

Paving Fabrics, Increasing the Benefits by Proper Installation Work

E. R. Steen

Fibertex A/S, Hjallerup, Denmark

ABSTRACT: Today paving fabrics are being used in new asphalt overlay systems as an accepted solution for the dual purpose of reducing and/or delaying the occurrence of reflective cracking and to act as a water-proofing membrane, thus protecting the subbase from surface water penetrating and softening the underlaying soil layers with loss of bearing capacity as a result.

The concept of bonding the new asphalt to the old asphalt through a membrane system consists of a bituminous tack coat spread in sufficient quantity to bond the paving fabric to the existing road surface. The tack coat saturates and penetrates the paving fabric, making a bond to the new asphalt overlay and at the same time creating a stress absorbing waterproofing membrane in between.

It is extremely important that paving fabrics are installed properly. Improperly placed fabrics will reduce the long-term benefit of the membrane system. This paper describes how a proper installation work of an effective nonwoven paving fabric should to be carried out.

1 INTRODUCTION

I have been involved in the design and installation of paving fabric interlayers for waterproofing and/or stress absorbing purposes on over 200 projects.

Whether the main purpose is to keep up the bearing capacity by preventing surface water from softening the subsoil or it is to reduce reflective crackings by stress-relieving various expansions and contractions, actual site conditions should be taken into consideration in order to obtain the expected increase in design life. Thus making the paving fabric interlayer cost effective (Caltrans, 1990).

This paper focuses on the necessity of having a sufficiently detailed but still practical check list for quality control when unrolling paving fabric interlayers on basis of the most commonly used construction procedures. The expected membrane effect is obtained by unrolling a paving fabric onto a bituminous tack coat. The succeeding hot asphaltic material will soften the tack coat ensuring the penetration and saturation of the paving fabric:

The check list should follow the steps below:

2. Preparation of the existing road surface
3. Spraying with hot bitumen or bitumen emulsions
4. Unrolling of the paving fabric
5. Paving with hot mixed asphaltic materials

This check list for quality control can easily be modified to be suitable where alternative methods or types of asphaltic pavements are used in connection with paving fabrics. For example, thin overlays such as chip-sealings, polymer-modified open graded drainage layers or use of cold mixed asphaltic materials.

2 PREPARATION OF THE EXISTING ROAD SURFACE

The existing road surface should be cleaned thoroughly to remove dirt, oil, water and other impurities, in addition possibly after patching and levelling large holes and cracks. Cracks more than 5 mm wide should be patched.

If too much of the bitumen disappears into large crocodile cracks a levelling course is required.

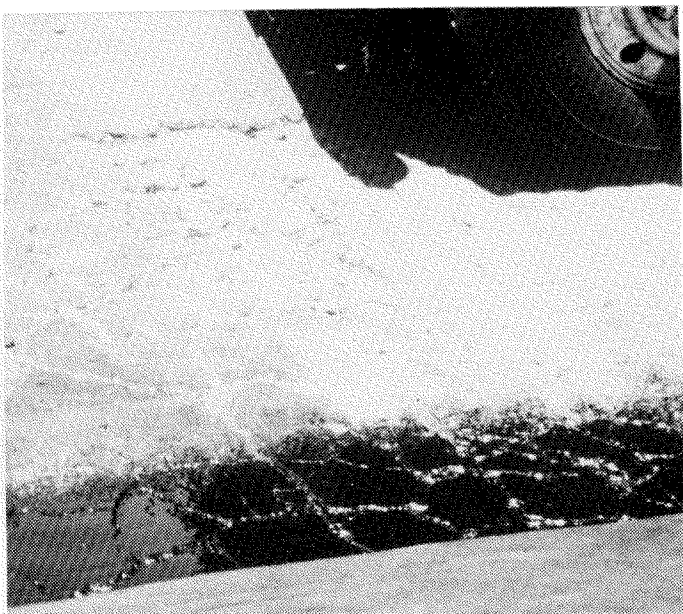


Figure 1. A levelling course should be considered.

3 SPRAYING WITH HOT BITUMEN OR BITUMEN EMULSIONS

Pure bitumens or polymer-modified types of bitumen without solvents are applicable.

To avoid that the type of bituminous tack coat chosen penetrates the paving fabric too soon, causing inconvenient fat stains on top of the paving fabric, the weather conditions should be taken into consideration. The warmer the climate, the harder type of bitumen is to be used. As a rule of thumb, the penetration of the bitumen should be similar to the penetration of the bitumen binder used in the asphalt overlay.

On the other hand, a too hard type of bitumen should be avoided as the surface of a too hard bitumen will not be sufficiently sticky to ensure bonding of the paving fabric during unrolling.

The bituminous tack coat should be sprayed evenly and in a suitable width so that no part of the existing road surface is, before unrolling of the paving fabric, without bitumen. There should be no stripes in the sprayed bitumen.

The height of the spray bar unit should be set exactly for proper coverage.

As to the nozzle openings the angle of the long axis should be adjusted as well so that the spray fans do not interfere with each other.

The necessary quantity of the sprayed bituminous tack coat, before unrolling the paving fabric, is calculated according to the following equation:

$$Q_{\text{necessary}} = \frac{Q_c + Q_{\text{fabric}}}{E} \times 100 \text{ g/m}^2 \quad (1)$$

Where: Q_c = Additional amount of pure bitumen according to the condition of the existing road surface should be estimated on site.

An open and eroded road surface requires more bitumen than a dense and smooth surface. Based on experience between 50–150 g/m² is recommended. Minimum on top of a dense surface and maximum on top of an open surface. After milling, however, around 200 g/m² on top of the road surface depending on the milling machine.

Q_{fabric} = The amount of pure bitumen the paving fabric requires to be completely saturated in accordance with the manufacturer's directions.

Needle-punched paving fabrics on the market require between 900–1300 g/m² bitumen. Minimum when the paving fabrics in addition to being needle-punched are pre-compressed and thermal bonded on only one side. Maximum when the paving fabrics are only needle-punched.

E = Percentage of bitumen emulsion. When hot bitumen is to be used, the figure will be 100. But when bitumen emulsions are to be used, the variations in the percentage of bitumen emulsion are to be calculated proportionally so that the retention of pure bitumen will still be as if hot bitumen was to be applied.

Deviances measured in the sprayed bituminous tack coat should not exceed ± 100 g/m². If excessive amounts of bitumen are used, this may result in sweating and surface instability beyond making the process more costly. If insufficient bitumen is applied, the required membrane effect may not be achieved and there is a great risk that non-adhesive areas occur.

4 UNROLLING OF THE PAVING FABRIC

The paving fabric has to be kept dry. If the paving fabric contains water, the heat from the hot asphaltic material cannot soften the bituminous tack coat sufficiently to force out water and saturate the paving fabric.

If the paving fabric rolls are distributed along the road, make sure that the waterproof and sun-protecting plastic wrapping is not damaged.

The paving fabric must be flexible and easy to handle with approx. weight between 140–150 g/m². The purpose of using a paving fabric is to create a membrane effect, not to establish reinforcement (Vicelja, 1989). Therefore it would be a misunderstanding to use heavier grade fabrics for gaining more reinforcement resulting in ineffective misplacements with bigger risk for failures. (Even if e.g. a 300 g/m² fabric is used, the increase in reinforcement would not be worth mentioning compared to the strength achieved from real reinforcing material).

The paving fabric should be needle-punched, with a combination of needlepunching and thermal bonding on only one side.

The needlepunching to ensure that the paving fabric does not delaminate when it sticks to both the sprayed bitumen and the machines' wheels or tracks at the same time. The thermal bonding on one side only gives a pre-compressed fabric with minimum requirements for bitumen and with the smooth side upwards, to increase the resistance against passing of the machines' wheels or tracks.

The paving fabric should be made of polypropylene fibers to ensure a flexible behaviour in contact with hot asphaltic materials, and to ensure that milled asphaltic materials containing paving fabrics are recyclable (Caltrans, 1986).

In order to ensure proper installation of the paving fabric, wrinkles should be avoided by keeping the paving fabric tight during unrolling.

By using special mechanical equipment a rapid unrolling free of wrinkles, even in slight curves, can be obtained. However, if large wrinkles resulting in triple thickness of paving fabric should occur (more than 3 mm height), the wrinkles should be slit, laid flat and if necessary treated with additional bituminous tack coat.

When unrolling in sharp curves or at extreme directional adjustments, unnecessary wrinkles in the paving fabric should be avoided by making more transverse joints.

Unrolling of the paving fabric can take place when the hot bitumen has been sprayed and sufficiently cooled, or when – using bitumen emulsion – the bitumen emulsion has been allowed to set.

If hot bitumen is used as tack coat, weather temperature should be above +5°C. If bitumen emulsion is used, weather temperature should be above +10°C. Otherwise, the bituminous surface will not be sticky enough to ensure bonding of the paving fabric during unrolling.



Figure 2. Unrolling by hand

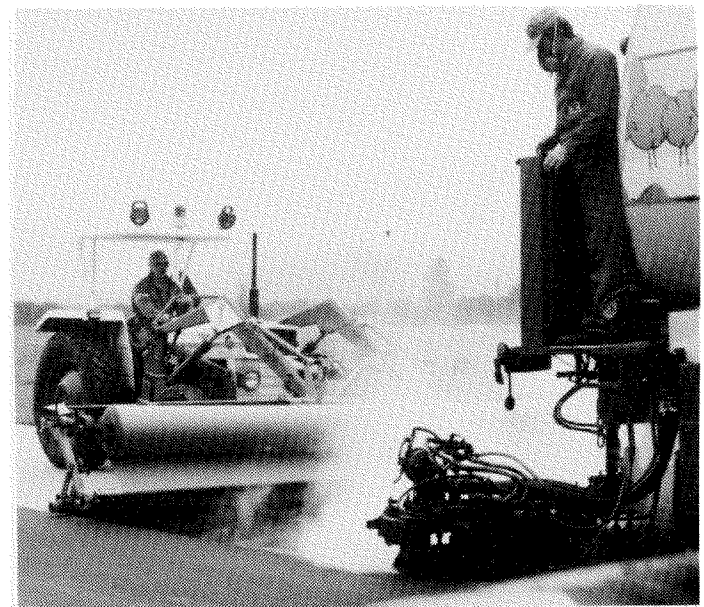


Figure 3. Unrolling by special mechanical equipment

The paving fabric should be joined together by overlaps of between 10–15 cm. Not less than 5 cm and never more than 30 cm.

Transverse overlaps should be made in the direction of paving to prevent edge pick-up by the paver. Besides, those overlaps not already tacked should be added necessary amount of bituminous tack coat in between the two layers of paving fabric.

5 PAVING WITH HOT MIXED ASPHALTIC MATERIALS

Generally the thickness of the asphalt overlay on top of the paving fabric should be between 2,5–5 times larger than the diameter of the biggest grain in the asphaltic material. Furthermore, working with asphalt concrete, the thickness of the asphalt overlay regardless of the grain sizes, should as a minimum be more than 3 cm on top of old asphaltic pavements, and more than 4 cm on top of concrete slabs.

The hot mixed asphalt overlay chosen can be laid on top of the unrolled paving fabric immediately after unrolling of the paving fabric.

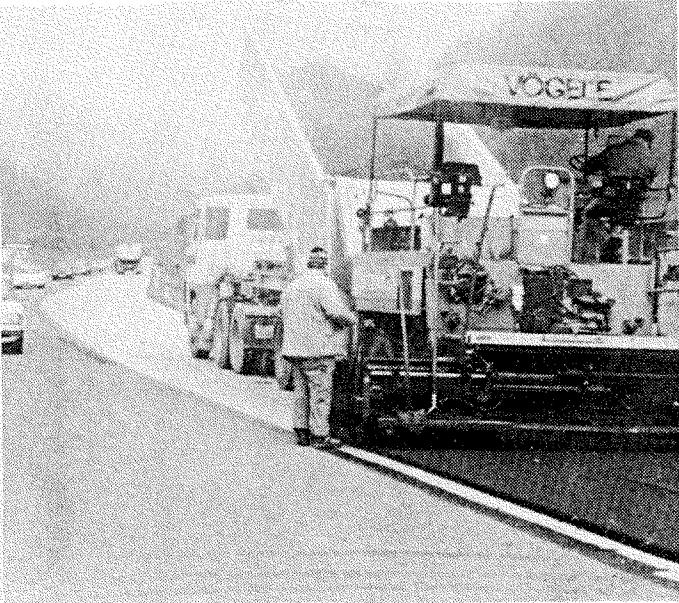


Figure 4. Paving on top of the unrolled paving fabric

If tyre sticking and pick-up occurs, a small quantity of the asphaltic mix should be distributed manually on top of the paving fabric in the wheel paths of the vehicles.

Temperature of the asphaltic material should be above $+140^{\circ}\text{C}$ to ensure enough retention heat in the new asphalt overlay to soften the underlying bitumen sufficiently.

If the temperature of the asphaltic material exceeds $+170^{\circ}\text{C}$, a small quantity of asphaltic material should be sprinkled manually. As a rule of thumb about 1 kg/m^2 for each degree Centigrade exceeding 170°C should be applied.

The truck drivers are not allowed to use their brakes in front of the asphalt paver.

Truck drivers should avoid unnecessary driving in fat spots or at longitudinal overlaps or changing of direction in a violent manner.

6 CONCLUSIONS

With more than 20 years of experience in the U.S.A. and more than 10 years of experience in Central Europe the method with paving fabrics has proven to be a cost-effective way to repair cracked road surfaces.

Many Road Engineers and Contractors have obtained a high level of experience, and many reports have been written on the basis of their results.

Experience has given both good and bad results. This is due to the fact that not all the contractors have quite understood how to handle the paving fabric or why it should even be placed. This did sometimes result in improper placement or procedures.

In the light of recent years' better understanding for quality control the best thing might be to throw away many of the old reports written, and instead focus on the future.

But the fact remains, that if the installation work is done properly and if the procedures/quality control are suitable, every new report written in this topic should draw the conclusion that: incorporating paving fabrics in asphalt overlays extends the design life of the new asphalt overlays, providing a moisture barrier and increasing the fatigue life of pavements at the same time.

REFERENCES

- Vicelja, Joseph L. (1989) Pavement fabric interlayer: Benefits – Construction – Experiences, *University of Liège Conference Reflective Cracking in Pavements*
- Caltrans – California Department of Transportation (June 1986), Recycling Asphalt Concrete: Experimental Construction. Technical report, including information on recycling pavements containing various fabrics.
- Caltrans – California Department of Transportation: (February 1990) Evaluation of paving fabric test installations in California. Technical report, based on 10 years' performances of paving fabric interlayers in AC-overlays.