



**XXIV<sup>th</sup> World  
Road Congress  
Mexico 2011**  
Mexico City 2011.

# **Maintenance and Rehabilitation Methods for Concrete Pavement - Results of a Survey by PIARC**

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Federal Highway Research Institute



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2. The World Road Network in General and the Proportion of Concrete Pavement
3. The Best Practice Guide  
„Maintenance of Concrete Pavement“
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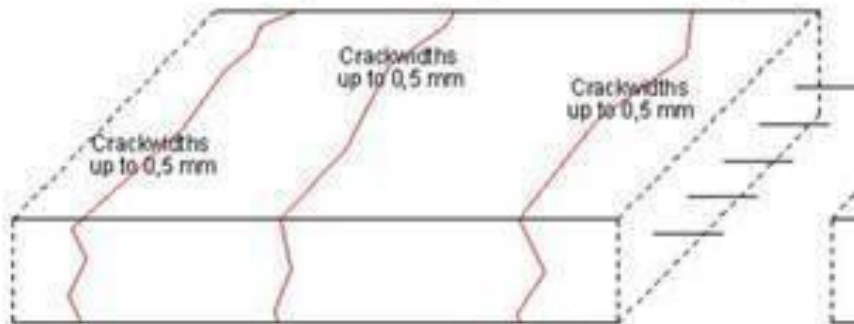
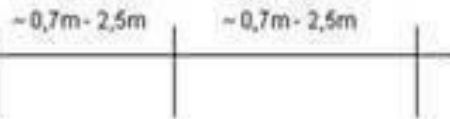
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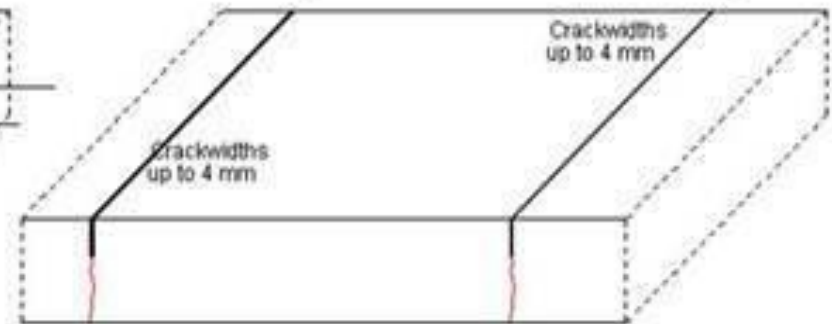
## Concrete Pavement



**Continuously Reinforced  
Concrete Pavement  
(CRCP)**



**Jointed Plain  
Concrete Pavement  
(JPCP)**





PIARC Technical (Sub-)Committee D2c,  
Issue 2: “Maintenance of Concrete Pavement”

- How many paved roads world wide?
- How many concrete pavement?
- Which types of construction in use?
- How long is the service life?
- Which type of maintenance and rehabilitation in use?
- How long are the maintenance intervals?

**=> Best Practice Guide for Maintenance of Concrete Pavement**

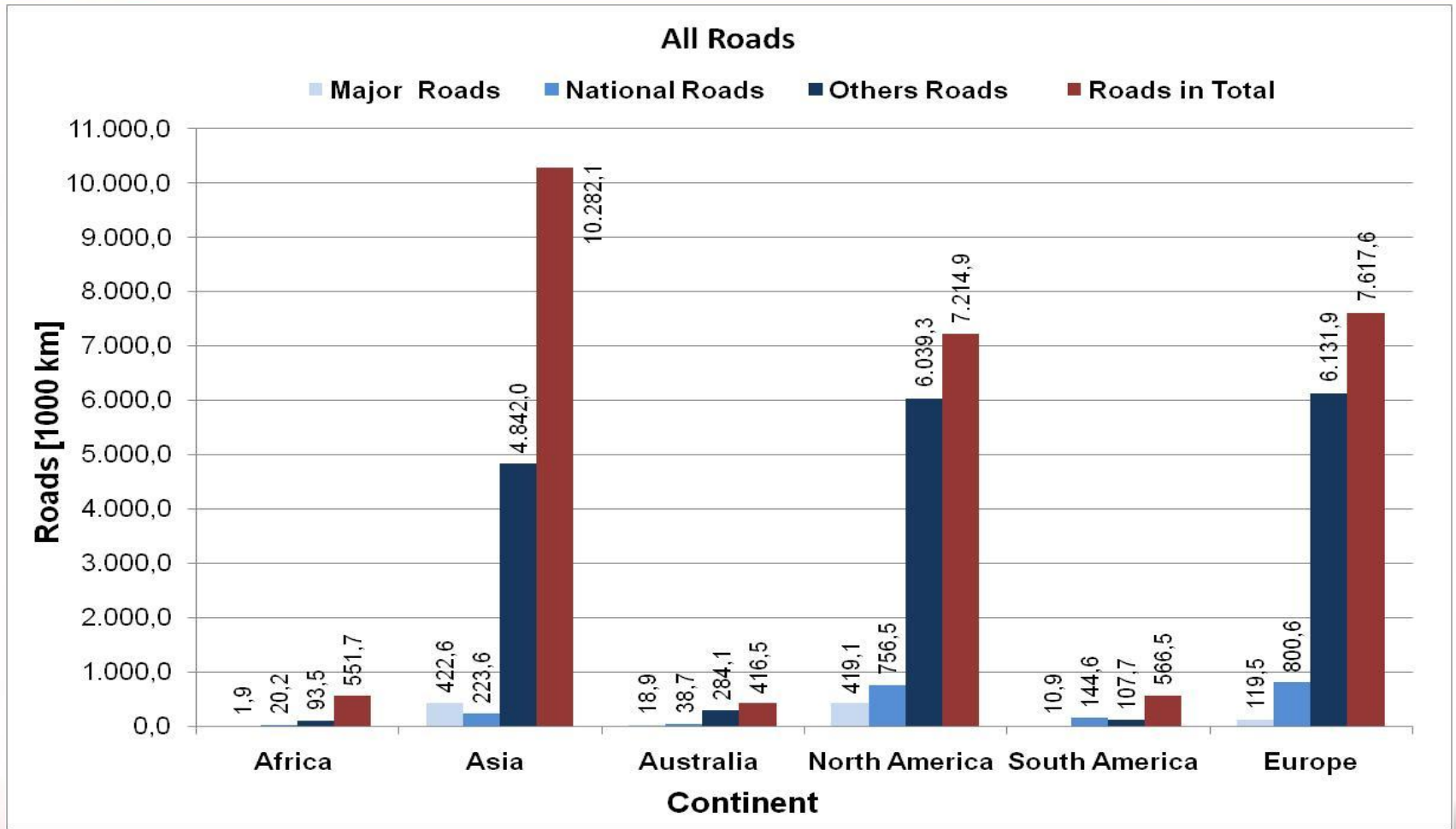


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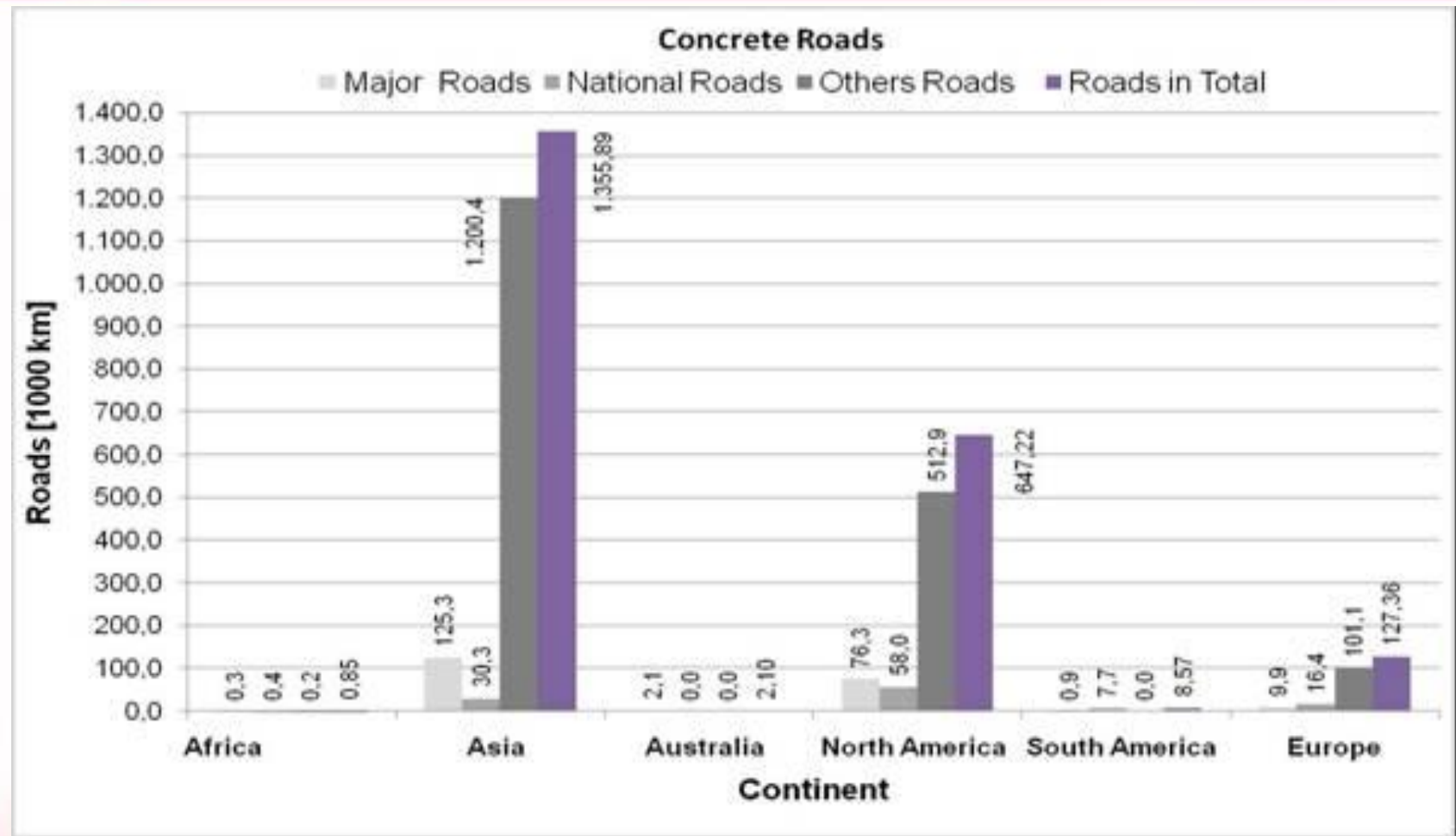
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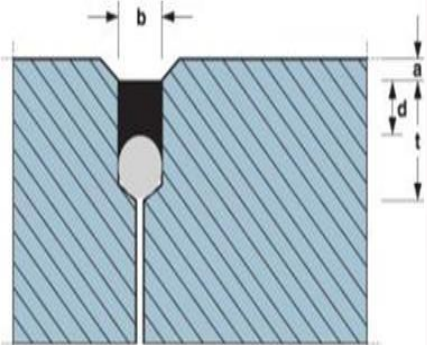


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Repair and renewal  
of joint fillers  
(20 Countries)



Widening and  
filling of cracks  
(19 Countries)



Repair of edge damage  
and broken-off corners  
(14 Countries)

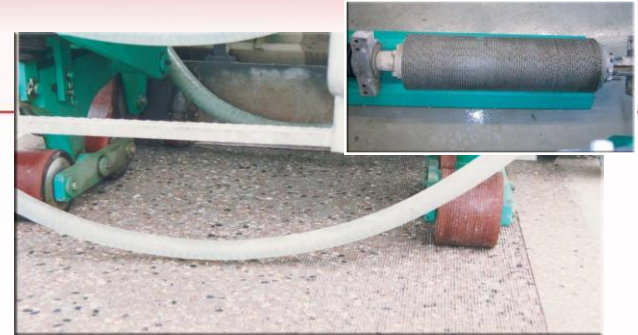




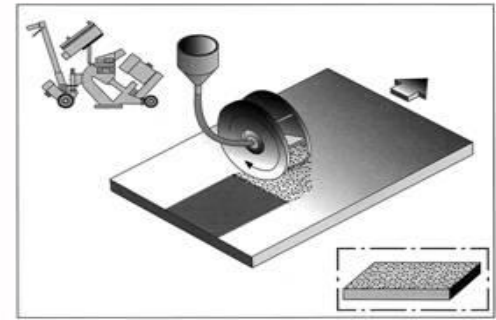
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Diamond grinding  
(14 Countries)

Diamond grooving  
(9 Countries)



Jet blasting  
(5 Countries)



Coating with  
Reactive resin  
(6 Countries)  
and  
Reactive resin mortar  
(3 Countries)





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Vertical re-alignment  
of slabs  
(10 Countries)



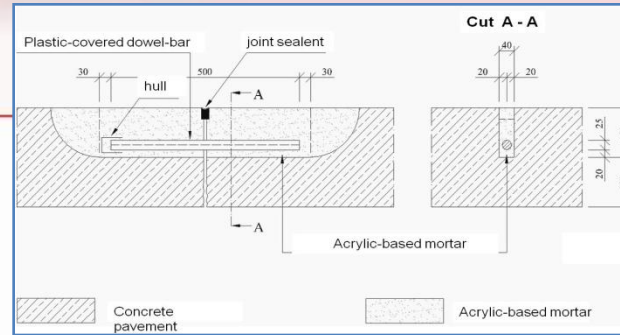
Renewal  
of single lanes  
(11 Countries)



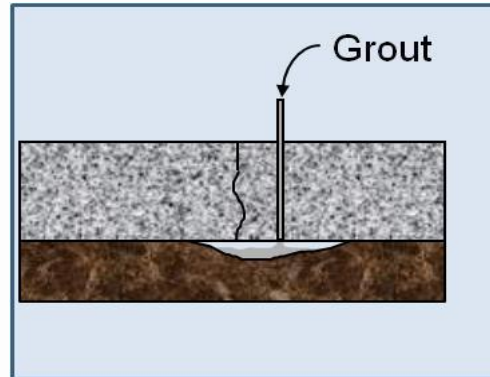


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**Subsequent doweling and  
stitching/tie-ing  
of joints and cracks  
(13 Countries)**



**Stabilising of slabs  
(16 Countries)**



**Replacement of single slabs  
(17 Countries)**



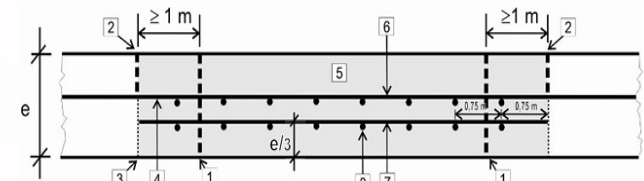


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**White topping  
(12 Countries)**



**Punch out  
(6 Countries)**



- 1 Saw cut over full depth
- 2 Saw cut 5 cm
- 3 Removal of the concrete - sound vertical face
- 4 Keeping in place of the reinforcement steel over 1 m
- 5 Broken up concrete
- 6 New reinforcement steel - tied splice over 1 m
- 7 Extra reinforcement steel in lower third part of the pavement
- 8 Transverse reinforcement



# PIARC - Manual: Best Practice Guide

## For Maintenance of Jointed Plain Concrete Pavements (JPCP) and Continuously Reinforced Concrete Pavements (CRCP)

PIARC-Working Group D2c

June 2011



Technical Committee D2-c Concrete Roads  
Issue 2: Improved Maintenance Methods

### Case study

#### REHABILITATION OF CRCP WITH HIGH EARLY STRENGTH CONCRETE ON THE SCHOEMANN FREEWAY IN SOUTH AFRICA

Authors: **Ismaele Costa**  
**David Perrine**

In the year 1986/88 the Ben Schoeman freeway was built as a Continuously Reinforced Concrete Pavement (CRCP). It is the main corridor connecting Johannesburg and Pretoria and for the national economy of great importance. The CRCP performed very well during the past 10 years. However, during the last few years the number of punchout failures occurring on the pavement has been on the increase, mainly due to water ingress through the joints. With the Average Annual Daily Traffic bordering on 100000 on one section of the freeway, appropriate activities on the freeway, even during weekends, impacts severely on the traffic. Concrete repairs on a CRCP make it even



#### Literature Review

The existing *spitbook* on the Schoeman freeway had to be quickly and carefully repaired. To avoid major traffic back-up, the rehabilitation had to be done in a night shift from 21:00 p.m. to 05:00 a.m. The only solution could be high early strength concrete. Whether this has never been attempted in South Africa. Therefore, never revealed that it is being done in North America about recently. It

was found that the mix design has to meet the following requirements: before opening to traffic: flexural strength and compressive strength 2.1 MPa and 20 MPa and a high shrinkage value. Furthermore all materials had to be available in South Africa and the workability had to be guaranteed. 7 mix designs were found to be suitable.

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### Case study

#### Full Depth Replacement of Concrete Panels with Rapid Strength Concrete in California

Authors: **B. Ben, B. Finzer, B. Ben, T. Omer, Perrine, Jr., Long Beach, CA, USA, T. P. Chow, Concrete Department of Transportation, Sacramento, CA, USA, E. Johnson, Roads Engineering, El Segundo, CA, USA**

During the past decade rapid strength concrete (RSC) has been extensively used in California for rehabilitation and improvement of highways, city streets, and airfields, where acceleration of construction was a concern. The required rate of strength gain, the prime constructability consideration for specification of RSC, is defined by the minimum strength required for opening lanes to traffic within the planned closing time. Most frequently technical specifications require that prior to opening lanes to traffic RSC achieves a minimum flexural strength of 2.8 MPa (400 psi). When work is performed during short time lane closures allowing for curing of the last laid placed into pavement within 1 to 4 hours, contractors have been frequently using the following two types of RSC: RSC with calcium sulfoaluminate rapid hardening cement (ASTM C1600) - for maximum duration of curing of 1 to 2.5 hours; or RSC with Type III high early strength Portland cement (ASTM C150) and non-phosphoric accelerator of hardening (additive rate of accelerator of hardening based on its dry weight is approx. 0.01 to 0.03) by weight of Portland cement - for maximum duration of curing of 2.5 to 4 hours plus. The project description below explains typical scope and sequence of work performed during full depth replacement of individual slabs.



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Authors: **Ismaele Costa**  
**David Perrine**

### Results of the survey on maintenance of concrete roads

A survey on the maintenance of concrete roads was conducted by the committee D2 "Road Pavement" / Subcommittee D2c "Concrete Roads" in 2009 - 2011. The aim of the survey was to determine in which countries and to what extent concrete roads exist and which maintenance measures are being applied.

In order to obtain an overview, the total length of the network of paved roads worldwide needed to be established. Three road categories were specified: major roads (highways, interstate highways, national roads, federal roads, rural roads...) and other roads (district roads, village roads). Furthermore, the total length of which proportion concrete roads represented, and which type of construction had been used, were to be determined. Thereafter, the type of status assessment, maintenance measures and the intervals at which these measures were carried out were determined. Finally, financial and time aspects of new construction and maintenance were discussed.

With these points, a questionnaire was prepared and sent out worldwide. 35 countries participated, including in Europe, Belgium, Germany, Bulgaria, Estonia, Greece, Great Britain, Ireland, Italy, Lithuania, Luxembourg, Norway, Austria, Poland, Portugal, Romania, Russian Federation, Sweden, Spain, the Czech Republic, Hungary, Serbia and Slovenia.

In North America, Canada, Mexico and the USA participated, which is the whole North American continent. From South America, Argentina, Brazil, Chile and El Salvador participated. From Africa, there was feedback from Morocco, Namibia and South Africa. In Asia, China and South Korea participated in the survey. Finally, there was a response from Australia. With these 35 of the 207 countries in the world, 96% of the world's land area was involved in the survey. To account for the remaining countries, the reference book *Elmer* [1], [2] and two internet sites were referred to [3], [4] and relevant data was pursued. It was established that in total, there are 26.6 million kilometres of paved roads, including 2.1 million kilometres of concrete roads.

#### Paved roads worldwide

Of the 26.6 million kilometres of paved roads, 10.3 million kilometres are in Asia, 7.8 million kilometres in Europe and 7.2 million kilometres in North America. This is followed by South America with 0.8 million kilometres, Africa with 0.6 million kilometres and Australia with 0.4 million kilometres. When considering only the major road network (highways or interstate

highways), most are located in Asia, North America and Europe. 422.6 thousand kilometres, 419.1 thousand kilometres and 119.5 thousand kilometres respectively, in Asia, South America and Africa, there are considerably less, respectively 18.9 thousand kilometres, 10.8 thousand kilometres and 1.9 thousand kilometres. Table 1 shows all road

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## **Best Practice Guide for Maintenance of Concrete Pavement**

- Available on the PIARC-Webside in English, French and Spanish
- Worldwide the same Knowledge about Maintenance for Concrete Roads
- High Quality Maintenance everywhere possible
- The need for Update of the Best Practice Guide in a view Years
  - New materials or technologies can be considered, e.g. Precasted Concrete Slabs



**Thank You  
for Your  
Kind  
Attention!**

