ROAD PAVEMENTS

29 September 2011 (morning and afternoon)

TECHNICAL COMMITTEE D2

INTRODUCTORY REPORT

CONTENTS

INTRODUCTION

In the PIARC 2008-2011 cycle, under the Strategic Theme D (Quality of Road Infrastructure), the committee D.2 “Road Pavements” was subdivided into three sub-committees:

D.2.a. Road surface characteristics
D.2.b Flexible and semi-rigid pavements
D.2.c Concrete pavements

The three sub-committees worked on five issues:

D.2.1 - Reducing construction time and cost;
D.2.2 - Improved maintenance methods;
D.2.3 - Road noise mitigation;
D.2.4 - Monitoring of innovations;
D.2.5 - Adaptation to climate change.

Each issue was under the responsibility of a working group with members from the three sub-committees. Each working group developed its working plan and products. Results are presented in technical reports.

Two sessions of the congress are organized by Technical Committee D2 on Thursday 29 September. In the morning, issues D.2.1 and D.2.2 will be discussed and issues D.2.3, D.2.4, D.2.5 in the afternoon.

This introductory report presents a summary of the work on each issue and some questions to stimulate discussion.

ISSUE 1: REDUCTION OF CONSTRUCTION TIME AND COST

Whatever be the type or size of a construction work, the same two questions always arise:

“How long will it take?” and
“How much will it cost?”

In most cases, the client is hoping to get an answer that ensures the shortest possible construction time and the lowest possible initial cost. The same is true for road authorities who want to build, rehabilitate or repair a pavement.

Construction time and construction cost, however, are often conflicting parameters. Achieving a shorter construction time may require extra craftsmen and machines which increases the cost of the project. On the other hand, the cheaper the work, the less performing the equipment and the less experienced the staff, which may be resulting in a longer execution time.

To tackle this problem, the following steps were covered:

- Inventory and analysis of traditional methods to reduce construction time and cost
- Definition of indicators or criteria to assess the strengths and weaknesses of these methods
- Analysis methods in the light of these indicators
- Collecting and reading the case studies, with identification and analysis of methods to reduce construction time and cost integrated in these cases
- Conclusions

In a first step, the examples collected related only to rigid pavements. Subsequently, cases of flexible pavement projects and works have been added to produce a comprehensive report by the D2 Committee.

Without going into details of the report on this issue, inventory methods have been divided into 3 categories:

- Tendering conditions
- Organization of the worksite
- Adequate technical choices related to:
    - general aspects
    - concrete pavements
    - asphalt pavements

The case studies that were analyzed show that the means put in place to move towards the goal of reducing construction time and cost are multiple, cumulative and cross following choices made by the authors of the project.

The main conclusions are as follows:

- Requirements to reduce construction time and cost can be different. In any case, it is better to speak of optimization, while retaining the goal of maintaining quality.
- The methods described and analyzed in the report to reduce construction cost and time should be handled with caution. It is the same with the systems bonuses/ penalties, which may lead insidiously to an unacceptable decline in the quality of the works.More than ever, project design should incorporate all the events across the lifespan, particularly with regard to environmental and economic impacts. To do this, tools such as Life Cycle Assessment - LCA or Life Cycle Cost Analysis - LCCA can be valuable, especially if the project is large.

Many questions remain unanswered and deserve no doubt more thoughts, thus:

1. Is it useful to prioritize the methods or means used to reduce cost and delay of a project to identify those most used?

2. If the LCA and LCCA approaches discussed above are very interesting, one wonders about their availability and their practical implementation?

3. What are the incompatibilities between the most frequent basic requirement of reducing cost and time and taking into account environmental constraints? What solutions are possible?

4. The performance specification tender procedure is becoming more popular with clients, especially because it gives more warranty to maintain the viability and therefore the feature of the works in the long term.

    - What are the essential contractual requirements that the owner or the contracting authority is obliged to impose, particularly on the duration of the warranty period or service levels?
    - Is this type of tender possible for smaller sites?
    - What precautions must be taken against a possible failure of the contractor?

ISSUE 2: IMPROVED MAINTENANCE METHODS

The definition of this issue includes two aspects, firstly the methods where recent improvements have been made and, secondly, the maintenance strategies.

The first aspect is essentially technical while the second focuses more on the maintenance management of pavements.

A large survey was undertaken first to learn about the situation of cement concrete pavements, and after to identify the situations where maintenance needs, with the will to improve the quality interventions, are most present.

It can be considered that 35 countries have responded and provided relevant information. The key product of the group that worked on this issue is a guide of best practices for maintenance of concrete pavements, JCPC slabs and conventional CRCP.

The report contains two main sections:
1. Description, analysis and assessment of damage encountered
2. Maintenance methods to repair

Each chapter contains three parts: the first covers all types of pavements, the second deals with concrete slab pavements (JCPC) and the third deals with continuously reinforced concrete (CRCP).

The report is complemented by the results of the investigation into the situation of concrete pavements and maintenance procedures associated with them.

What could be the conclusions for this issue 2 and what are the possible prospects?

The most useful and efficient maintenance methods of cement concrete pavements have been described. There is no doubt that improvements and interesting innovations have been made in recent years (eg lifting slabs before injection, surface treatment with resin-based products, CRCP repair). To keep up, a technology watch would be useful.

Besides the management strategies related to maintenance of roadways, there is an aspect more directly related to available techniques, which concerns the determination of the best criteria for moving from regular maintenance to rehabilitation, or reconstruction of a road pavement.

Regardless of the quality and effectiveness of maintenance practices, what data are relevant to consider in terms of cost, impact on traffic, environmental, economic, etc ... to justify the need for further maintenance operations or to guide the project towards a total renovation operation?

ISSUE 3: ROAD NOISE MITIGATION NOISE

The topic of noise mitigation was explored through a questionnaire and through the editing of a report. This latter was organized and edited by examining the conceptual framework for managing road noise, tire-pavement noise fundamentals (mechanisms, main systems which act as source, mechanisms complexity and practical needs), several practical solutions (asphalt rubber friction course, poroelastic road surface, porous asphalt– single-layer, porous asphalt– two-layer, stone mastic asphalt, thin and ultrathin surfacing, surface dressing, porous concrete, exposed aggregate concrete, drag textures, diamond grinding, longitudinal tining). Finally, national and multi-national quiet pavement initiatives (European and multi-national overview, United States Overview) were described.

Based on the analyses the following key conclusions can be drawn.

There are a number of national/international projects and research programs looking at reducing the physical impacts of environmental noise, developing innovative reduction measures and/or assessment schemes and/or reducing costs. There is a strong focus on source-related mitigation measures and an increasing emphasis on cost-effectiveness. Many solutions are proprietary products. It still remains crucial that knowledge and experiences are shared in order to permit that innovations and products developed for use within specific member states may be equally beneficial/valid for use in a wider area. Hence, there is the need for the standardization of components and acoustic labeling for helping towards achieving the selection of the appropriate products.

Due to the evolution of traffic spectrum, it becomes more and more relevant to include truck tire noise in mitigation research.

Application of the concept of sustainable development to road Infrastructure implies the opportunity of considering, in future projects, the combination of noise, air pollution and other environmental issues.

ISSUE 4: MONITORING OF INNOVATION

The fostering, evaluation and implementation of innovation in road design and construction was explored by examining the innovation policies implemented by agencies with a focus on practical examples and experience in order to assist countries in the development of existing policies or in the implementation of new strategies to foster innovation.

The purpose of the monitoring of innovations strategy was to review the recent changes in construction and maintenance of road pavements to identify where innovations have been introduced towards improving roadway durability, recycling and re-use. In addition, an assessment of the developments taking place in road administrations to foster innovation was completed.

A questionnaire on innovation needs was developed and circulated through the committee members to their respective countries. The purpose of the questionnaire was to develop an understanding of innovation needs that in the opinion of the country representatives were not being adequately addressed. The key questions asked in the survey were:

1. Does your country have a particular policy on innovation?
2. How are innovation needs defined and by whom?
3. Do you believe that it is necessary to foster innovation to address the following issues:
    i. Reducing availability of raw road building materials
    ii. Substitute products for bituminous binders
    iii. Adaptation to climate change
    iv. Environmental concerns and changing regulations
    v. Reduction of traffic disruption during road work
    vi. Performance levels
    vii. Innovation in calls for tender
    viii. Technology transfer

A total of 8 types of innovation policies were identified from the survey and the basic principles of innovation policies along with their advantages and disadvantages were summarized. It was found that innovation can 'pave the way' to making our engineers and contractors competitive on the world market while cost-effectively extending the service life of our transportation infrastructure while minimizing the impact of construction on the road users. By fostering collaboration between government agencies, industry and academia, it is possible to 'partner' to develop new policies, processes, and procedures to reduce time and cost and improve the safety of our infrastructure. While innovation ultimately leads to a benefit, which can include a reduction in cost, it is important to recognize that an investment in innovation is necessary to achieve the ultimate benefits. This typically requires some basic fundamental research and partners who are willing to take risks to develop the innovation. These risks can be financial, technological and commercial.

When evaluating an innovation, it should be recognized that there is a variety of procedures for introducing an innovation and each may have its own benefits and risks. The alternatives presented provide a basis evolution of the phases to incorporate innovative policy, design and construction techniques and procedures into an agency's procurement and delivery process for transportation infrastructure.

ISSUE 5: ADAPTATION TO CLIMATE CHANGE

The majority of the scientific community is in agreement that increasing atmospheric concentrations of carbon dioxide and other greenhouse gases as a direct result of human activity is causing a global change in climate. Between 1906 and 2005, the global average near-surface air temperature increased by 0.74°C. It is expected that global average near-surface air temperature will further increase in the years to come, despite efforts to reduce greenhouse gas emissions through mitigation actions.

Climate change is highly likely and almost certain to result in reduced ice and snow coverage, changes in freeze-thaw cycles, rising sea levels, more frequent and intense storms, with rises in average surface temperature and more severe heat waves and prolonged droughts, directly impacting the performance of our infrastructure, depending on its location.

Climate change can have a direct impact on the performance of our transportation infrastructure. More frequent and intense rainfalls in certain parts of the world may result in flooding and higher groundwater levels, which in turn may lead to erosion, slope instability and reduced structural strength and bearing capacity of road structures. In other parts of the world, the structural strength of road structures may also decrease as a result of thawing of permafrost. Yet in other locations, roads may become exposed to higher incidence of freeze-thaw cycling which will accelerate pavement deterioration, which results in increased maintenance costs. Conversely, increases in the ambient temperature may cause bituminous-bound materials to become susceptible to permanent deformation in the form of rutting. In the years to come, climate change will impact the way roads are planned, designed, constructed, operated and maintained.

Committee D.2 on Road Pavements produced a document to sensitise the road sector to the likely impacts of climate change on road pavements and to provide guidance on how to go about:

1. Assessing the vulnerability of road pavements to the direct impacts of climate change, and;
2. Identifying and prioritising possible adaptation measures for road pavements that could be applied immediately or phased in over time, so as to avert the negative consequences of climate change on the serviceability of road networks.

In order to better understand the vulnerability of road pavements to the direct impacts of climate change, and to assess the degree of concern and level of readiness of the roads sector, a questionnaire was sent to committee members. Based on the responses received from 21 countries, it became clear that most countries were concerned about the levels of precipitation, where increased levels could cause flooding and impact on the structural integrity of pavements (and may necessitate the imposition of load restrictions), and decreased levels of precipitation could dry out the subgrade impacting on the overall durability of the pavement. Most coastal countries raised concern about rising sea levels which, when combined with storm surges, could lead to flooding and therefore also road closures. The likely increase in road closures as a consequence of land slides caused by higher precipitation levels was also raised. Several countries expressed concern about an increased frequency in the number of freeze-thaw cycles, leading to frost heave, cracking and potholing. With regard to increased temperatures, several countries, including those with cold winter conditions, raised concern about increased potential for rutting and bleeding in bituminous-bound pavement layers during summer.

In the report, guidance is provided on how to conduct risk and vulnerability assessments, and on how to deal with the effects of climate change on road pavements.

REPORTS

The Committee D.2 has produced documents on the following five topics:

D.2.1 Reduction of delay and construction costs
D.2.1 Improved maintenance methods
D.2.1 Road noise mitigation
D.2.1 Monitoring of innovation
D.2.1 Adaption to climate change.