VEHICLE/SURFACE INTERACTION

18 September 2007 (am)

TECHNICAL COMMITTEE C4.2

INTRODUCTORY REPORT

CONTENTS

EXECUTIVE SUMMARY

After a presentation of the Committee activity report by the Chairman, the results of the work of the different Working Groups will be presented, namely on the following topics:

- “Trends in vehicle-road interaction monitoring for design and management”
- “Road traffic noise emission – Measurement methods”
- “Reference tyres for skid resistance testing”
- "Guidance on managing skid resistance and pavement evenness"
- “Evaluating the performance of the automated pavement cracking equipment”
- “Methods and equipment for inspecting unpaved roads”
- “Advanced road works acceptance methods and criteria”

Apart from the regular Committee work, several international meetings organized by the Committee will be recalled, namely:

- the 5th International Symposium on *“Pavement Surface Characteristics of Roads and Airfields”* in Toronto
- an International Seminar on *“Paved and Unpaved Roads Monitoring and Management”* in Bamako (Mali)
- a workshop on *“Automated detection of pavement cracking”* in Québec
- a workshop titled *“Impact of Emerging Vehicle, Pavement and Monitoring Technologies on Road Vehicle Interaction: where will we be in 30 years?”* that will take place during this Congress (Thursday 20).

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1. COMMITTEE ACTIVITY REPORT

by Bjarne SCHMIDT, Committee Chair

After a presentation of the Committee mandate, membership and organization of work, the Chairman will focus on some of the outstanding activities, namely the 5th International Symposium on *"Pavement Surface Characteristics of Roads and Airfields"* in Toronto, an International Seminar on *"Paved and Unpaved Roads Monitoring and Management"* in Bamako (Mali), a workshop on *"Automated detection of pavement cracking"* in Québec and a workshop titled *"Impact of Emerging Vehicle, Pavement and Monitoring Technologies on Road Vehicle Interaction: where will we be in 30 years?"* that will take place during this Congress (Thursday 20).

2. A 20 TO 30 YEARS VISION

by Francesca LA TORRE, Working Group Leader

The World Road Association (PIARC) has identified the issue of "having a 20 to 30-year vision of developments in vehicle and road pavement characteristics" as one of the key issues to be addressed on the 2004-2007 term.

This issue has been tackled by Working Group A of C4.2 committee focusing on two aspects:

- how are vehicles changing with respect to their influence on pavement design and management and where will they be in 20 to 30 years;
- how can pavement managers keep track of these changes and consider them in pavement design and maintenance activities.

Two parallel activities have therefore been performed by WGA to address these different aspects:

- for solving the issue on vehicle changes the C4.2 Committee has organized a Workshop where the different actors involved (vehicles, trucks and tyre manufactures, road managers, pavement designers and researchers) can share their views and understand the impact of these evolutions on road/vehicle interaction;
- to have a clear picture of what are the tools and devices available or under development to keep track of the evolution in vehicle/tyre/road interaction an inventory database has been set up by WGA concerning devices for monitoring traffic action on the road surfaces.

PIARC roundtable workshop: "Impact of Emerging Vehicle, Pavement and Monitoring Technologies on Road Vehicle Interaction: where will we be in 30 years?"

This Workshop will be held during the Paris Congress and will address the following key topics:

- How can we improve our shared understanding of emerging technologies in vehicles, tyres and roads?
- What impact will this have on our roads over the next 30 years?
- Can future vehicle design rules be less prescriptive and more performance based?
- Can we make cars, trucks, tyres and roads safer with new technology?
- Can road managers take advantage of vehicle technology in designing new roads?

The main outcome of the Workshop will be the identification of the trend in emerging technologies and their possible impact on pavement, vehicle and tyre design.

The Workshop will be held in two sessions: a morning roundtable session limited to invited experts and pre-registered attendees on a limited number basis. The afternoon session will then be open to all the World Congress attendees, without a specific prior registration to the Workshop, to discuss the main outcomes of the roundtable and future directions.

TRALOMI: an inventory of the devices and techniques for monitoring traffic actions (mainly loading and stresses) over the road pavements

The key issue of this activity was to define the devices available or under development capable of defining the road traffic loading or the resulting stresses in the pavement in order to allow the pavement managers and designers to account for the continuous evolution in vehicle and tyre characteristics. As far as one of the main interest of the C4.2 Committee is road tyre/friction it was decided to include in the database also speed monitoring devices as these play a key role in the definition of the friction levels to be required in a given condition. Pavement condition monitoring devices (such as friction and roughness measuring devices) are, on the other hand, not included in the database.

The result of the inquiry show that some road authorities have already in place monitoring systems based on the Weigh-in-Motion technique (**Figure 1**), capable of defining the actual load applied by the travelling trucks on the surface, even though most of the responses indicated that they rely on overall traffic counts (either automated or based on manual traffic counts).

Figure 1 – Weigh-in-Motion devices

On the other hand the use of "stress-in-motion" devices (**Figure 2**), capable of providing stress distributions at the tyre/road interface in the longitudinal, transversal and vertical direction still seem to be limited to research applications.

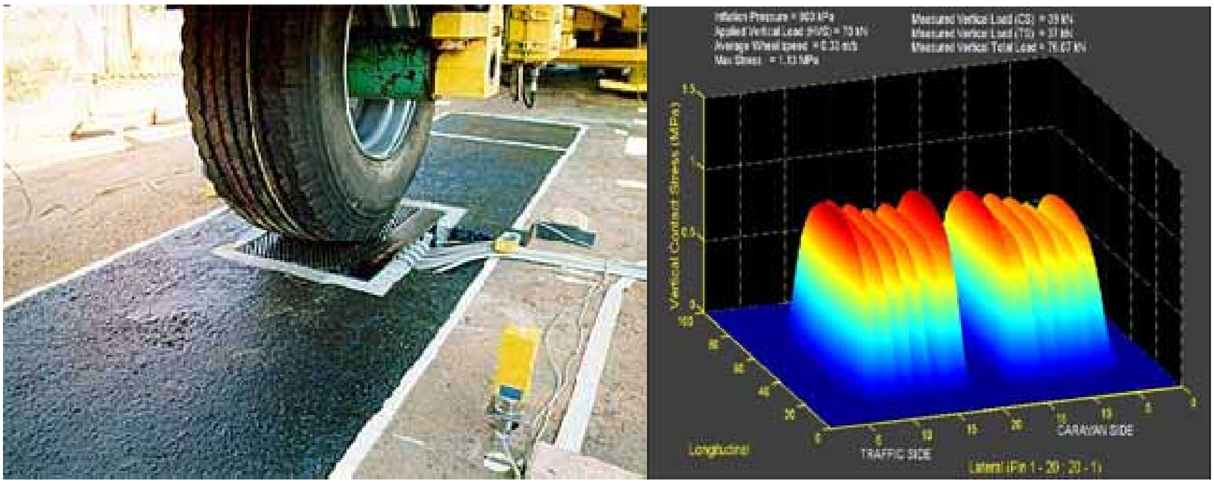


Figure 2 – "Stress-in-Motion" devices

3. ROAD TRAFFIC NOISE EMISSION – MEASUREMENT METHODS

by Manfred HAIDER, Working Group Leader

Working group B of PIARC TC 4.2 "Road/Vehicle Interaction" was concerned with the sound emitted by vehicles circulating on roads all over the world. The noise emission properties of specific vehicle/tyre/pavement combinations are the result of several generation mechanisms, of which the most prominent one at speeds above 30 km/h is the rolling noise generated by tyre/road interactions. For this reason the road surface plays a very important role both in the generation mechanisms for road traffic noise emissions and in the strategies for road traffic noise abatement. The noise performance of pavements can be considered a special surface characteristic, as it is mostly attributable to the properties of the wearing course, i.e. the topmost layers of a road construction. While the influence of the road surface on road traffic noise emission is important, also the contributions of tyre and vehicle must not be neglected, especially in urban locations and in low-speed situations.

The working group members have been following and actively participating in the research in low-noise road surfaces and improved methods for acoustic pavement characterisation. Major EU projects aiming at noise reduction technologies like SILENCE and QCITY have put a focus on road surfaces and dedicate a lot of effort both to reduce noise and to provide a system for measuring the success in road traffic noise reduction.

Today the most promising noise reductions are achievable with porous road surfaces which not only forbid sound generation in the high-frequency range, but also attenuate the sound along its propagation path. Additionally, variations of more traditional road surfaces like SMA (Stone Mastic Asphalt) or EACC (Exposed Aggregate Cement Concrete) are optimized to reduce the vibration excitation of tyres in the desired frequency ranges.

With all that has been achieved, several major questions still remain to be answered. Some of the most important topics are:

- Internationally comparable acoustic road surface classifications
- Long-term performance of low-noise road surfaces
- Adaptation of low-noise road surfaces to special tyre and vehicle types (passenger cars, trucks)
- Impact of noise emission reductions on the overall noise pollution as shown by noise maps
- Integration of acoustic parameters into road monitoring, maintenance and management

Many of the future tasks in this field depend on the availability of reliable measurement methods to assess the noise performance of road surfaces. One possible approach is to measure the noise emission of individual vehicle pass-bys either from the general traffic or from selected test cars travelling on the road surface under test. These tests are essentially modelled after the ISO 362 standard describing the approval testing of vehicles (**Figure 3**) and are standardized in ISO 11819-1. The second major approach is to measure the near-field noise levels by use of mobile trailers or test cars with standardized test tyres. ISO/CD 11819-2 describes this kind of test, but as experience has shown, the definition and supply of suitable test tyres is not an easy task.

Figure 3 – Car pass-by noise measurement setup according to ISO 362.

The presentation in this committee session intends to point out the methods in use and in development, their advantages and disadvantages and their suitability for the intended applications. The single most important focus for the near future will be to increase the reliability of the results by combining the output of several methods and to establish an international classification scheme for the noise emission of road surfaces.

4. REFERENCE TYRES FOR SKID RESISTANCE TESTING

by Michel GOTHIÉ, Working Group Leader

Of all the different methods used to assess the skid resistance of a road surface, the majority are based on a friction coefficient measurement at various slip speeds, or on the combination of friction measurements and macrotexture measurements. The skid resistance assessment is classically done by measurement of transverse skid resistance (skidding case and curve) or longitudinal skid resistance (braking case).

In the 70s, the PIARC C1 committee, in charge of surface characteristics, expressed the need for the manufacture of a special tyre. Grouping together their needs and addressing only one manufacturer enabled PIARC to cut down unit costs, but also to facilitate comparisons between the various measuring countries. At the time the tyre retained was a radial tyre (165x380xR15) corresponding to a widely used size on passenger cars in the seventies. In order to improve the measurement sensitivity to surface characteristics, a smooth tyre was chosen. To assess the skidding resistance level mobilized by users with their treaded tyres, a grooved tyre was also specified. (**Figure 4**). Several companies successively produced these test tyres: GOODRICH, MALOYA and VREDESTEIN. More than 3000 tyres have been manufactured and used for more than thirty years for friction measurements, mainly in Europe.

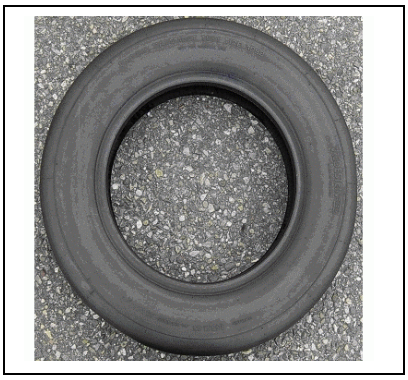
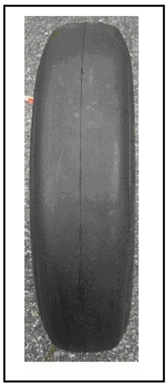
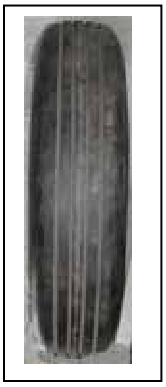




Figure 4 - PIARC Tyre Smooth Ribbed

Some comparisons made during this period have shown that the changes in the production characteristics of these test tyres (hardness in particular), and the ageing of the rubber compound blends over time has gradually led to differences in the results obtained

In addition, to increase the repeatability of the tests, it was necessary to “wear in” the tyres before their use for measurements.

The current characteristics of the PIARC tyre are listed in two technical specifications, which include the following recommendations:

- the procedures to be followed prior to using a new test tyre,
- what precautions should be taken when storing these tyres.

They have been produced by the ex C1 Committee for Surface Characteristics and can be downloaded on the PIARC website: http://www.piarc.org/en/publications/tech-report/.

In early 2006, PIARC Technical Committee C 4.2 “Road/Vehicle Interaction”, with responsibility for PIARC test tyres, decided to give the manufacturing of the next series to the American Company « Specialty Tires of America » which already makes and markets the tests tyres for the ASTM trailer, the GRIPTESTER , the ROAR, the SFT, etc.

Some recent studies have demonstrated the representativity of the measurements carried out with these test tyres. In order to do this, a database was constructed by the various users of PIARC tyres. This database was supplied by the measurement results obtained on various pavements surfaces, both with PIARC test tyres and with current trade tyres.

The main devices which contributed to this database were: the Austrian RoadSTAR, the Belgian ODOLIOGRAPHE and the French ADHERA. These devices use either a PIARC ribbed tyre (RoadSTAR) or a PIARC smooth tyre (ODOLIOGRAPHE and ADHERA). The measurements were carried out either on roads opened to traffic, and showing important surface changes, or on test tracks.

For example, some measurements were carried out on a section in Austria with RoadSTAR which shows interesting variations of longitudinal skid resistance (**Figure 5**). This figure shows that the PIARC ribbed tyre gives friction levels situated in the lower part of the envelope of the results obtained with new trade tyres. As to the PIARC smooth tyre, it is rather clearly below the prior envelope, being more representative of a worn tyre than of a new tyre and thus representing a worst case scenario for friction measurements.

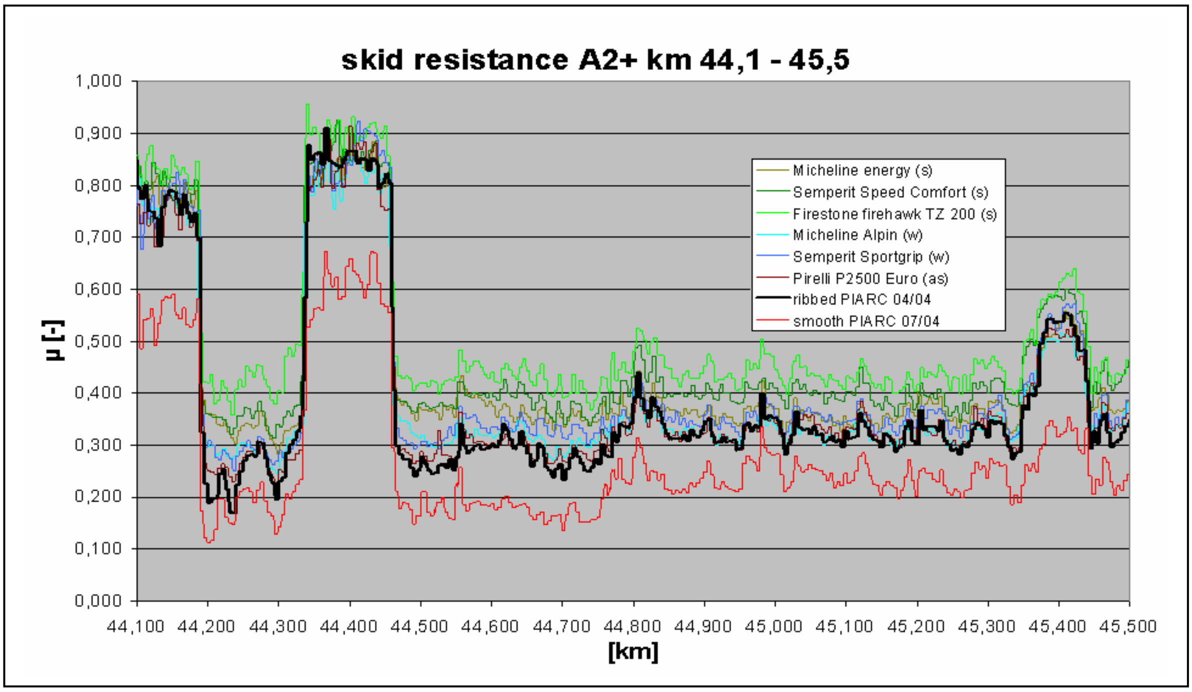


Figure 5: Comparison tests carried out by ARSENAL RESEARCH in Austria

The tests carried out for this report, show that the PIARC tyres, smoothed or ribbed, characterises well the performance offered to the users by the various pavement surfaces. Indeed, the comparisons made with some trade tyres show very close results from the friction coefficients measured on surfaces with good skid-resistance, or very good skid-resistance. On the contrary, on average or bad surfaces the values obtained with PIARC tyres give more important differences than with those obtained with trade tyres, but always in terms of a reduced friction level. This trend of PIARC tyres continues the right way, increasing the range of values and thereby enlarging the number of classes which can be used for the pavement skid resistance characterization.

5. GUIDANCE ON MANAGING SKID RESISTANCE AND PAVEMENT EVENNESS

by Ramesh SINHAL and Brian FERNE, Working Group Leaders

Working Groups C2 and C3 have developed guidance on the best practice for measuring and managing skid resistance and pavement evenness. Previous PIARC programmes of work in this area have concentrated on the harmonisation of measurement techniques by international experiments to compare measuring equipment and interpretation of the results. This four year session has concentrated more on collating worldwide practices in the measurement, interpretation and use of the data into practical up-to-date guides. Questions have been circulated throughout the committee to ascertain:

- For skid resistance and texture: Strategies for managing surface condition to limit skidding accidents, measurement techniques, relationship between skid resistance and accidents, treatment options, cost effectiveness.
- For evenness: Strategies for managing evenness, influence of evenness, measurement techniques, interpretation and indices, treatment options, cost and benefits of managing evenness.

The underlying reason behind providing skid resistant road surfaces is to limit the number and/or severity of accidents where vehicles skid. This requires different approaches in different circumstances (e.g. for different traffic levels, standards of geometric design or type of road surface construction) – this is the case in many countries. In some cases it may also be appropriate to think beyond the provision of skid resistant surfaces, e.g. to consider problems of road contamination, surface defects (e.g. localised loss of texture, potholes or unevenness) or poor drainage, that could also lead to vehicles losing control and skidding.

The objective of this work has been to identify a range of strategies for maintaining surface condition to limit skidding accidents and to give a way of deciding which options are appropriate in different circumstances. In practice there are a range of issues to consider apart from selecting the best technical solution, e.g. budget constraints, low perceived priority, questions over liability of road administrations.

Several countries have identified that there is a range of accident risk for individual sites. With knowledge of how accident rates vary with level of skid resistance and other factors, as illustrated in **Figure 6**, and the aid of cost/benefit analysis any available budget can be correctly targeted at priority sites. The cost of such treatments can easily be covered by accident savings over a short period of time.

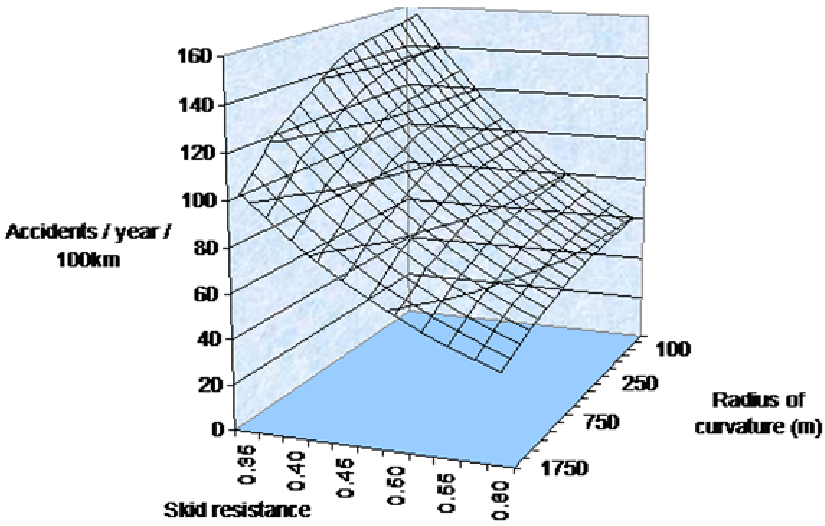


Figure 6 - Relationship between skid resistance and accident rate

Figure 7 - Testing of skid resistance in wet conditions

What is evenness? Pavement evenness, or roughness as it is often known, is generally defined as an expression of irregularities in the pavement surface that affects the ride quality of a vehicle, and thus the road user. Thus evenness is an important parameter because it affects the convenience to the road user. For developing countries, it is often expressed as ride quality, but its effect on vehicle delay costs, fuel consumption and vehicle maintenance costs can also be important. The World Bank considers road evenness to be a primary factor in the analyses and trade-offs involving road quality and user cost and evenness is a major parameter within the HDM4 model. For developed countries, the emphasis is rather different with ride quality still being important but with the effect of profile on safety and dynamic loading rather more important and more recently an added emphasis on fuel consumption in view of its environmental impact.

Many countries are using the International Roughness Index to help highway engineers manage their network, from network level screening, indicating network performance, comparing regional needs or using as intervention triggers for treatment works, involving further investigation or direct selection of the maintenance treatment. In some cases these values are used as a major input to decision–support tools such as the HDM4 model. In most cases the IRI index is averaged over 100m lengths but in some countries this is considered as lacking in detail. Other countries are using more fundamental measures of evenness which can be reported meaningfully at shorter intervals and thus indicate more local defects which can then be efficiently repaired in a more economic manner. The user response, shown by red spots in **Figure 8**, generally corresponds to local high unevenness values, indicated by peaks in the blue line. However, some user responses do not correspond to peaks in the profile but relate to very discrete local defects, for example potholes. **Figure 9** illustrates how an advanced profile analysis technique, based on 3-dimensional profiles, can identify such local defects and enable more robust maintenance decisions by the local highway engineer.

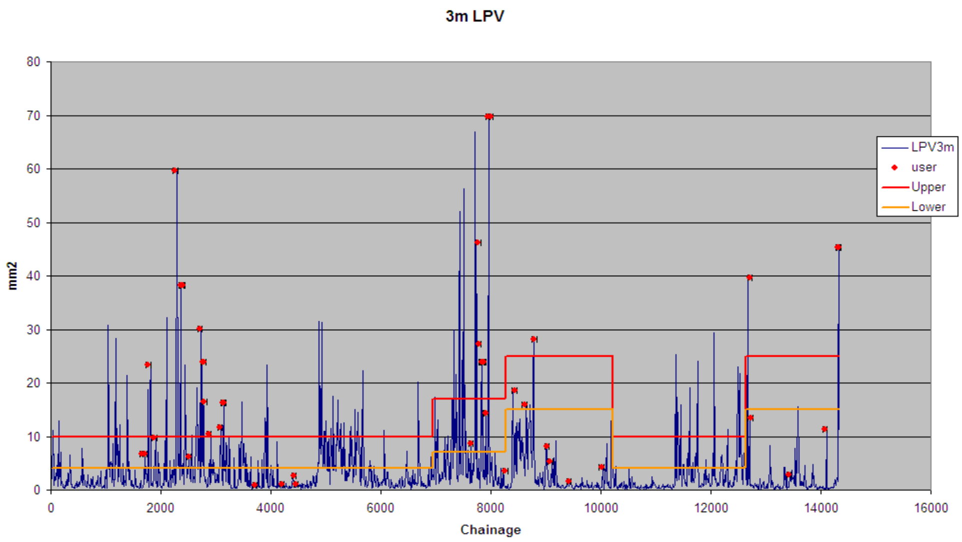


Figure 8 - Profile of road evenness, thresholds and user dissatisfaction

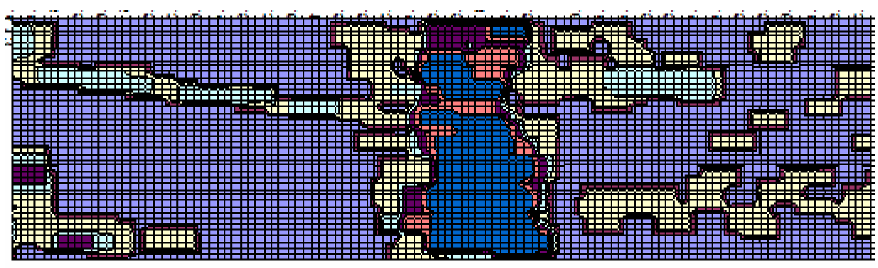


Figure 9 - Plan view of analysis of 3 dimensional profile of road

A summary of this work will be presented at the Congress.

6. PERFORMANCE EVALUATION OF AUTOMATED PAVEMENT CRACKING DETECTION EQUIPMENT

by Michel BOULET, Working Group Leader

Cracks type, severity and extent are the most important information to select maintenance and repair actions. This information is in fact, the basic data of a pavement management system. Much progress has been made by some road administrations, service providers and researchers to develop automated systems to collect this data.

The document entitled "Automated Pavement Cracking Measurement Equipment – Worldwide Progress Report", which was prepared by a working group of Committee C1 of during the previous cycle, presented the conclusions of a worldwide survey concerning validation testing and the use of automated pavement cracking measurement equipment. This survey revealed that performance tests on this type of equipment are only conducted infrequently, and that the tests are very often incomplete and not uniform. In addition, all of the experiments involving comparison of the results obtained using automated equipment with those obtained by the another method faced the same distress definition problems. In light of this, the study recommended that further work be conducted in order to develop more precise methods to identify pavement distresses and to propose acceptable methods for evaluating the reliability of automated pavement cracking measurement equipment.

The speaker will first present more detailed specifications of the pavement cracks and identification methods in order to improve the reproducibility of the measurements. He will pursue with the presentation of the methodologies for evaluating and classifying automated pavement cracking measurement equipment in terms of reliability (bias and repeatability). Briefly, three testing methods will be presented: for research, project and network levels. Each road administration would use the proper one in function of its needs.

Figure 10 - Example of using crack grids method to test the automatic crack measurement systems (source: TRL Limited).

Technical Committee members of WG D hope the concepts presented in this session will be a real progress leading to increasing quality level of crack data measurements and will help road administrations to manage their road network in a better way.

7. METHODS AND EQUIPMENT FOR INSPECTING UNPAVED ROADS

by Yves PROVENCHER, Associate Member

This article presents the results of the report "Survey of monitoring methods for unpaved roads" produced by Working Group D, which highlights the importance of unpaved roads and identifies future research directions.

Unpaved roads are by far the most commonly constructed type of road in the world. They often serve as the primary, indispensable link between countries and as primary routes for global commerce. Despite this, they don't always receive the attention they deserve from decision-makers. This can be seen from the limited quality and quantity of information available on the network of unpaved roads.

Despite this lack, the situation isn't quite as dark as it may seem. A recent international investigation carried out by Working Group D revealed that some organizations (public, military, or resource management) are managing their road networks efficiently. There is thus expertise to be shared among the international community. To identify the information that should be exchanged among these organizations, it is important to understand how unpaved roads are managed, the importance given to maintenance, and how road services use the information that they collect. The primary goal of our survey was to identify the practices and inspection equipment that are currently being used to manage unpaved roads and thus, to explore the potential for developing new technologies or methods that can promote the use of best management practices. Even though the majority of the evaluation techniques used for unpaved roads are not complicated, many countries remain unaware of the importance of analyzing the condition of their system of unpaved roads so that they can perform the necessary maintenance. If the necessary skills and information could be transferred to the managers of these roads, many countries could greatly improve the current condition of their road networks and by so doing, improve their economy. Based on these observations, there's a clear need to develop well-defined standards (in addition to IRI) for the evaluation and maintenance of networks of unpaved roads, and to harmonize the various inspection methods used by all countries.

Once universal standards have been established, the way is open for the development and implementation of new maintenance and inspection techniques.

Figure 11 - Example of ruts and distortions. (Source Mahamadou OUEDRAGO, Burkina Faso)

Figure 12 - Example of an unpaved road that bear high loads. (Source: FERIC)

The limited level of response to our survey, combined with the limited amount of information available to those who did respond, confirms that this important global network has been neglected. More effort must be invested to provide an understanding of the extent of deterioration of these roads and how it affects the transportation efficiency and costs on those roads. This information will justify better control of the road conditions.

8. ADVANCED ROAD WORKS ACCEPTANCE METHODS AND CRITERIA

by John EMERY, Working Group Leader

Pavement performance, a major component of transportation asset management, is the focus point for surface characteristics, pavements, management, smoothness, and safety interaction. Pavement performance monitoring for new surfaces and during their life-cycle, and performance-prediction, are fundamental to pavement management systems, and as input to transportation asset management systems. The use of performance monitoring can range from project pavement construction quality assurance for acceptance, to post-construction warranty requirements such as smoothness achieved and maintained, to long-term monitoring indices (index representative of roughness, rutting, distresses, friction, noise, and deflection) for asset evaluation. From a surface characteristics viewpoint, it is important that the monitoring equipment, quality of information, and its integration meet recognized standards – you cannot manage what you cannot measure. There must be flexibility to incorporate new surface characteristics, such as the top-down cracking of long-life asphalt pavements, that involves considerable performance extrapolation. For cold climates, the winter surface condition and its monitoring, particularly for timely travel advisory information, adds another dimension. It is also imperative that the pavement surface inventory, performance monitoring, and performance prediction information are technically sound and user-friendly.

The focus of Working Group E, Advanced Road Works Acceptance, of Technical Committee 4.2, Road/Vehicle Interaction, has been a synthesis of performance-related surface condition measurements for parameters (properties) typically used for acceptance of road construction and maintenance, both short term (as constructed or rehabilitated) and longer term (warranty, performance-related contracts, and maintenance contracts, for instance), including measurement method, methodology, quality, and reporting (current trends/future, 'low tech', and 'high tech'). These activities included the development of interpretation and use guidelines for the acceptance parameters, and recommendations on acceptance criteria (not specifications), in a user-friendly guide format. The parameters reviewed and accepted for interpretation, user guidelines, and acceptance criteria are: smoothness (International Roughness Index); irregularities (‘bumps’); rutting (may be part of surface distress); surface condition (‘distresses’ – cracking, texture, segregation, ravelling/fretting, flushing, etc. – typically as a pavement condition index); permeability; noise generation (particularly for urban areas); deflection (structural condition); and friction (typically benchmark and then selective) – noting that others can be added as necessary. These WGE activities extend the previous work of Committee 1, Surface Characteristics, on the derivation of surface condition indicators (indices, single and combined), that are particularly useful as key pavement performance indicators in the pavement management system (PMS), maintenance management system (MMS), and transportation asset management system (TAMS) dynamic interaction. Accurate data are the critical aspect of any PMS, MMS, and TAMS.

The infrastructure road sector flexible and rigid pavements network represents about 60 percent of a typical transportation agency's assets and is generally their primary interest. There is a trend for road construction, maintenance, and rehabilitation specifications to move from end-result to performance-related and warranty. There are also new ways of financing major road projects such as public-private-partnering for infrastructure construction, maintenance, and operation that require performance criteria. Many agencies are currently initiating TAMS, with pavements an important component as shown in **Figure 13**. Pavement and bridge deck surface characteristics, performance monitoring, and performance prediction are central to the PMS, MMS, and TAMS integrated activities that ultimately address the key public requirements for safe and smooth pavement surfaces.

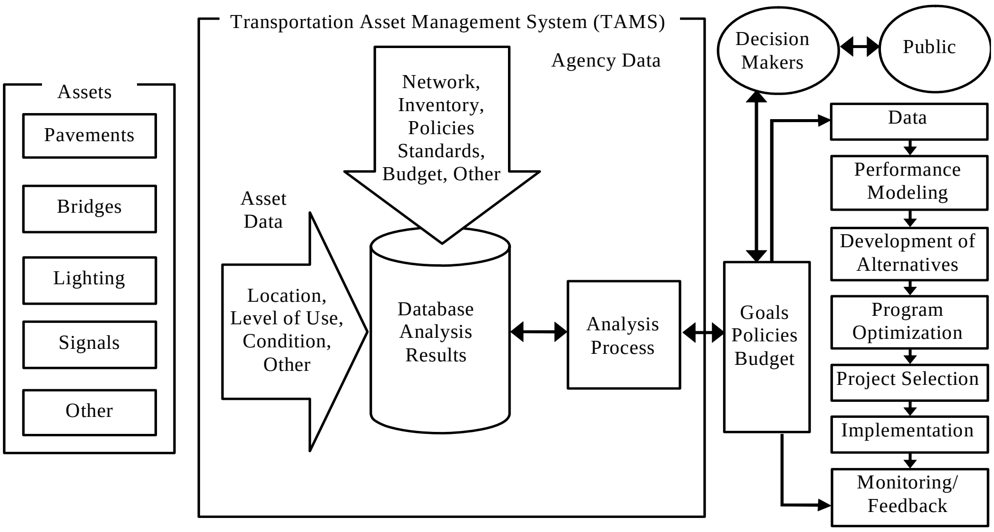
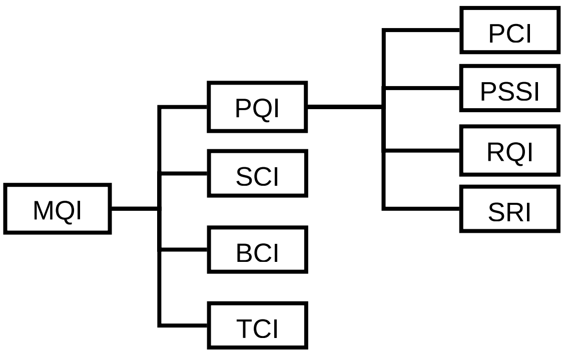


Figure 13 - Typical flow of asset and agency data in and out of a generic transportation asset management System (TAMS). Adapted from [1].

A single index is a number representing directly or indirectly (derived) the result of the measurement or assessment of a single condition feature (property) of the pavement surface such as cracking, ravelling, rutting, bleeding, smoothness, friction, noise, or deflection. A composite index (global index) is a number representing the combined (aggregated) contributions (typically weighted) of different single condition features (properties). Different formulas and weightings can be applied for the combination of the different single indices into a composite index. A practical example of the use of single and composite indices is given in **Figure 14** based on current Chinese expressway practice.



MQI Maintenance Quality Index (0 to 100)
PQI Pavement Quality Index (0 to 100)
SCI Subgrade Condition Index (0 to 100)
BCI Bridge and Tunnel Condition Index (0 to 100)
TCI Traffic Condition Index (0 to 100)

PCI Pavement Condition Index (0 to 100)
PSSI Pavement Structure Strength Index (0 to 100)
RQI Ride Quality Index (0 to 100)
SRI Pavement Skidding Resistance Index (0 to 100)

$PQI = W_{PCI}PCI + W_{PSSI}PSSI + W_{RQI}RQI + W_{SRI}SRI$

W_n Weighting Factors for Asphalt and Concrete

Figure 14 - Chinese use of derived indices for overall expressway system maintenance quality. Adapted from [2].

It should be noted that the WGE activities to develop pavement surface condition indicators and associated acceptance parameters did not include either airport airside pavements or winter road conditions. Integration of acceptance parameter activities and road user needs activities is considered important to cover all season, safe road conditions, for instance for road network maintenance contracting in colder climates where winter maintenance operations can represent a significant portion of the year-round maintenance costs.

BIBLIOGRAPHICAL REFERENCES

[1] Organization for Economic Co-Operation and Development *Asset Management for the Roads Sector*, 2001.

[2] Ministry of Communications of China, "*Expressway Maintenance Quality Evaluation Standards"*, 2002.

TENTATIVE CONCLUSIONS

As the Workshop on the "Vision to the next 20-30 years" has shown, still more than in the past, PIARC should strengthen the links with the automotive industry in order for both sectors to understand their respective plans and constraints so that the necessary co-ordination can be established. In particular, in the next term(s), the Committee should keep track of the development of vehicle-based techniques for monitoring traffic/pavement interactions.

The Committee will have to keep managing the PIARC test tyre for skid resistance measurements, its availability and the stability of its characteristics.

The Committee has realized – namely after the International Seminar in Bamako – the need for more consideration to be given on how to monitor, manage and maintain the most common roads in the world, namely unpaved ones.

This, while still pursuing the reflection and exchange of experience regarding the development and use of advanced monitoring techniques (distress, cracking), pavement management methods and policies (friction, texture and evenness), acceptance methods and criteria and global condition indices for paved roads.

Regarding the significant, proven influence of road surface characteristics on traffic noise emission, PIARC should help to develop internationally comparable acoustic classifications of road surface materials and technologies, by exchanging experiences and data from the different countries. The Committee should think of the need and timeliness of integrating acoustic parameters in monitoring, management and maintenance of road pavements.