



Portable Falling Weight Deflectometer (LWD) is applied for measurement on many different pavement surfaces.

Quality control based on reliable data

A chain is never stronger than the weakest link - in this article we focus on the importance of calibration of measuring equipment

PRIMA 100 (portable light FWD - LWD) from Carl Bro, Pavement Consultants has been produced since 1998. The equipment is applied for determination and quality control of surface E moduli of almost all kinds of unbound layers and generates very precise and accurate measurements.

READ ABOUT

- Quality control based on reliable data
- Airports in Finland - project won for the third time
- Practical experience with *PRIMA 100*
- US FWD User Group Meeting 2004
- Upgrading of *PRIMA 100*

Topic of this issue:

This topic of Carl Bro Pavements Consultants' newsletter has focus on the use of *PRIMA 100* and quality control of data collection.

Never stronger than the weakest link

Many of our customers are using their *PRIMA 100* daily and know that a correct calibration of the equipment is essential in order to generate reliable data on the basis of the results collected.

A well-known fact is that a chain is not stronger than the weakest link and this also holds for a FWD. We therefore recommend that the *PRIMA 100* load cell is calibrated every second year and the geophones are calibrated every 12 months e.g. in connection with the annual service overhaul of the equipment.

As a manufacturer of falling weight deflectometer equipment, Carl Bro Group has a calibration station for absolute calibration. The station is calibrated once a year by the internationally approved institute DANAK.

Absolute calibration of *PRIMA 100*

If the *PRIMA 100* only has a centre geophone, one of the most important calibration points is based on the seismic geophone and the loading cell.

The geophone off set and slope values are tested and loaded to the processor during calibration. As the geophone has a measuring accuracy of 1/1000 mm, it is very important to make sure that these values are not displaced

by any pushes or blows. The offset and slope values of the load cell are adapted to the real values and entered to the processor.

Stacking tower testing

On *PRIMA 100* equipment with a centre geophone and two extra geophones, all geophone offset and slope values are tested and calibrated. After loading of this data in the processor, all geophones are verified to each other in order to secure that the measured data is calculated correctly. This is done with so-called stacking tower equipment.

It should be mentioned that the above stacking tower test is a test that the user can carry out himself. We recommend the stacking tower tests in order to find any inaccuracies in the geophones. An error indication should always result in a new absolute calibration of the equipment.

More information on absolute calibration and verification with stacking towers is available.

MORE INFORMATION:
FINN IVERSEN AND KLAUS OLSN
FIV@CARLBRO.COM, KLO@CARLBRO.COM
TEL: +45 8228 1400

Customer support

We find that customer support is a vital part of cooperation about advanced equipment. In order to improve our customer support, we have implemented new procedures, systems and employed new staff to take care of the support. Our goal is to secure that our customers receive immediate and efficient support.

Our first measure is support e-mails for the below three products:

PRI2100 FWD/HWD: pri2100-support@carlbro.com
 PR/MA100 LWD: prima100-support.carlbro.com
 RoSy DESIGN: rosydesign-support@carlbro.com
 (both road and airport versions)

These mailboxes are administered by our experts on FWD equipment, design and back-calculation, pavement technology, etc. Our customers are thus sure to receive qualified replies from experts.

Questions about the products can be sent to the above e-mails and if you have questions to more than one product, please send you questions to the relevant e-mails.



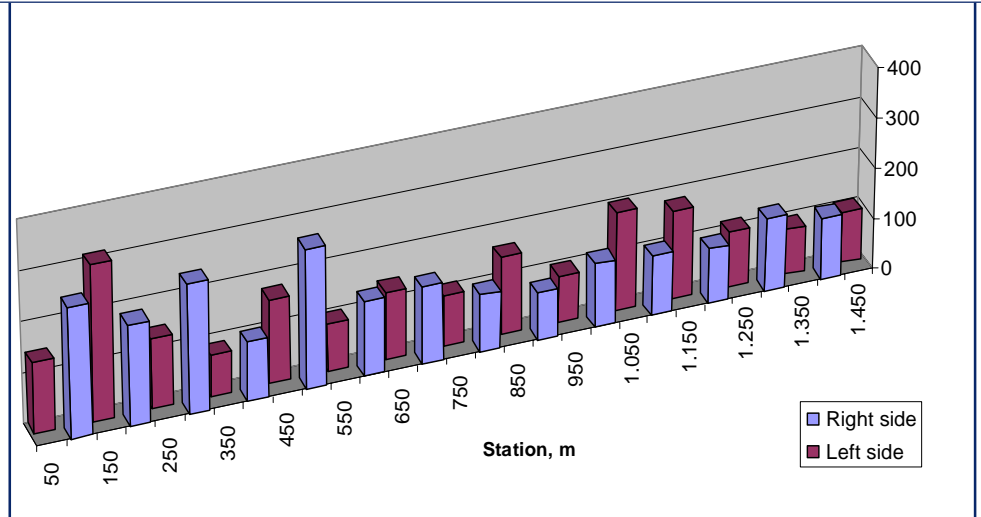
Carl Bro won contract for four airports in Finland

Carl Bro Pavement Consultants has been awarded a large measuring project on four airports in Finland, the Kauhava, Halli, Tapere-Pirkkala og Helsinki-Vantaa airports.

The project scope is measuring of bearing capacity, determination of any reinforcement needs on the runways, taxiways and calculation of PCN values (Pavement Classification Number) before and after reinforcement. The PCN value is applied for determination of which aircrafts may apply the respective airports.

The projects were put up for tender by Civil Aviation Administration Finland and the project was carried out during autumn 2004. Carl Bro Group has now won the projects three times in succession.

MORE INFORMATION:
 TROELS KRAGH/TTK@CARLBRO.COM
 TEL: +45 8228 1400



Surface E-modulus for gravel, MPa

Using mini FWD PR/MA 100 (LWD) - practical experience

Portable Falling Weight Deflectometer (LWD) is equipment of many possibilities and is applied for measurements on many different surfaces and under many different conditions.

This article will discuss working methods with the light portable FWD (LWD) in order to pass on the experience gained from the use of the mini falling weight deflectometer.

The experience has been gained from bearing capacity investigations on various container terminals in both Denmark and Italy in connection with renovation of pavement structures and a gravel road condition survey in Denmark. The projects comprised both core taking from the pavement structure for determination of the layer composition and measurements with the LWD on each layer down to the subsoil.

Efficient planning is essential

First of all efficient planning of the work is always a good idea. The equipment can be used without any preparations but if more than 5-10 points are to be measured at various depths, planning of the work will be of great advantage, as this will ensure a better and more secure execution of the measurements and a better survey of the measuring data, which will again optimize the subsequent data processing.

A well-functioning equipment is very important. Furthermore, we recommend bringing along tools and spare parts for the parts that are especially exposed under the work, such as extra batteries, and battery holder and an extra wire for the connection between computer and LWD. We also recommend bringing along special tools for dismounting of loading plates and extra weights and buffers, if any of these would be needed for the measuring job.

Especially, it is important to make sure that the LWD has been calibrated within the year of measuring; otherwise the measured data may be useless. In order to obtain correct results when using the LWD, checking of the program setup is essential so that the settings comply with the equipment. If a new plate size is mounted, this should also be changed in the setup menu.

Reference system on site

When planning the project, it is of great advantage to work out a sketch of the measuring area containing marking of the measuring points. The measuring points should have reference numbers corresponding to the numbers applied with the measuring data. This reference system should be simple and unique, so that it is easy to use and measuring points in the field can be complied with the data. A reference system could be chaining of the points and a roadside - e.g. 125-R and 175-L. If it is possible, the reference numbers and the positioning of measuring points should be decided before the measurements are performed in the field.

Furthermore, the reference system should allow addition of extra points if this is needed. Also, it should be taken into account, whether measurements are done on more than one layer in the same point. In such cases the reference system could be extended to indicate the depth in which the measurements were performed - e.g. 125-R-25 and 125-R-45 (chainage 125 - right side - depth 25 cm).



The US FWD User Group Meeting 2004

It is becoming a tradition that Carl Bro participates in the User Group meeting in the USA as well as in Europe. Meetings we enjoy to participate in and where it is possible to meet users and listen to the valuable experiences that the FWD people gain all over the world within this field. Experience and know-how that we consider very important in our continuous work to develop and improve equipment and software.

Earlier this year we supplied a FWD to FUGRO, Texas, and the equipment was subjected to a SHRP calibration in the Southern FWD Calibration Center Texas with a very good result. FUGRO presented this FWD at the US FWD User Group Meeting.

A new SHRP calibration programme in the USA

As a manufacturer of mobile calibration equipment for absolute calibration of FWDs, one of the very interesting subjects at this meeting was the plan to revise the SHRP calibration programme in the USA.

An interesting discussion took place between users, calibration equipment manufactures, and calibration centre staffs. The intention is to bring all the best from the old programme to the new programme. One of the issues was the wish to have a mobile system, which was of particular interest to Carl Bro as a manufacturer of the only mobile calibration system on the market.

During the Group Meeting, Carl Bro performed a demonstration of the Carl Bro calibration equipment and procedure. The future will show, whether this equipment can be implemented in the new and improved SHRP calibration programme.

MORE INFORMATION:
RENE CLEMEN
REC@CARLBRO.COM
TEL: +45 8228 1400

CONTINUED FROM PAGE 2

Marking of measuring points - a good idea

Depending on the project scope and complexity, marking on site of the individual measuring points with spray or the like will be of advantage. This will secure that all points are easily found again and that all points are measured. Furthermore, contractors may use the markings to find the points for any excavation work in a particular point.

Particularly in connection with excavation and registration of the pavement layers and falling weight measurements on each layer down to the subsoil, a very good planning of the work and coordination with the contractors to carry out the excavation work is needed, as the engagement of excavation teams and excavators is normally very expensive. Attention should be called to the fact that the contractor engaged may both take care of the excavation to the individual layers and rehabilitation of the excavations after the measurements including the compaction and the backfilling works.

Gravel road testing

The mini FWD is operated by one man and is thus very well-suited for screening of a road or an area. On a 1,400 m long and 5-6 m wide gravel road in Denmark the LWD was applied for screening of the general condition of the road. Measurements were carried out at intervals of 50 m shifting from the right to the left roadside. The LWD was transported on a trolley and the 34 points with 6-7 drops in each point could easily and quickly be measured in order to determine a surface E modulus along the road. On the basis of these measurements the weak sections could easily be identified and decisions could be made as to where test excavations would be most beneficial (see picture of graph).

The LWD may be used in many ways. The above methods are some of the methods that make the use of the LWD efficient and secures that the data collected is more precise and safe.



LWD applied for screening of the general condition of the gravel road

MORE INFORMATION:
TROELS KRAGH / TTK@CARLBRO.COM
TEL: +45 8228 1400



Upgrading of *PR/MA* 100 to version 2004

The *PR/MA* 100 from Carl Bro Group has been improved considerably since the first portable falling weight deflectometer saw the light of day in 1998.

PR/MA 100 can always be upgraded to a newer or the newest version. Below, we list some of the possibilities:

• The Bluetooth solution

The newest version of *PR/MA* 100 is our wireless (Bluetooth) PDA solution allowing the measured surface E modulus to be displayed on the screen at once. Data is, however, also stored for later analysis at e.g. the office or documentation. This means that it is possible to work freely with the *PR/MA* 100 equipment, while the portable PC (PDA) is either placed in its cover on the equipment or in the operator's breast pocket. The wireless solution also means no irritating cables in the measuring area.

• Wireless connection

Another possibility that remains is upgrading to wireless connection between *PR/MA* 100 and PC (with a range of up to 200 m).

• Cable connected solution

The last upgrading possibility that we will mention here is the 5m cable connection between *PR/MA* 100 and PC - however - with new hardware and software allowing viewing of historic data.

All new models and upgrades are supplied with the latest compaction program, which is a very good tool for calculation of surface E moduli or layer thickness. When upgrading, the calibration is always part of the upgrading.

For further details on upgrading solutions, please contact Finn Iversen on +45 8228 1400 or e-mail fiv@carlbro.com or Klavs Olsen on +45 8228 1400 or e-mail klo@carlbro.com.

MORE INFORMATION:
FINN IVERSEN
FIV@CARLBRO.COM
TEL: +45 8228 1400

Upgrading of *PR/MA* 100 to version 2004 in five ways:

1. *PR/MA* 100 with a 5-metre communication cable for PC.
2. *PR/MA* 100 with wireless antenna connection up to 200 meter for PC. Supplied with a 5-metre communication cable for cable connection.
3. *PR/MA* 100 with wireless antenna connection (up to 200 metres) for portable PC. GPS integrated in display unit. Supplied with a 5-metre backup communication cable.
4. *PR/MA* 100 with PDA Bluetooth coupling. Supplied with an additional 5-metre backup communication cable for PC.
5. *PR/MA* 100 with PDA Bluetooth coupling and GPS coupling. Supplied with an additional 5-metre backup communication cable for PC

ADDRESSES

Carl Bro Pavement Consultants
Kokbjerg 5, DK-6000 Kolding
Phone +45 8228 1400 Fax +45 8228 1401

Group head office:

Carl Bro Group
Granskoven 8, DK-2600 Glostrup
Phone +45 4348 6060 Fax +45 4348 6007

Norway:

Carl Bro Pavement Consultants
PB 4814, Nydalen, N-0484 Oslo
Phone +47 2220 7660 Fax +45 8228 1456

Sweden:

Carl Bro Pavement Consultants
Vassgatan 2, Box 1118, S-405 23 Göteborg
Phone +46 (0)31 710 34 39
Fax +46 (0)31 710 34 30

Germany:

GSA Gesellschaft für Strassenanalyse mbH
Villenstrasse 21, D-67657 Kaiserslautern
Phone +49 (0) 631 / 36 61 40
Fax +49 (0) 631 / 36 614-99

Czech Republic:

PavEx Consulting s.r.o.
Srbská 53, CZ-612 00 Brno
Phone +420 5 415 89 243
Fax +420 5 412 383 65

Spain:

Carl Bro Pavement Consultants
Apartado de correos 218, E-21400 Ayamonte
Phone +34 62 773 8035
Fax +34 62 773 8035

Ireland:

Carl Bro Ireland Ltd.
Frankfort Cort, Dundrum Road, 14 Dublin
Phone +353 1 207 4800
Fax +353 1 207 4810

United Kingdom:

Carl Bro UK Ltd.
Sectrum House
2 Powderhall Road, EH7 4GB, Edinburgh
Phone +44 131 550 6434
Fax +44 131 550 6499

Websites:

www.pavement-consultants.com
www.carlbro.com
www.prima100.com

E-mail:

cbpc@carlbro.com