EUROPEAN COOPERATION
IN THE FIELD OF SCIENTIFIC
AND TECHNICAL RESEARCH

COST
Secretariat

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Brussels, 10th January 1995
FF/sm

TECHNICAL COMMITTEE

on

TRANSPORT

(58th meeting)

SUBJECT : Proposal of a new project presented by the Danish delegation: "Use of Falling Weight Deflectometer in Pavement Evaluation".

PROPOSAL FOR A NEW COST PROJECT

Use of Falling Weight Deflectometer in Pavement Evaluation

1. **PROPOSER STATE**

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4. **TITLE OF PROPOSED RESEARCH PROJECT**

Use of Falling Weight Deflectometer in Pavement Evaluation

5. **GENERAL OBJECTIVES**

Development of an European common code of good practice for use of falling weight deflectometers in pavement evaluation, which encompasses the following:

- Expand FEHRL harmonisation proposal also to incorporate strengthening evaluation on basis of FWD-tests
- Establish common requirements for calibration of measurements and machines
- Extend use of FWDs also to encompass network level evaluation.
- Establish a preparatory basis for possible european standardisation in the field.

This relates to the situation today where usage and experience in pavement evaluation by means of FWD is very different among the European countries utilising this equipment. Also the need for common requirements for calibration and correlation of various machines on the market is an apparent need.

6. SECONDARY OBJECTIVES

- independency of FWD makes within the Single European market.
- mobility for consultants providing FWD Bearing Capacity Tests
- extend knowledge about FWD testing on roads with flexible and rigid pavements

7. CURRENT STATE OF KNOWLEDGE IN PROPOSED FIELD OF RESEARCH

Use of FWD testing is a growing requirement in modern pavement maintenance management and already implemented as routine procedures in some european countries and in others only as an equipment used in research or special investigations.

Different procedures and usage has been investigated by a FEHRL FWD group for 2 years at the aim of elaborating guidelines for making measurements with FWD's. This work has ended up in a common FEHRL publication that will be submitted in beginning of 1995. The title of this Technical Note will be: "Harmonisation of use of FWD's for evaluation of flexible pavements on project level".

8. SPECIFICATIONS OF REQUIREMENTS FOR CARRYING OUT RESEARCH IN THE FIELD IN QUESTION

To carry out the research are required.

- A forum for collection of strengthening procedures on network level in European countries
- Collaboration about a joint proposal for strengthening evaluation procedure based on FWD measurements
- Establishment of FWD calibration protocol and calibration station in collaboration with FWD manufactures
- Instrumented field measurements
- Comparative laboratory investigations

GROUNDS FOR AND DESIRABILITY OF CARRYING OUT THE PROPOSED RESEARCH IN THE FRAMEWORK OF COST CO-OPERATION

This proposed project is a continuation of the terminated FEHRL FWD activity who prepared the FEHRL publication on harmonisation of use of FWD's for evaluation of flexible pavements on project level.

This activity has shown great interest among several COST member countries and revealed their need for further co-operation.

Until now many countries has carried out parallel research in the field and formulated national standards and procedures this will effectively be coordinated within the proposed COST co-operation.

This proposed COST project group will also enable conveyance of knowledge in the field to less experienced countries in the field including the CEE-countries.

Finally the proposed project will contribute to pooling of abilities of several COST countries with experience in the proposed research field.

10. BENEFITS OF THE PROPOSED RESEARCH PROJECT

The primary advantage of the project lies in the description of procedures in different countries of usage of FWD in structural pavement evaluation. This will be a prerequisite for exchange of consultancy services within the Single Market. Also the project will establish common requirements for carrying out measurements and strengthening evaluation as well as demands for calibration of measurements and machines.

The harmonisation of the knowledge about use of the FWD in pavement evaluation will be brought to a higher level. This will result for many countries to achieve a better method for pavement condition evaluation and maintenance of roads. Hence maintenance costs will become more effective when appropriate decisions can be made and this will lead to saving of much money in the EC countries.

Involvement of european pavement consultants and road authorities will enhance European harmonization and will favour standardisation of bearing capacity evaluation and consulting activities in the field.

11. DESCRIPTION OF THE PROPOSED RESEARCH PROJECT

The proposed research project is continuation of the successful FEHRL FWD Activity group who has drafted the FEHRL publication no 1: "Harmonisation of FWD Measurements and Data processing for Flexible Road Pavement Evaluation at Project Level" as a result of three FEHRL FWD Seminars held in The Netherlands, France and Denmark with contributions from 14 european countries.

The proposed research project will give the complementary description of post processing of FWD data at project level to following items which were not covert until now:

(i) the calculation of in-situ layer stiffness
(ii) the correction of layer stiffnesses to standard conditions
(iii) the calculation of critical stresses and strains
(iv) the estimation of residual structural lives and required thickness of strengthening overlays

and extend the harmonisation of FWD measurement also to encompass the use at network level, which will provide 'rough' estimates of the timing of maintenance and strengthening requirement to the road agency.

Finally the research project will focus on quality assurance of FWD measurements from a calibration point of view in three aspects:

(i) calibration of all FWD sensors and equipment read out.
(ii) calibration check on a real pavement at an instrumented calibration station
(iii) equalisation of data from different FWD makes

12. EXISTING OR PLANNED WORK IN THE PROPOSING STATE

Draft proposal is under preparation for harmonisation of FWD measurements on flexible road pavements at project level in FEHRL.

Several comparative investigations and tests on FWD makes has been made in the Netherlands by the Delft University of Technology.

Elaboration of QA guidelines are under way in more member countries.

13. LIST OF UNDERSTANDINGS AND/OR RESEARCH INSTITUTES IN THE PROPOSING STATE ACTIVE OR INTERESTED IN PROPOSED RESEARCH PROJECT

Danish Road Institute, research and development.

FEHRL FWD Activity group consisting of participants from DWW and C.R.O.W., the Netherlands, TRL, UK, VTI, Sweden, LCPC, France, and DRI, Denmark.

14. DURATION OF THE PROPOSED RESEARCH PROJECT

Three years

15. APPROXIMATE ESTIMATE OF THE COSTING/INDICATION OF THE SCALE OF THE PROJECT AT NATIONAL AND INTERNATIONAL LEVELS

The proposed research project is estimated to require 5 man/year and an overall cost of 2.0 million ECU.

16. LIST OF RECENT PUBLICATIONS IN THIS RESEARCH FIELD IN QUESTION

DRI publications dealing with use of FWD:

The use of non destructive testing in flexible pavement : rehabilitation design
Hans Jørgen Ertman Larsen , R.N. Stubstad
Danish Road Institute
Roskilde, 1983. - 28 p.
Note ; 143

State-of-the-art stress, strain and deflection measurements
Hans Jørgen Ertman Larsen , Per Ullidtz
Danish Road Institute
Roskilde, 1989. - 14 p.
SVL note ; 216

Strengthening overlay design as routine procedure, a crucial star in the PMS implementation
Jan M. Jansen
Danish Road Institute
Roskilde, 1991
Note ; 230, p. 49-59

Experiences in using falling weight deflectometers as routine equipment
Bjarne Schmidt
Danish Road Institute
Roskilde, 1989. - 19 p.
Note ; 220

Pavement Instrumentation, - in the Danish Testing Machine, Water and Bearing Capacity
Jorgen Krarup
Danish Road Institute
Roskilde, 1991. - 16 p.
Note ; 232

Papers dealing with FWD comparison from other COST states:

The Netherlands

Comparative Study of Falling Weight Deflectometers (orig. in Dutch)
Van Gurp, C.A.P.M., Houtman, F. and Dorsman, J.
Delft University of Technology
Delft, 1988.
Reports 7-88-401-9 and 7-88-401-10

Inter-FWD Tuning (orig. in Dutch)
Van Gurp, C.A.P.M.
C.R.O.W.
Ede, 1990.
Publication 37-I, - pp. 219-229.

Comparative Study of Ten Falling Weight Deflectometers
Van Gurp, C.A.P.M. and Dorsman, J.
Delft University of Technology
Delft, 1990.
Reports 7-90-401-11

Calibration methods for falling weight deflection test (orig. in Dutch)
Breeuwer, R.
TNO-Delft University of Technology
Delft, 1990.
Reports TPD-HAI-RPT-90-65

Basic concept of a reference falling weight (orig. in Dutch)
Breeuwer, R.
TNO-Delft University of Technology
Delft, 1992.
Reports TPD-HAI-RPT-92-02

Harmonisation in Falling Weight Deflection Testing (orig. in Dutch)
Van Gurp, C.A.P.M.
C.R.O.W.
Ede, 1992.
Publication 60-I, - pp. 111-122.

First Step to Falling Weight Deflectometer Pulse Shape Calibration Factors
Van Gurp, C.A.P.M. and Dorsman, J.
Delft University of Technology
Delft, 1993.
Reports 7-93-401-13

Comparative Study and Field Calibration of Falling Weight Deflectometers
Van Gurp, C.A.P.M. and Dorsman, J.
Delft University of Technology
Delft, 1994.
Reports 7-94-401-14

Sweden

Temperature correction of Falling Weight Deflectometer data.
Bergstedt, B.
BCRA Conference proceedings.
Tronheim, Norway, 1990. pp. 291-304.

A simple correlation approach to interpretation of deflection data.
Anderson, O.
BCRA Conference proceedings.
Tronheim, Norway, 1990. pp. 435-445.

Pavement strain versus back-calculated data.
Lenngren, C.A.
BCRA Conference proceedings.
Tronheim, Norway, 1990. pp. 459-473.

Norwegian/Swedish in-depth pavement deflection study.
Moss P.M., Wiman L.G., Jansson H. and Mork H.
BCRA Conference proceedings.
Tronheim, Norway, 1990. pp. 817-852.

Performance Based Asphalt Strain Criteria.
Djårf L.
BCRA Conference proceedings.
Minnesota, USA, 1994.

Pavement Analysis Based on Measured In-Depth Daflection Data
Jansson H., Wiman L.G.
BCRA Conference proceedings.
Minnesota, USA, 1994.

17. LIST OF SPECIALISTS IN OTHER COST STATES

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Draft Technical Annex to the MoU

GENERAL DESCRIPTION OF THE PROJECT

Introduction

Use of FWD testing is a growing requirement in modern pavement maintenance management and already implemented as routine procedures in some european countries and in others only as an equipment used in research or special investigations.

To expand possibility of exchanging services within this field of pavement strengthening evaluation in the EU Single Market a formulated Common Code of Good Practise will be a prerequisite.

The FWD is already used in some EU countries and in US-SHRP programme chosen as the authorised equipment for bearing capacity assessment of pavements.

A. **General background.**

State of the Art.

Different procedures and usage has been investigated by a FEHRL FWD group for 2 years at the aim of elaborating guidelines for making measurements with FWD's. This work has ended up in a common FEHRL publication that will be submitted in beginning of 1995. The title of this Technical Note will be: "Harmonisation of use of FWD's for evaluation of flexible pavements on project level".

Motivation.

Until now many countries has carried out parallel research in the field and formulated national standards and procedures this will effectively be coordinated within the proposed COST co-operation.

This proposed COST project group will also enable conveyance of knowledge in the field to less experienced countries in the field including the CEE-countries.

Finally the proposed project will contribute to pooling of abilities of several COST countries with experience in the proposed research field.

B. **OBJECTIVES FOR THE PROJECT.**

Development of an European common code of good practice for use of falling weight deflectometers in pavement evaluation, which encompasses the following:

- Expand FEHRL harmonisation proposal also to incorporate strengthening evaluation on basis of FWD-tests
- Establish common requirements for calibration of measurements and machines
- Extend use of FWDs also to encompass network level evaluation.
- Establish a preparatory basis for possible european standardisation in the field.

This relates to the situation today where usage and experience in pavement evaluation by means of FWD is very different among the European countries utilising this equipment. Also the need for common requirements for calibration and correlation of various machines on the market is an apparent need.

C. **WORK PROGRAM.**

The proposed research project is continuation of the successful FEHRL FWD Activity group who has drafted the FEHRL publication no 1: "Harmonisation of FWD Measurements and Data processing for Flexible Road Pavement Evaluation at Project Level" as a result of three FEHRL FWD Seminars held in The Netherlands, France and Denmark with contributions from 14 european countries.

The proposed research project is made up of four tasks.

TASK 1:

This task will give the complementary description of post processing of FWD data at project level to following items which were not covert until now:

(i) the calculation of in-situ layer stiffness
(ii) the correction of layer stiffnesses to standard conditions
(iii) the calculation of critical stresses and strains
(iv) the estimation of residual structural lives and required thickness of strengthening overlays

TASK 2:

This task will extend the harmonisation of FWD measurement also to encompass the use at network level, which will provide 'rough' estimates of the timing of maintenance and strengthening requirement to the road agency.

TASK 3:

Finally the research project will focus on quality assurance of FWD measurements from a calibration point of view in three aspects:

(i) calibration of all FWD sensors and equipment read out.
(ii) calibration check on a real pavement at an instrumented calibration station
(iii) equalisation of data from different FWD makes

TASK 4:

This task is the concluding and production stage of the proposed work program. It will give following deliverables:

- proposal for common code of good practise in FWD procedures at network level
- recommendations on post processing of FWD data
- recommendations on calibration protocol for FWD machines
- specifications for FWD calibration stations

D. DURATION.

The estimated duration of this action is ~~two~~ three years.

E. ESTIMATED COSTS.

The estimated cost of this action is 2 million ECU.