

SURFACE CHARACTERISTICS

Tuesday 21 October 2003 (8.30 – 12.00 a.m.)

SESSION AGENDA & INTRODUCTORY REPORT

SESSION AGENDA

1. Activity Report

Mr. Bjarne SCHMIDT (C1 Chairperson/DENMARK)

2. Measurement of Surface Characteristics

Mr. Ramesh SINHAL (C1 member/UK)

3. Interaction Models

Mr. James C. WAMBOLD (C1 member/USA)

4. Indicators

Mr. Bojan LEBEN (C1 member/SLOVENIA)

5. Contribution to Management of Road Assets

Mr. John EMERY (C1 member/CANADA)

6. Reference Tires

Mr. Michel GOTHIE (C1 member/FRANCE)

7. The TROWS Project

Mr. Michel GOTHIE (C1 member/FRANCE)

8. Discussion, Summary and Conclusions

Mr. Bjarne SCHMIDT (C1 Chairperson/DENMARK)

CONTENTS

EXECUTIVE SUMMARY	4
COMMITTEE ACTIVITY REPORT	5
VEHICLE/TYRE/ROAD IN TERACTION	6
REFERENCE TYRES	7
SURFACE CONDITION INDICATORS	8
MEASUREMENTS	9
SURFACE CHARACTERISTICS AND ASSET MANAGEMENT	11
TENTATIVE CONCLUSIONS	12

EXECUTIVE SUMMARY

After the activity report of the Committee presented by the Chairman, this session will deal with five topics:

- A review will be presented of all available models describing vehicle/tyre/road interactions in terms of relationships between causes and effects. The considered effects bear on safety, serviceability and costs.
- The problem of maintaining the reproducibility of the different batches of the reference tyre for skid resistance testing will be discussed and possible solutions suggested.
- The objective of this paper is to define the field of use of these global indices, compared to individual surface indicators. The role of surface characteristics in PMS will be described and then needs of global users in terms of surface characteristics will be identified. Finally, the potential to combine indicators into a combined index will be presented.
- A state-of-the art report will be presented on the measurement of surface characteristics, namely: friction, texture, roughness, deterioration and noise. The presentation will include a discussion on the reasons and requirements for such measurements.
- Finally, a presentation will show how surface characteristics play an important role in asset management both in developing and in developed countries.

Contributors:

DESCORNET Guy
EMERY John
GOTHIÉ Michel
LEBEN Bojan
SCHMIDT Bjarne
SINHAL Ramesh
WAMBOLD Jim

Belgium
Canada
France
Slovenia
Denmark
United Kingdom
United States of America

COMMITTEE ACTIVITY REPORT PRESENTED BY BJARNE SCHMIDT COMMITTEE CHAIRMAN

This session will start with a brief summing up of the Committee activity since the previous World Congress. Among the topics dealt with by the different working groups set up within the Committee, some have already been the subjects of publications. Five topics will be presented in this session. One of them, namely the problems related to the measurement of various surface characteristics, will be the subject of a more extensive presentation in an additional session organised by the Committee that is entitled "Monitoring for Safe, Smooth and Sustainable Roads".

VEHICLE/TYRE/ROAD INTERACTION

PRESENTED BY JIM WAMBOLD

WORKING GROUP LEADER

The group was involved in developing a state-of-the-art report to provide a better understanding of the interaction phenomena between the vehicle, tyre and surface. Models and indices for the interaction of vehicle, tyre and surface were collected and listed showing how they are related to the following three areas:

- Safety: including wet friction, winter friction and vehicle control.
- Serviceability: including ride quality, noise and vibrations.
- User Costs: including pavement loading, fuel consumption and transport costs.

Reports from members on the State-of-the-Art on Models were as follows:

- Wet Friction by M. Gothié (FR) and J.J. Henry (US)
- Winter Friction by J.C. Wambold (US)
- Vehicle Control by J.C. Wambold (US)
- Ride Quality by J.C. Wambold (US)
- Noise by U. Sandberg (SE) and G. Descornet (BE)
- Pavement Loading by J. Wambold (US) and D. Cebon (GB)
- Fuel Consumption and Transport Costs by L. Sjögren (SE)
- Traffic Induced Vibration by P. Giannattasio (IT) and M. D'Apuzzo (IT).

As texture and roughness are in most cases the main factors, a synthetic chart is presented that shows which wavelengths of the road surface profile cause the different effects.

Since no report was contributed to those subjects, splash & spray (affecting safety), tyre & road wear (related to serviceability) and slab curl (affecting costs) are recommended to be dealt with by the Committee in the next four-year term.

REFERENCE TYRES

PRESENTED BY MICHEL GOTHÉ

WORKING GROUP LEADER

In the early seventies, PIARC Committee C1 initiated the manufacture of a special tyre for use on devices to measure friction coefficients. Although the tyre is not the only important factor in this measurement, the use of this special tyre by many countries has allowed – and still allows – easier exchange of results of measurements.

As the Swiss manufacturer of the PIARC tyre ceased his activities in the years 1995-1996, Committee C1 was forced to look for a new partner for this specific production. A Dutch manufacturer accepted to produce a new series in accordance with the original specifications for this special tyre. This series was released early in 1998 and supplied late in 1998 by a Dutch company to all clients.

As early as at the end of 1998, comparative tests conducted in France showed considerable differences between results obtained on the same surfaces with the tyre of the 1990 series and the tyre of the 1998 series.

This finding was confirmed by other tests in 1999, and prompted PIARC Committee C1 to ask explanations from the manufacturer and supplier of these special tyres. The latter two made concrete proposals resulting in new tests performed in two member countries of C1 (the Netherlands and France) with their respective devices on commonly encountered surfaces. With the results of these tests two reports were produced in which different suggestions were made: the Dutch (who used their DWW trailers measuring a longitudinal friction coefficient with 86 % of slip) suggested four models to correct the values obtained with the tyres of 1998; the French (who used their ADHERA device measuring a longitudinal friction coefficient with a locked wheel) suggested to retain the tyre of the 1998 series – and use the results obtained with it as such – in the short term. On the other hand, they suggested to change the ranges of references used in France, using a model based exclusively on measurements made with the ADHERA device.

The users of the tyres were informed on those tests, and a meeting was arranged for them in Delft in September 2002. Also invited to this meeting was a representative of the two companies. As an outcome of this meeting, working group D made recommendations to Committee C1, with a time schedule including stages to be completed within six months, one year and two years.

All this should provide C1 with the necessary information to decide whether there is a need for considerable developments in the characteristics of the present PIARC tyre (size, composition, etc.). The decision should be made before starting a new production of the PIARC tyre when the 1998 series is out of supply.

SURFACE CONDITION INDICATORS

PRESENTED BY BOJAN LEBAN

WORKING GROUP LEADER

The objective of this paper is to define the field of use of these global indices, compared to individual surface indicators. The role of surface characteristics in PMS will be described and then needs of global users in terms of surface characteristics will be identified. Finally, the potential to combine indicators into a combined index will be presented. Level of service for road users, road operators and for road administrations for a whole life concept will be defined and a proposal for the use of surface condition indicators will be prepared.

It is intended to prepare recommendations for data processing, referencing in time and location, and storage for the efficient design, construction and maintenance of road pavements. Functional classification including classifications with use of two level families (single and combined indices) and two levels per family, taking into account the complexity and the level of aggregation will be explained. Examples will be used to explain how special indices characterising the pavement condition permit an assessment of the efficiency of different approaches, from a commercial and a macroeconomic view and to support maintenance planning goals with use of structural and service index rating. It is not intended to make a comprehensive collection of information about indices, but to use examples of different types of indices including those from HDM-4.

One of the limitations of use of combined indices is that the individual performance indicators used by the various countries/world regions have limited comparability (use of different factors, rating systems, measuring procedures, etc.) and thus some harmonisation approaches will be mentioned to initiate wider activities to specify pavement characteristics in uniform terms.

A list of general definitions (such as index, condition index, single index, composite index, etc.) to be used throughout the report will be described separately and a list of detailed items to include in the PIARC dictionary will form part of the annex "Terms and Definitions".

Condition or performance indicators can thus be used also as an objective tool for use in road construction and maintenance at various administrative levels, from local roads to international highways.

MEASUREMENTS

PRESENTED BY RAMESH SINHAL WORKING GROUP LEADER

Working Group A is concerned with the measurement of surface characteristics as they relate to trafficked pavements. Previous PIARC programmes of work in this area have included studies and a number of international experiments, designed to provide information leading to the harmonisation of techniques for the measurement of texture, friction, longitudinal and transverse road profiles. At the last World Road Congress, in Kuala Lumpur, a proposal was made to investigate the harmonisation of rolling noise measurement and for the development of more consistent methods of measuring surface distress condition through the use of automated systems.

In the current programme the Working Group has been concerned with both new and ongoing studies relating to the improvement and harmonisation of measurements of friction, texture, noise, distress and evenness. Currently many of these parameters can be measured directly or indirectly at traffic speed by multi-function machines, such as that illustrated in Figure 1.



Figure 1 - Example of multi-function equipment for monitoring road surface condition characteristics



Figure 2 - Example of unpassable road in developing country

Such machines are not suitable for all road environments either in practical or economic terms. For example, in developing countries where conditions such as those shown in Figure 2 can be encountered, other monitoring solutions would be required but elements of the multi-function approach could still find application. The ultimate objective of the work is to ensure that the surface characteristics can be measured by suitably robust and economic techniques with an accuracy that is sufficient for the defined purpose and can be expressed in terms of an index that is meaningful to road administrations.

To this end, five subgroups were formed from the main working group to collect and evaluate the latest data and information available on the following topics:

- Friction and texture
- Profilometer measurements
- Noise
- Surface deterioration
- Requirements as regards measurement needs.

As part of their work each subgroup maintained liaison with other relevant PIARC working groups and with a wide range of external organisations, in particular, those Standardisation bodies covering the measurement of the surface parameters.

The *Friction and Texture* subgroup reviewed recent and ongoing studies in this area produced a state-of-the-art report on developments aimed at validating a common index for assessing skid resistance and to improving measurement systems.

The *Profilometer Measurements* subgroup initially focused on reporting the results of the PIARC EVEN project and then on examining and reporting on the lessons learnt on the measurement of reference profiles.

The subgroup on *Noise* produced a state-of-the-art report that covers measurement methods, status of standardisation, comparison of measurement methods, ongoing developments and discusses the need for a comparative experiment similar to those previously carried out for friction and evenness measurement techniques.

On the *Surface Deterioration* topic, the subgroup has carried out an initial wide-ranging review of practical automated measuring systems covering the surveying of visual distress parameters. However, for their report, they have concentrated on the detection of cracks, as they have discovered that, as yet, this is the only visual distress parameter that currently can be routinely measured.

The last subgroup has reviewed the reasons and *requirements for surface measurements* in the light of the growing volume and speed of road traffic. It has also examined the need for road measurements not provided by existing systems and the practical feasibility of making such measurements.

In recognition of the need for the sharing of information on technical developments with emerging countries, Working Group A made a number of contributions to a PIARC international seminar, held in Havana Cuba, in April 2002, on Road Surface Characteristics.

Overall therefore, the programme of work carried out by Working Group A provides an up-to-date view on developments relating to the measurement and harmonisation of the assessment of road surface condition parameters. It has addressed issues on road serviceability that are important to road managers and government highway departments in both developed and emerging countries. It has also identified required characteristics that are not covered by existing measurement systems.

SURFACE CHARACTERISTICS AND ASSET MANAGEMENT

PRESENTED BY JOHN EMERY

Road infrastructure asset management is integral to the technically sound, life-cycle cost-effective provision of safe, smooth, secure pavement surfaces that are critical to economic growth, international competitiveness, and most importantly – the quality of life. For developed countries, the asset management focus is moving from infrastructure expansion to the more efficient use, and systematic, sustainable preservation, of the built transportation infrastructure. For developing countries, emerging economies and countries in transition, the focus is still on constructing the basic road infrastructure, but with a growing awareness that appropriate pavement maintenance management technology must be incorporated to nurture and preserve the pavements through the timely, effective use of limited technical and financial resources. Pavement performance, a major component of transportation infrastructure asset management systems, is the meeting point for road surface characteristics, pavements, management, safety and sustainability technical interaction.

Pavement performance monitoring for new surfaces and during their life cycle, and performance–prediction, is fundamental to pavement and maintenance management systems, and as input to an asset management system. The use of pavement performance monitoring information can range from new project warranty requirements, such as smoothness achieved, to long-term monitoring indices (composite index representative of road roughness, rutting, surface condition (distresses), frictional characteristics and/or load-deflection) for network level asset evaluation. From a surface characteristics viewpoint, it is important that the pavement performance monitoring equipment and methodology adopted, the quality of information obtained, and its integration with the user's requirements (maintenance management for instance) meet recognized recommendations and standards. This will also involve a consideration of appropriate technology for the limited technical and financial resources of developing countries. For cold climates, the winter pavement surface condition, particularly with regard to frictional characteristics and snow/ice control, adds another dimension.

TENTATIVE CONCLUSIONS

It is imperative that the pavement surfaces inventory, condition (performance) monitoring and performance prediction information are technically sound and user-friendly within the full context of road infrastructure asset management. Though a lot of efforts were made in the recent years, in which PIARC C1 played a significant role, the goal of harmonising measurement and assessment methods - including global indices - is still to be pursued actively. Following the work done and the recommendations made by this Committee, a durable solution has to be developed by the next Committee with a view to providing a stable, reproducible test tyre for friction testing.