technical issues – Existing QA of FWD

First Party QA		
	Strengths	Weaknesses
FWD	<ul style="list-style-type: none"> • Details of internal checks given in DMRB. 	<ul style="list-style-type: none"> • No external checks • Little real data assessment
TRACS	<ul style="list-style-type: none"> • Details of internal checks in specification • Monthly check on sites convenient to contractor • Real data collected in field 	<ul style="list-style-type: none"> • Monthly check sites are not audited by 3rd party
Third Party QA		
FWD	<ul style="list-style-type: none"> • None 	<ul style="list-style-type: none"> • No requirement for third party audit
TRACS	<ul style="list-style-type: none"> • Details of 3rd party checks in specification. • Internal records checked • Contractor Repeat Surveys (CRS) • Flexibility, as contractors can chose sites to a certain degree • Auditor Repeat Surveys • Real data collected in field 	



QA SPECIFICATION

- Drawn up with consultation from industry
- Covers application to in-service pavements – not foundations!
- Working version released
- Industry has been working to this for more than a year now
- Needs to be “officially published”/ brought into force
- HA has informed industry that they expect these working practices on their network
- “Living document”



Specification content

- Section 1: Specification for Dynamic Plate Test Device
- Section 2: Accreditation
- Section 3: Quality Assurance
 - Reaccreditation
 - 1st Party (Contractor) QA regime
 - 3rd Party (Auditor) QA regime



Accreditation

- Eligibility check
 - List of devices
 - “New” devices need to demonstrate they meet Section 1
- Mandatory checks (pass required to obtain accreditation)
 - Deflection reproducibility continues to be based on CROW Protocol F correlation trial
 - Deflection repeatability tests (CROW)
 - Elapsed chainage check
- Non Mandatory checks
 - Temperature measurement check
 - GPS accuracy check (if fitted)

1st Party QA regime

- Survey contractor should have QA checks including:
 - Vehicle operation and maintenance
 - Staff training
 - Equipment calibration – static and dynamic
 - Equipment checks during surveys
 - Data processing and delivery
 - They may have ISO:9001/ UKAS accreditation etc
 - These will need a specification or defined procedures by which to operate
 - DPT Specification is the perfect document for these



1st Party QA regime – Quality checks required

- Every Six months - Stack/tower consistency check
 - to ensure the deflection measurement equipment (geophones) are operating consistently with each other
- Every Month - Contractor's calibration site
 - to calibrate the location referencing equipment and to monitor the long term consistency of the deflection data
- Every two weeks - Primary check
 - to calibrate the location referencing equipment and to monitor the medium term consistency of the deflection data
- Daily - Daily Checks
 - to check the short term consistency of the measurement equipment from day to day
- After routine maintenance
 - To determine the maintenance has not affected the deflection measurements



Process for QA checks



- Contractor visits QA site
- Calibrates equipment as required
- Subsequent runs are used for QA checks



- Contractor processes data and compares against reference
- Are the results “as would be expected” for the conditions experienced during that particular survey?
- If not, investigate, resolve and/or repeat as necessary



- RECORD details of QA checks.
- Inform Auditor of outcome and deliver results (within 14 days)
- Discuss with Auditor any issues /points of interest

Auditor (3rd party) QA

- Auditor role includes:
 - Organisation of accreditation (and reaccreditation trials)
 - Checks that the Contractor's QA procedures are suitable and delivered to the required standard.
 - Assessment of Contractor QA checks
- May also include:
 - Advice on QA checks following routine maintenance
 - Spot checks on the survey equipment
 - Audits of documentation
 - Arbitration between client and contractor if any disputes arise
 - Setting up (and maintaining) a database on a National Network of Primary sites ?????



Implementation

- TRL has been appointed Auditor by the Highways Agency (from Oct 2012 until April 2014)
- All UK & Ireland FWD operators asked if they are, or have been, working on the HA network
- Auditor will work with these Contractors to ensure that surveys on the HA network are covered by the process



Implementation

- Auditor expectation is
 - All (HA) FWD contractors will provide Contractor Calibration Site results (monthly, 4-6weeks) throughout the year
 - Contractors can optionally provide Primary Check data (2-weekly)
 - Contractors can optionally provide Daily Check data
- These MUST be provided before accreditation trials
 - ftp facility provided
- Non-delivery of data, or unsatisfactory data, may result in accreditation trial certificate not being issued



Status of HA accreditation and QA processes

- In 2010 and 2011 HA continued to fund accreditation and development of QA (ASPECT3)
- For 2012 and 2013 HA is funding FWD accreditation and QA and auditing (ASPECT4)
- There will be a further review in 2013/14
- Current thoughts
 - There is an expectation that from 2014 the industry will directly contribute to accreditation
 - From 2014 the industry may be asked to contribute **directly** to external QA audit

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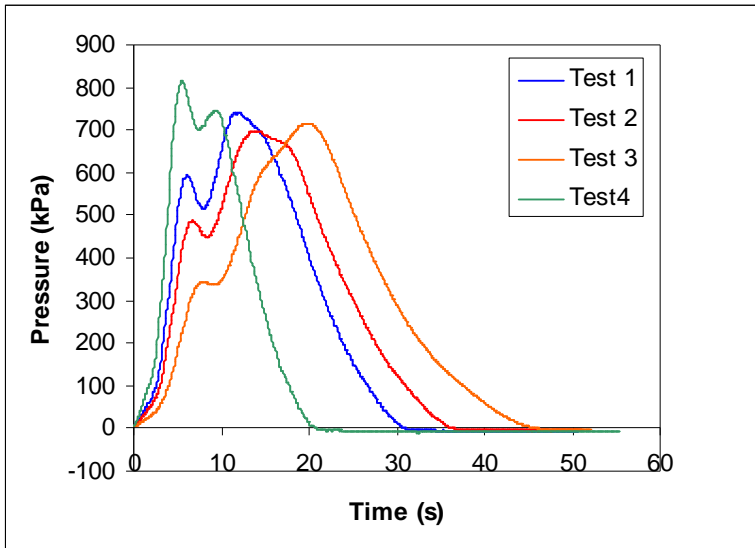
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Section 1: Definition of a DPT

- Class
 - To cover LWD, FWD, Heavyweight and Super heavyweight
 - And future machines....
- Plate
 - 300mm circular (solid or segmented)
- Load cell
 - Performance requirements (?)
- Pulse shape
 - Defined shape and characteristics
- Measurement
 - Defines sensors and locations
- Any other requirements?

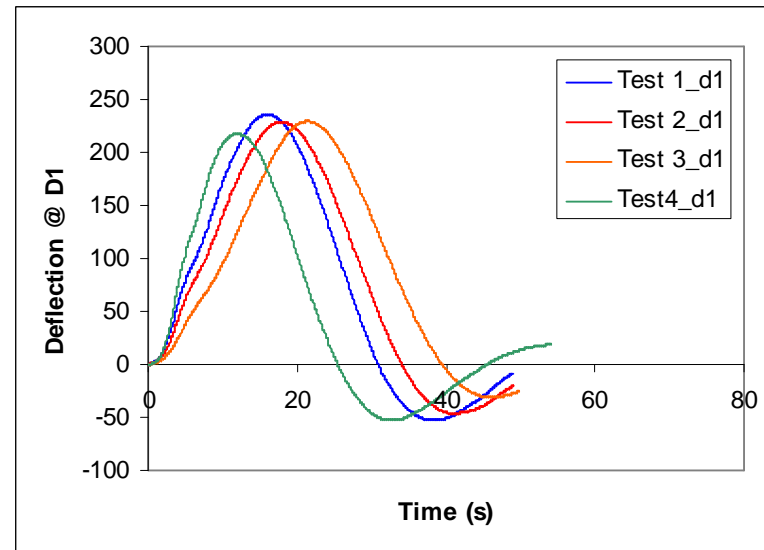


Varying load pulse on one FWD



FWD pulse with different durations

Deflection response at Geophone 1



Extracts from :Staring at Deflection Traces: Looking for the Truth in Time Histories by David P Orr, Cornell LRP

Brand	Average Rise Time (mSec)
Carl Bro	13.2
Dynatest	13.1
JILS	18.4
KUAB	14.5

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Question...

How should we accredit UK FWDs in future?

Main Options:

- USA SHRP-LTPP
 - emphasis on calibration of components on individual machine

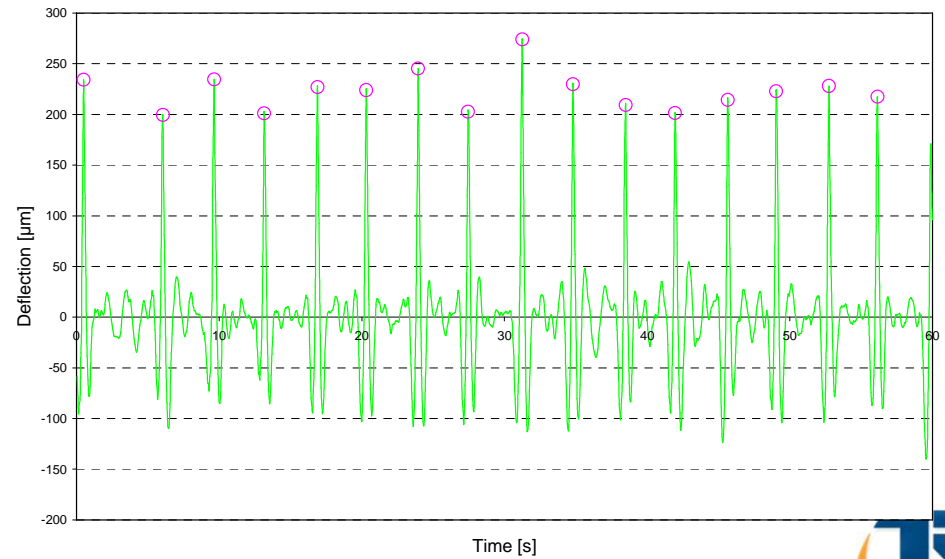
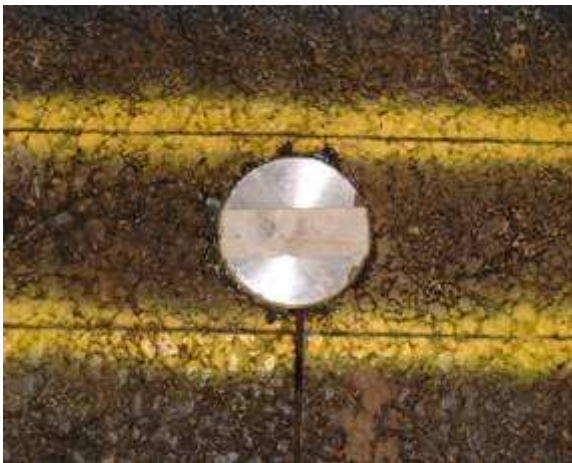
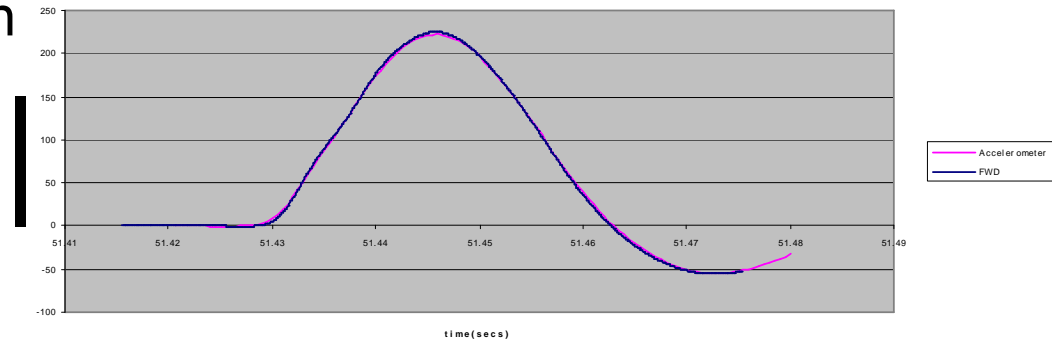
- Dutch CROW protocol
 - emphasis on correlation of whole systems against "fleet"



Alternative accreditation approach? (1)

- Use independent deflection measure e.g. accelerometer?

Comparison of FWD and Accelerometer: 300mm off



Alternative calibration approach? (2)

- But an accelerometer confirms just the response of part of the system – the deflection measuring part
- What about the correctness of the loading system?
- For rolling wheel loading, pavement response depends on load configuration and speed – the load configuration can be defined fairly easily but will the response of the tyres remain the same over time?
- For FWD impulse loading the response also depends on these parameters – what is the correct loading pulse? – how well defined is this?

Alternative calibration approach? (3)

- Could we compare/calibrate all deflection measuring devices with the deflection response under a standard axle at traffic speed?

Some questions for discussion? (1)

- Can we define a specification for a standard 'F'WD for each main purpose?
- Is calibration of the individual components adequate or do we need to check the whole system?
- If we use the fleet mean as the reference, how many machines and of what type are needed?
- If so, how do we identify and prevent a steady change in the mean of the fleet?

Some questions for discussion? (2)

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?

Thank you!

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