

C 4.5 EARTHWORKS, DRAINAGE AND SUBGRADE

Recommendations to Decision makers

Promoting optimal use of local materials

Identifying progress in terms of soil and rocky materials treatment for road applications

- Large development in soil treatment techniques in developed countries over the two last decades. Nevertheless, too many developing countries don't have access to these techniques (cost, lack of binders, lack of adapted equipment etc.)
- Technical guidelines elaboration in the developed countries, for soil treatment, accepted by owners, contract managers, contractors, binders producers etc.
- Need to integrate soil treatment in a sustainable development approach, by taking into account positive aspects (granular materials saving, increasing the use of available materials in the project, limitations on dumping of natural materials...) but also limiting aspects such as energy expenditure and greenhouse gas emissions.
- Elaborate and develop reliable techniques for soil treatment in developing countries. These techniques must be based on a high use of local manpower and simple equipment, instead of heavy, imported equipment for punctual use.

Identifying progress in the use of wastes and industrial by-products as earthwork materials

- High variability of waste and industrial by-products used as road materials. If the use of such materials is common in developed countries, it remains marginal in numerous other countries.
- Two opposing policies are observed: promoting the use of such materials (in France for example) in spite of potential environmental risks and, on the other hand, a rigorous application of the precautionary principle and, thus, systematic dumping (Switzerland for example).
- The nature of industrial by-products used as road materials is governed by local industrial conditions. Except particular cases, there is no or very little importation or exportation of these materials.
- If the impact on environment is a widely recognized concern, it must be addressed more thoroughly.
- Need to set up a quality and following policy for use of these materials.
- For the proper use of these materials both geotechnical and environmental aspects need to be taken into account.

Having indicators representative of the condition of geotechnical structures for road asset management

- A particular focus should be on obtaining good cost, safety and reliability data for asset management regimes operating a 'reactive' approach and those operating a 'pro-active' approach. This would inform the decision to adopt a particular asset management strategy.

- The effective and consistent valuation of geotechnical assets should be explored.

Technical aspects

Promoting optimal use of local materials

Identifying progress in terms of soil and rocky materials treatment for road applications

- Important progress in the design and availability of specialized equipment for soil treatment.
- Develop the understanding of physical, chemical reactions during settings of binders in soil treatment, in order to optimize its effect and durability.
- Improve the adaptation of soil treatment to marginal materials or materials not compliant with specifications, in order to increase their use in earthworks.
- Develop specific road binders or specific methods in order to limit or eliminate the negative effect of disturbing elements (chemical or mineralogical) contained by some soils.
- Climatic changes foreseeable at short and medium term makes it essential to establish reliable methods, equipment and products to ensure placing too dry soils for right compaction as embankment complying with the technical and environmental aspects and without excessive need for local fresh water which is lacking at this time.

Identifying progress in the use of wastes and industrial by-products as earthwork materials

- The destination of these materials is quite similar in the different countries; very often in embankments and sometimes in capping layers or as substitution materials.
- Need to improve the use of these materials thanks to specific platforms for a suitable elaboration to control geotechnical and environmental characteristics.
- For the proper use of these materials both geotechnical and environmental aspects need to be taken into account.
- Great interest to adapt and develop specific tests in order to characterize these materials from both geotechnical and environmental points of view. It appears that the conventional tests used for natural soils are not always adapted to the specificity of wastes and by-products.

Having indicators representative of the condition of geotechnical structures for road asset management

- The effective and consistent valuation of geotechnical assets should be explored.
- The work highlighted that a coherent framework is needed for the evaluation of different types of assets. In particular, areas of whole life costing, risk management and value management should be integrated. This would enable assets with a low frequency of failure but a high impact on the network (such as geotechnical or

structures assets), to be compared in terms of risk and value with assets such as pavements that have a high frequency of failure but a relatively low consequence.

Recommendations to PIARC

Promoting optimal use of local materials

Identifying progress in terms of soil and rocky materials treatment for road applications

- Promote the development of reliable techniques for soil treatment in developing countries. These techniques must be based on a high use of local manpower and simple equipment, instead of heavy, imported equipment for punctual use.

Identifying progress in the use of wastes and industrial by-products as earthwork materials

- Well-adapted general legislation (national, European) for countries involved in the development of the use of such materials, even if a need for technical guidelines appears clearly in order to define more precisely the conditions of use.
- If the impact on the environment is a widely recognized concern, it must be addressed more thoroughly.
- Need to improve the use of these materials thanks to specific platforms for a suitable elaboration to control geotechnical and environmental characteristics.
- Need to set up a quality and monitoring policy for use of these materials.
- Great interest to adapt and develop specific tests in order to characterize these materials from both geotechnical and environmental points of view. It appears that the conventional tests used for natural soils are not always adapted to the specificity of wastes and by-products.

Having indicators representative of the condition of geotechnical structures for road asset management

- Consideration should be given by PIARC to extending the current study to look more widely at performance indicators adopted world wide by operators of other infrastructure systems such as flood defences, dams and railways.
- The specific evaluation of the particular merits of the different indicators was outside the scope of the current work but is an area for future potential activity.
- A pro-active asset management approach requires good quality, interoperable data. International work in this area is currently being undertaken and should be supported by PIARC to aid the implementation of geotechnical asset management systems.
- The work highlighted that a coherent framework is needed for the evaluation of different types of assets. In particular, areas of whole life costing, risk management and value management should be integrated. This would enable assets with a low frequency of failure but a high impact on the network (such as geotechnical or structures assets), to be compared in terms of risk and value with assets such as pavements that have a high frequency of failure but a relatively low consequence.