

GEOTECHNICS AND UNPAVED ROADS

30 September 2011 [morning]

TECHNICAL COMMITTEE D4 GEOTECHNICS AND UNPAVED ROADS

INTRODUCTORY REPORT

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1. ABSTRACT

Technical Committee D4 forms part of the Strategic Theme D – *Quality of road infrastructure* – which aims to improve the quality of road infrastructure through effective management of road assets and in line with the expectations of end-users and management requirements. For the session 2008-2011, the committee's name was changed to “Geotechnics and Unpaved Roads” to clarify the scope of this committee which consists primarily of geotechnical engineers working for road authorities, research centres, universities and consulting firms.

At the beginning of each 4-year session PIARC defines terms of reference to guide the work of each technical committee. For the session 2008-2011, the terms of reference of TC D4 comprised three themes:

- Theme 4.1: Innovations in processing and use of local materials.
- Theme 4.2: Innovations in construction and maintenance of unpaved roads in developing countries.
- Theme 4.3: Adaptation to Climate Change

This introductory report presents the work plan followed by TC D4 to address these three themes.

2. COMMITTEE MEMBERS WHO HAVE CONTRIBUTED

The following members contributed to the writing of this introductory report:

Martin Samson, Canada
Bernard Dethy, Belgium
Guy Raoul, France
Aurele Parriaux, Switzerland

Moreover, the members listed below have contributed to the work of one or other of the themes addressed by Technical Committee D4. Their valuable contributions have enabled us to present this technical session at the World Congress.

Martin Samson	Canada	Chair
Jean-Claude Auriol	France	French-speaking secretary
Alex Kidd	UK	English-speaking secretary
Paul Garnica Anguas	Mexico	Spanish-speaking secretary
Bernard Dethy	Belgium	Co-leader of theme 4.1
Guy Raoul	France	Co-leader of theme 4.1
David Tele Olodo	Benin	Responsible for theme 4.2
Aurele Parriaux	Switzerland	Responsible for theme 4.3.
Youssouf Berthe	Mali	Member
Enrique Garcia Dapena	Spain	Member
Vitezslav Herle	Czech Republic	Member
Dirk Heyer	Germany	Member
Adamou Idi	Burkina Faso	Member

Amede Kouakou	Ivory Coast	Member
Otto Leibniz	Austria	Corresponding Member
Ahmed Mansourian	Iran	Member
Anastasios Mouratidis	Greece	Member
Lovisa Moritz	Sweden	Corresponding Member
Ana Petkovsek	Slovenia	Independent Contributor
Fabrizio Russo	Italy	Member
Eleni Sakoumpenta	Greece	Member
Jose Luis Rodriguez	Spain	Member
Francois Tollo	Benin	Member
Katarina Zgutova	Slovakia	Corresponding Member

3. ISSUES

As previously mentioned the terms of reference of Technical Committee D4 for 2008-2011 comprised the following three themes:

- Theme 4.1: Innovations in processing and use of local materials
- Theme 4.2: Innovations in construction and maintenance of unpaved roads in developing countries
- Theme 4.3: Adaptation to Climate Change

Theme 4.1 follows logical continuation of a theme discussed during the previous section. Indeed, the technical committee 4.5 [2004-2007] produced a report promoting the optimal use of local materials [Promoting optimal use of local materials, Ref PIARC 2007R9]. Where the previous report stopped at demonstrating that re-use of local material was beneficial in several aspects including environmental and financial, the work of this session illustrated how the re-use of local materials can be maximised. Particular attention was paid to innovative techniques but also to proven methods that can be put into practice despite limited resources and equipment, which is relevant for developing countries. This theme was the subject of a well-appreciated seminar held in Iasi [Romania] in June 2007.

In addition, the committee had participated in October 2005 at the 1st symposium on earthworks in Europe held in Paris as part of the TREMTI congress. Several of the topics [soil treatment, climate change etc.] were very relevant for our technical committee. A second conference was held in London in 2009 with technical Committee D4 being strongly represented and members made a number of presentations.

The second theme [4.2] illustrates expansion of the scope of Technical Committee D4. This is a new theme for the committee and represented an ideal subject for a technical seminar to be held in a developing country. The theme considers not only construction techniques but also maintenance of unpaved roads. This subject provides an ideal opportunity to discuss all of those commercial products offered to treat pavement materials.

The third theme [4.3] was also discussed during the previous session. However, the objective was to identify climate change impacts on road works, including earthworks and drainage. The report produced by Technical Committee D4 [Anticipating the effects of climate change on road earthworks, Ref. PIARC 2008R12] concluded with reflections on proactive adaptation to climate change for works. The new issue on adaptation to climate change naturally follows the work of the previous session. One element previously noted was that few road authorities seemed to have procedures in place for adaptation to climate change.

4. WORK PROGRAMME

4.1 Theme 4.1: Innovations in processing and use of local materials

During the 2008-2011 session, Technical Committee D4 undertook to improve their knowledge on the topic of optimal use of materials found on the site of road projects. This is a recurring problem that the technical reports from previous sessions had already highlighted.

This theme is a permanent challenge for earthworks and a measure of ongoing progress in the construction of earthworks. The use of locally available material on the site of a road project is still both an economic objective and a priority for enhancing sustainable development.

The impact of earthworks is critical to the cost-effectiveness of projects at all levels within the fill up to the lower pavement foundation layers, which may involve some form of treatment. Material which is won locally helps to optimize the earth-moving and the design of pavement structures, in effect minimising the transport movements required for construction. This constitutes a fundamental contribution to protection of the environment. Materials from external quarries may then be reserved for higher quality uses in the pavement layers, especially when such resources are becoming scarce for reasons of exhaustion or environmental constraints.

Greatest progress can be made when considering the use of local marginal natural materials encountered when developing road projects. These are the most difficult materials to re-use, without technical specifications in the majority of countries. When recovery is possible, they provide new resources for the project which may become essential to the economy of certain countries.

The issue of local marginal materials demands an innovative approach, modified technical specifications and new techniques developed from experience. It is this area where TC D4 wanted to extend and expand knowledge through exchanges between member countries using a survey undertaken for this purpose.

The survey objectives were:

- To produce a wide-ranging and well-documented inventory of natural marginal materials locally encountered in the different member countries;
- To share technical solutions, planned or implemented for use and/or improvement of these materials;
- To share feedback and innovation;
- To discuss methods and specifications applied to this type of material;
- To define how to understand and manage the risks;
- To highlight innovative techniques and methods both used and planned;
- To identify performance and the means of measuring it.

The survey was launched on 21 November 2008 and continued for two years. Finally, responses were collected and compiled from 21 countries. Responses were received from the following countries, listed by continents:

Europe: Austria, Belgium, Czech Republic, France, Germany, Greece, Italy, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

Africa: Benin, Ivory Coast and Mali.

America: Bolivia, Brazil, Canada and Mexico.

Asia: Iran.

The summary report on this subject will be published shortly.

4.2 Theme 4.2: Innovations in construction and maintenance of unpaved roads in developing countries

The committee chose to address this theme by organising an international seminar in an African country particularly concerned with the issue of development and maintenance of unpaved roads.

The seminar was held on 29-31 October 2009 at the Palais des Congrès in Cotonou, Benin. It was attended by over 100 African participants from Benin, Burkina Faso, Senegal, Togo and Ivory Coast. Also in attendance at the seminar were 10 members of TC D4, deputy secretary general of PIARC, 2 European experts and a delegation from Haiti.

The theme of this seminar was: “1st International Seminar on Geotechnics and Unpaved Roads”. Three themes were discussed:

- Theme 1: Challenges and recent developments in engineering design and construction of unpaved roads
- Theme 2: Maintenance of geotechnical and unpaved roads
- Theme 3: Innovations and Research

Twenty papers were presented and are available on the PIARC website at the following address:

<http://publications.piarc.org/fr/seminaires/seminaires09/cotonou-octobre09.htm>.

The main conclusions from this seminar will be presented during the technical session of D4 committee.

4.3 Theme 4.3 : Adaptation to Climate Change

This topic was discussed during the previous session and was the subject of a report entitled “Anticipating the effects of climate change on road earthworks” [Ref PIARC 2008R12]. For this first report, the objective was to identify climate change impacts on road works including earthworks and drainage. It concluded by reflecting on proactive adaptation to works due to climate change. TC D4 wished to continue its work on this theme by drawing more on the anticipated effects of climate change by region and the probable events. This will be written from the perspective of a better understanding of the phenomena and their impacts which will enable us to be better prepared and better able to adapt works to these changing conditions.

The report prepared on this topic includes two parts:

Part I: Illustration of the main climatic effects expected with regard to geomorphological conditions of the Earth.

It will be shown by using world maps that climate change is distributed widely and different regions of the globe will be able to identify the major effects. Relief maps, in particular those for coastal plains and slopes are cross-referenced to the climatic maps. On these maps, sites are shown which are described in detail in Part II.

Part II: Types of situation demonstrated by detailed case studies.

The action of the phenomena is described for these sites and fully illustrated. For each case, both the negative and positive effects are considered for geotechnical structures. Options are also given to minimise the negative effects, in part taken from the previous report of TC 4.5. General reminders are given about the uncertainty of the prognosis.

A summary report on this theme will be published shortly.

5. ORGANISATION OF THE MEETING OF TECHNICAL COMMITTEE D4

5.1 Presentation of the work of Technical Committee D4

The organisation of the technical committee D4 meeting will revolve around the three themes discussed during the session which has now ended. Each of the theme leaders will first present the work of the committee then individual papers will be presented connected to the main theme. This will be followed by questions and discussions on the theme.

5.2 Individual Contributions

Technical Committee D4 launched a call for papers in February 2010 on two of the three themes discussed during the session. For the theme on “Innovations in processing and use of local marginal materials” the technical committee D4 solicited papers on feedback [in works, in trials, etc.] on the use of materials which had one or more of the following characteristics:

- Changeable or fragmentable;
- Containing particular elements [sulfates, sulphides, organic matter, etc.];
- Too wet or too dry;
- High clay content
- Homometric, ill-structured or with an unstable matrix.

For the theme “Innovations in construction and maintenance of unpaved roads in developing countries”, technical committee D4 solicited papers dealing specifically with unpaved roads, in relation to:

- The use of the HIMO technique [labour-intensive work];
- Improvement of local materials;
- The development of new techniques for construction and maintenance.

In response to this call for papers 35 abstracts were received and reviewed by the committee. Three communications on the theme of innovations in the use and treatment of local marginal materials and two others on the theme of unpaved roads were chosen for a presentation during the technical session because of their particular relevance to the topic.

5.3 Exchanges

Technical Committee D4 strongly encourages participation of delegates during the question and discussion period. These exchanges are the essence of the work of PIARC.

6. REFERENCES

- Promoting the optimal use of local materials, Ref. PIARC:2007R09;
- Anticipating the effects of climate change on road earthworks, Ref. PIARC:2008R12.

7. PRELIMINARY FINDINGS

The following conclusions can be drawn from the work of technical committee D4 on the three themes discussed during the course of the session 2008-2011:

On the theme 4.1 : Innovations in the use and treatment of local materials:

- The enquiry launched by Technical Committee D4 has identified families of the materials considered as marginal by the majority of countries consulted.
- The materials which are most commonly found, especially in Europe, are changeable materials such as argillaceous rocks and those materials composed of particular detrimental elements such as sulfates, sulphides and organic matter. The use of these materials in earthworks is generally possible with specific treatment if necessary and implementation through specific construction measures. Their use in selected earthworks, PST or foundation layers which requires treatment with binders is very difficult.
- The work of this session highlighted technical advances which will enable progress in the use of the potential resources available from marginal materials and control the likely project risks.
- The problematic use of certain types of marginal materials will depend upon their improvement. Further exchanges between member countries during the session 2012-2015 will prove very useful to improve knowledge of certain of the families listed in the present report, based upon feedback and experience. Changeable materials and above all those containing adverse elements are those which carry the greatest geotechnical risks. Improvements are still required in order to identify the adverse elements [especially if they are present in small amounts] by identification, specific tests, etc.
- The use of lateritic materials or replacement materials, a critical economic subject, needs to be fully understood.
- The use of certain materials, too dry or too wet links to the theme of adaptation to climate change and merits new studies and research.

On the theme 4.2 Innovations in the construction and maintenance of unpaved roads in developing countries.

- The most common road materials in Africa and South America are lateritic gravels but they are becoming more and more rare along the principal routes. This lack of good quality road materials leads to :
 - Increase in the costs of construction and maintenance;
 - Need to undertake a survey of the available resources [based on available information] and, in consequence, the need for better collaboration between the various institutions who possess this information;
 - Necessity to promote research into the treatment of local materials.

- The question of drainage remains a dominant factor.
- The lack of regular maintenance on unpaved roads has severe long-term consequences.
- It is necessary to have a good programme of works supported by knowledge of the network.
- It is necessary to pay attention to imported techniques and products; certain of these are totally ineffective in the long term. It is necessary to use them in appropriate areas and in the optimum conditions?
- The method HIMO is available throughout, it is efficient and beneficial from several points of view but requires good management of the works in order to avoid creating other socio-economic problems and should be applied to the right projects.

On the theme 4.3: Adaptation to Climate Change

- Despite the global consensus on the reality of climate change, there are still many road administrations who are little concerned about the impact that climate change will have on their infrastructure;
- It seems that the majority of countries who are preoccupied with the effects of climate change are still developing a strategy against this reality but are yet to take concrete actions.
- In the abundant literature on climate change, it is difficult to find elements specific to road construction. The socio-economic domain has need of practical recommendations for construction of safe and durable roads as well as adapting existing roads to new conditions.
- It is very important to realise that local conditions need to be taken into account and that these can differ notably in the higher altitudes.