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Over Ten Years of Experience in Germany and Scandinavia with Bituminous-Bounded Bedding Layer as an Improvement for CBP

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Note: The following is the notation used in this paper: (,) for decimals and (.) for thousands.

Summary
More than 70% of all damage in unbound paving construction with concrete paving stones results from the influence of water in the road construction. The bound construction method with quality control sufficiently performed offers solutions. However, it is much more expensive. An alternative is the flexible bound construction method such as the ECOPREC-construction method which normally is performed by the same construction steps like the unbound construction method and also uses available customary building materials. The experience gained with this construction method in Scandinavia and in Germany for over more than 10 years is the topic of this paper.

Keywords: bitumen setting bed, construction methods

Introduction

Concrete paving stones and the related paving construction methods are known worldwide for road construction. Additionally, concrete paving stones are used in many shapes and colors for the garden and landscaping. However, the unbound and the bound paving construction method with concrete stones have limits for certain applications and construction technical requirements. Load capacity, water permeability or thermal load and insufficient flexibility often are limited requirements for a free of damage concrete paving surface for long-term period. Especially, if water seeps into the construction more or less permanent, often this results in heavy damage in the paving surface already after a few years. Upon opinion of many specialists more than 70% of all damage in paving surfaces results from the influence of water in the road construction.

Against this background, which we can see worldwide, in the beginning of the 21st century SF-Kooperation accepted the task to develop a new construction method which kind of is a synthesis of the unbound and bound construction methods, so called semi-flexible.

During the 9th Conference on Concrete Block Pavement in Buenos Aires 2009, basics of this ECOPREC®-Construction Method were presented with a bituminous bound bedding and / or joint material. Here diverse pre-work in reference to this development were pointed out e.g. Masao Inuzuka [1] [2], Sudip L. Adhikari [3] [4] or tests of ICPI [5], as well as the approach for the development of the construction method with the brand name ECOPREC® [6]. Much practical experience was not part of the presentation at that time.

Damage Mechanism by Water for the Pavement Construction

Mainly the water which seeps into the road construction and remains in insufficiently permeable load layers causes the bedding and joint material of the pavement construction to

weaken under traffic loads. Often the material used is too soft so that it is being ground under traffic loads. Then the construction is washed away even more easily.

These effects show very well in the surface of the concrete stones by light fine grain deposits. Also the concrete stones rattle more and more and due to the resulting contacts corners and edges of the concrete stones split away. Finally the use of the pavement area continues to be reduced and then cost-intensive maintenance is necessary which can lead to intra-urban problems. A long-term and important aspect should be mentioned also. The acceptance of the pavement construction method overall will decrease due to these failure mechanisms. Of course, market shares will shift against the favour of concrete paving stones.

Experience with ECOPREC®-Construction Method

The ECOPREC®-Construction Method is characterized by the option of performing pavement areas on problematic undergrounds as e.g. water-impermeable base layers or water-sensitive undergrounds. Background is the flexible binding of the bedding material by the low bitumen content in the material and very low water permeability. The low binding also prevents that the bedding and if applicable the joint material will be dragged out from the road construction due to water influence. Accordingly the construction remains stabile on the long run! Also this low binding causes the material to be used with ordinary materials. For example, it keeps the ability to pour away in a not compressed condition and so can be used in a classical way.

The ECOPREC®-Construction Method in the built in and compacted condition which means the hot-prepared bedding material can be placed manually as well as by machine. This also prevents very effectively the penetration of rain water (< 1%) into the road construction which is underneath the paving layer and so supports permanently the durability of the construction. So far, no sensitivity towards frost effects have been noticed. The rain water must be dissipated as planned on the surface.

Due to warranty reasons, the ECOPREC®-Construction Method basically is made only with concrete paving stones of the corresponding licensees. In Europe there is insurance protection for this with an adequate coverage.

Since we gained experience in this construction method in Scandinavia and in Germany for a little longer than 10 years now, we can notice an excellent stability of the paving areas built in this way. The oldest area of 1.000m² was build in the year 2000 and is in the harbour of Århus in Denmark. In total more than 164.000m² paving areas with concrete stones in the ECOPREC®-Construction Method (Figure 1) have been built since the year 2000.So far without any damage caused by this construction method.

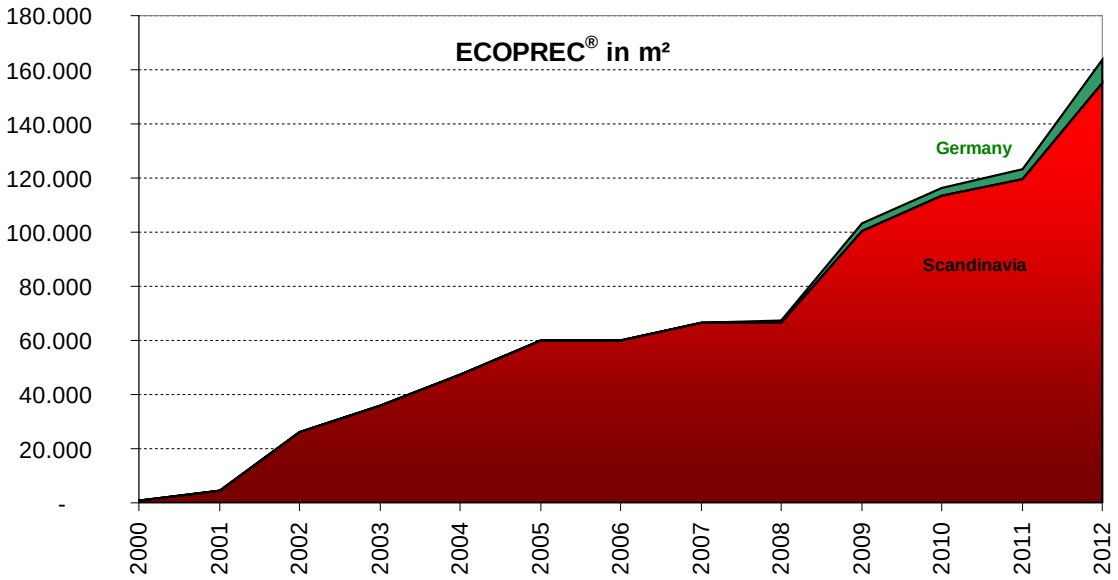

Figure 1: Development of the ECOPREC® Construction Method in Scandinavia and Germany [m²]

Costs and Limitations of the Costruction Method

Current experience showed that cost savings between 7-15 €/m² can be reached for maintenance steps on available base layers compared to completion depending on the range of the infrastructure in the road body. Also there is a time advantage compared to the completion. Of course, again this depends on the local conditions, but on average one working week per 1.000m² can be reached as an additional advantage.

If there are planned high load and corresponding compressed bearing layers or in general water impermeable bearing layers e.g. from concrete or asphalt the ECOPREC®-construction method is a must for a permanent paving construction without damage.

Practice oriented building performances amount to 1.000 – 1.500m² per working day when using road or bicycle path pavers. The time saving factor for laying the bedding by paver and pavement manually amounts to approximately 2-3 working days for 1.000m² compared to the common manual procedure only. Manual laying should be restricted to areas of less than 300m² according to current experience in Europe.

Deformation resulting from the bearing layers or the underground of course cannot be compensated by the ECOPREC®-construction method. The known regulations for a correct planning and performance of traffic areas still have to be observed.

The following figures show failures (Figures 2 and 3) with conventional bedding materials and construction of projects with ECOPREC® (Figures 4 to 15).

Typical Failures of Concrete Paving Stones in Sand Setting Beds



Figure 2. Typical loss of jointing sand in concrete paving stones



Figure 3. Large area damage by ponding and pumping of the bedding sand

Project Examples




Figures 3 and 4. Södra Sandby, Sweden; 5.000m² factory roads of the concrete plant; Year of construction 2001



Figure 5. Lund, Sweden; 1.500m² bus stop + road on concrete bearing layer; Year of construction 2004



Figure 6. Fakse, Danmark; 50.000m² green waste deposit (water protection area); Year of construction 2001-2005



Figure 7. Melle, Germany, 500m² city road; year of construction 2009



Figure 8. Åhus, Sweden; 10.000m² harbour area; year of construction 2010





Figures 9 and 10. Wolfsburg, Germany; 500m² Crosswalk, 300 busses/day; year of construction 2011; maintenance required after one year of use only.

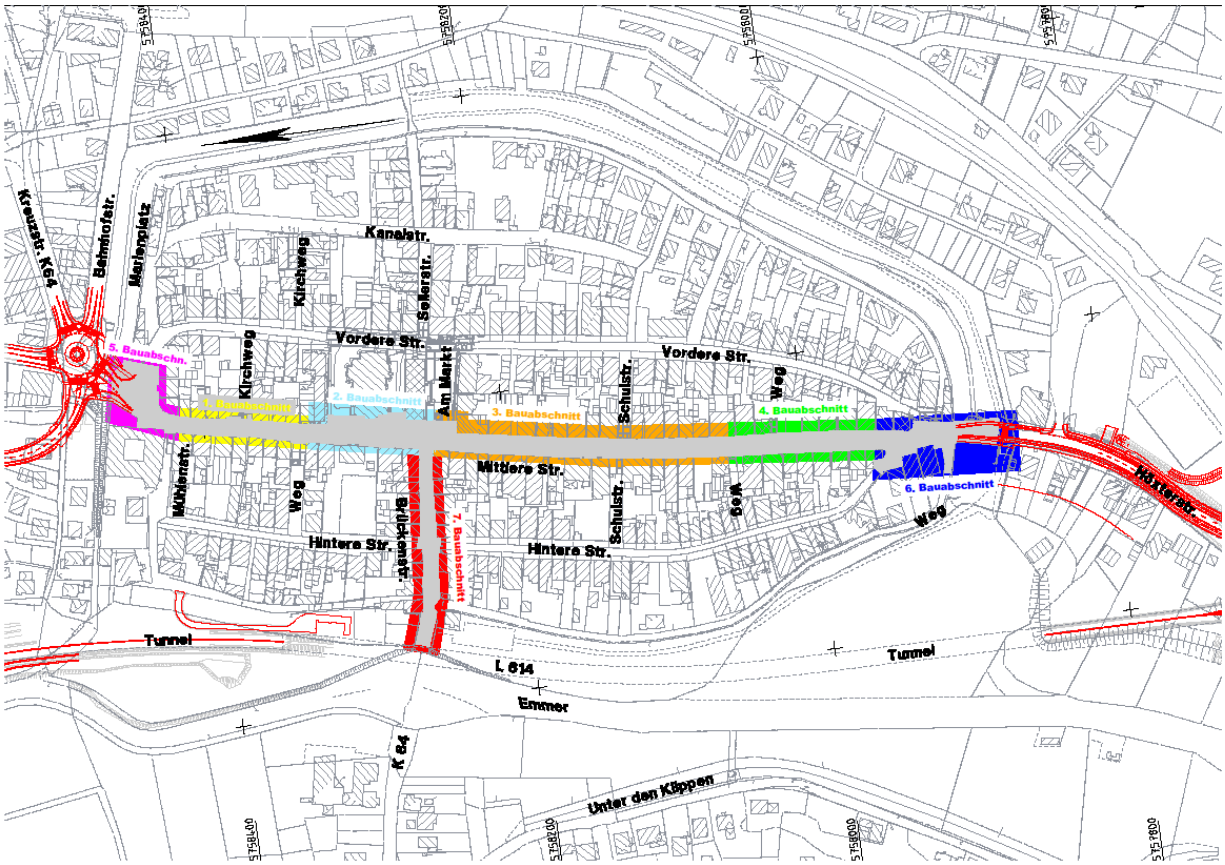

Figure 11. Lügde, Germany; 5.000m² main through road; remake on asphalt bearing layer; year of construction 2012 (still in progress)



Figures 12 – 15. Construction pictures from Lügde, Germany

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