GEOTEXTILE PAVING FABRIC FOR ROAD REHABILITATION WORKS: FIELD EXPERIENCE IN THAILAND

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ABSTRACT

This paper describes the successful use of paving fabric in road rehabilitation works between Saraburi and Nakhon Ratchasima province in Thailand. The paving fabric consists of a continuous filament nonwoven needle punched geotextile. The paving fabric when saturated with bitumen acts as a stress absorption and waterproof membrane between the new overlay and old pavement. Laboratory trial has shown that the use of paving fabrics delays cracks propagation from the old pavement reflecting up to the new overlay. It can extend the life of the new overlay by more than 2 times compared to overlays method without paving fabrics. The installation procedure, bitumen selection and spray rate for the successful application of the paving fabric are also highlighted in this paper.

1. INTRODUCTION

Geosynthetics for pavement rehabilitation provide the following functions such as waterproofing, stress absorption and reinforcement between the old and new asphalt concrete overlay. Experience has shown, in order for these functions to be fully exploited, the geotextile paving fabric must have optimum physical and mechanical properties. The paving fabric geotextiles must also be properly installed with a good combination of tack coat, spray quantity and curing time for it to work effectively as a stress absorbing membrane interface. Both field monitoring and laboratory test has shown that paving fabric can increased the design life of pavements overlay compared to conventional pavement rehabilitation technique.

The rehabilitation of Route No. 2 Saraburi to Nakhon Ratchasrima Province start at km 127 to km 210 (83km) for both inbound and outbound traffic to Bangkok with a carriageway width of 11m. The rehabilitation works started in January 2004 involved installation of about 1.5 million m² of paving fabric under a very tight working schedule and was successfully completed in May 2004

2. PAVING FABRIC PROPERTIES AND FUNCTIONS

2.1 Paving Fabric Properties

The chosen material for the road rehabilitation works consists of a nonwoven continuously filament needle punched 100% polypropylene geotextile designed specifically for use in road maintenance works. The paving fabric was tested by Bureau of Analysis and Checking under Department of Highway prior to application and its technical properties are given in Table 1.
Table 1. Properties of Paving Fabric Geotextile

<table>
<thead>
<tr>
<th>Properties</th>
<th>Test method</th>
<th>Specification</th>
<th>Polyfelt PGM 14</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grab tensile strength</td>
<td>ASTM D 4632</td>
<td>&gt; 450 N</td>
<td>520 N</td>
</tr>
<tr>
<td>Grab elongation</td>
<td>ASTM D 4632</td>
<td>≥ 50 %</td>
<td>&gt; 50 %</td>
</tr>
<tr>
<td>Mass per unit area</td>
<td>ASTM D 5261</td>
<td>&gt; 140 g/m²</td>
<td>140 g/m²</td>
</tr>
<tr>
<td>Asphalt retention</td>
<td>ASTM D 6140</td>
<td>≥ 0.8 liter/m²</td>
<td>1.1 liter/m²</td>
</tr>
<tr>
<td>Melting point</td>
<td>ASTM D 276</td>
<td>≥ 150 °C</td>
<td>165 °C</td>
</tr>
</tbody>
</table>

2.2 Paving Fabric Functions

2.2.1 Waterproof barrier
The main function of bitumen – impregnated paving fabric as a waterproofing barrier to prevent the penetration of surface water. The infiltration of moisture will weaken the shear strength of the base layer and in time, under traffic loading will lead to rutting and loss of bonding (Figure 1).

2.2.2 Bonding
The shear resistance at the interface between the old and new overlay must be high enough to prevent shear yielding through stress caused by braking or turning manoeuvres. The application of a paving fabric together with sufficient binder achieves higher bonding than is possible with normal (no fabric) techniques irrespective of special site requirements and other factors (e.g. variable climatic conditions).

2.2.3 Stress reduction
The bitumen – impregnated and compressible paving fabric is a stress absorbing membrane interlayer (SAMI) at the bottom of the new overlay. The purpose of this SAMI is to reduce the tensile stress in the new pavement in the vicinity of the tip of the crack in the old pavement and hence to absorb “stress” (Figure 2).

3. CONDITION OF OLD CONCRETE PAVEMENT
The old pavement consists of a continuous reinforced concrete where the sealant along the construction / expansive joint was deteriorating causing water to infiltrate to the sub base layer reducing the stiffness modulus of the underlying layers (Figure 3). During the raining season, severe pumping occurs along construction / expansive joints leading to cracking and differential settlement of the concrete pavement. The Department of Highway have evaluated different maintenance options and found paving fabric to be an economical and effective solution for the road rehabilitation linking...
Saraburi – Nakhon Ratcahsrima Province, to increase the life time of the new overlay to more than 2 time than using conventional rehabilitation technique.

The rehabilitation works consists of spraying a layer of tack coat followed by a paving fabric. The overlay consists of a layer of 4 cm binder course followed by a 4 cm modified asphalt concrete wearing course on the old concrete pavement (Figure 4).

4. CONSTRUCTION METHODOLOGY

The right construction methodology for the paving fabric installation is very important to ensure that the bitumen – impregnated fabric + asphalt concrete overlay work as a integral unit. The following installation guidelines was used for the rehabilitation works.

1. Cleaning of road surface and crack from debris.
2. Filling of cracked and pot-hole or levelling layer can be applied.
3. Apply tack coat for effective binding.

The resurfacing works was carried out during the daytime. Catholic rapid setting (CRS 2) emulsion was spread onto the old concrete pavement to provide the bonding of the paving fabric to the old pavement. The spray rate for the tack consists of 1.6 l/m2 emulsion (70% bitumen) and should have a penetration range of 90 – 200 pen. It is important for the emulsion to break before laying the paving fabric. During placement of the new asphalt over the paving fabric, the paving fabric was intact without

Figure 4: Typical cross section of rehabilitation works.

Figure 5: Determination of temperature in a concrete – asphalt concrete interlayer, University of Liege, Belgium (1)
melting in the asphalt concrete. This confirmed previous investigation that showed the laying temperature of hot asphalt is less than the melting point of polypropylene paving fabric (Figure 5).

The construction sequence for the resurfacing works with paving fabric are given in Figure 6, 7, 8, 9 and 10.

5. PERFORMANCE OF REHABILITATED ASPHALT CONCRETE OVERLAY PAVEMENT

Published test results conducted by Alun Regional Road Laboratory in France confirms the benefits of a paving fabric as a stress absorbing interlayer. The test shows that a paving fabric
is effective in delaying the start of a crack and also the curve is less steep, indicating that the fabric continues to slow the rate of crack propagation and is effective in extending the life of the asphalt system by more than 2 times (Figure 11). Based on these experience, it is anticipated that the rehabilitated road pavement at Saraburi – Nakhonratchasrima Province will meet or exceed the design life of the structure.

Figure 11: Crack propagation in asphalt concrete.

6. CONCLUSION

The use of paving fabric with the the right selection of tack coat, spray rate, and correct installation method was successfully used for the rehabilitation works between Route No. 2 Saraburi to Nakhon Ratchasrima Province.

Core samples taken after the resurfacing works showed that the old concrete pavement, paving fabric geotextile and the new asphalt concrete as a homogeneous unit. This excellent bitumen – impregnated geotextile bond provides its function as a water proof barrier, high interface shear resistance and stress absorbing membrane interlayer (SAMI) to ensure long term serviceability and performance of the road.

REFERENCE

1. Investigations in the development of temperatures under hot rolled asphalt mix, Technical Note Polyfelt PGM. Published Aug. 2001