

The reduced E-modulus can now be used to prepare a comparative table.

E-modulus of matrix	E-modulus of fibre grid	E-modulus ratio between matrix & fibre grid
Asphalt covering 6 kN/mm ² complex modulus CAST at 0°C (5 Hz)	Carbon fibre grid Glass grid Polyester grid	~ 1 : 26 ~ 1 : 7.5 ~ 1 : 1.6

Table 6: Ratio between the E-moduli of the matrix and fibre grid in reinforced asphalt pavement

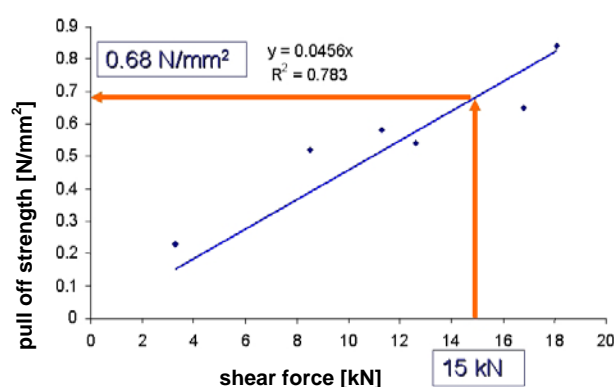
The comparisons in table 6 clearly indicate that the presence of polyester fibres in reinforced asphalt layers does not increase the tensile strength. The glass grid is effective as tensile reinforcement. The carbon-fibre reinforcement increases the tensile strength and the crack resistance of the asphalt layer substantially. The interlayer bond of the reinforced asphalt layer must be perfect in order to guarantee the effect of the reinforced asphalt layer. The interlayer shear bond has to be specified by the developer and monitored by the site management.

5. Interlayer shear bond of reinforced bituminous pavement layers

A grid is only effective with a perfect interlayer shear bond with the matrix. The tensile forces from the grid are transferred to the upper and lower bituminous layer via the interlayer bond. In various EU directives and road construction standards respectively, a shear force >15kN (Leutner method, Ø150mm test core) is required between the old and new bituminous layer (*Image 1*). In some countries it is not the shearing force that is tested, but rather the pull off strength. Graphic 2 shows the relationship of the shear force to the pull off strength.



Image 1: Leutner test setup



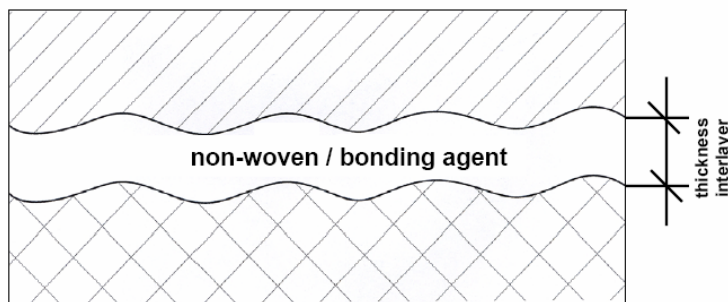
Graphic 2: Shear force/pull off strength

The interlayer shear bond always has two components:

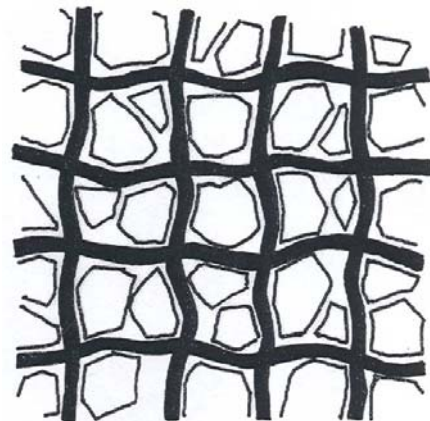
Interlayer shear bond = mechanical interlocking of the surfaces + adhesion provided by the bonding agent

With SAMI non-woven interlayers the non-woven material forms the substrate for the bonding agent. The SAMI non-woven interlay is applied as a relatively thick intermediate layer between the pavement layers. This prevents mechanical interlocking of the grains in the new mix with the old substrate (*Graphic 3*).

With the prebituminised S&P grids, on the other hand, there is no interlayer present. The fibre strands open under the influence of heat during the unrolling of the grid. Unrolling can therefore be carried out in road curves. The grid dissolves again at temperatures of 130-150°C during the installation of an asphalt overlay. The displacement-free S&P fibre strands of carbon or glass fibres give under the pressure of the grains of the mixture. During compaction the large grains penetrate through the S&P fibre strands and interlock with the substrate without hindrance (*Graphic 4*). The fibre strands of the S&P grid can also be displaced in longitudinal direction when compacting the mixture. They appropriately adapt to the uneven or cut milled surface of the substrate.



Graphic 3: SAMI non-woven interlay



Graphic 4: Fibre strands open up

In the case of traditional asphalt grids the fixed grid structure prevents the penetration of large particles of the mixture. Accordingly, traditional grids tend to form waves when an overlay is applied. The required interlayer shear bond is only achieved with traditional grids when an additional SAMI surface dressing is applied. The pre-coated chippings (4-8 mm) of the SAMI surface dressing guarantees the interlocking and thus the mechanical bonding components. Table 7 shows that prebituminised S&P asphalt grids that are laid without additional SAMI surface dressing are a very interesting option from the financial point of view,

SAMI surface dressing	Traditional grid	SAMI non-woven
1.6-1.8 kg/m ² polymer modified bitumen covered with 12-15 lt/m ² bitumen coated chippings 4/8 mm	of PP, PES, glass	120-140 g/m ² polypropylene non-woven and 1.0-1.1 kg bitumen
Costs ready-laid*: 2.5-3.5 €/m ²	Costs ready-laid*: 2-2.5 €/m ²	Costs ready-laid*: 0.8-1.2 €/m ²
Interlayer bond: o.k.	Interlayer bond: insufficient	Interlayer bond: reduced

Combination SAMI surface dressing + traditional grid Costs ready-laid*: 4.5-5.5 €/m² ⇒ Interlayer bond: o.k.
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Combination SAMI non-woven + traditional grid ⇒ Interlayer bond: reduced

Prebituminised S&P grid of glass fibre Costs ready-laid*: 3-5 €/m² <i>(cost is lower than traditional grid and SAMI surface dressing)</i> ⇒ Interlayer bond: o.k.
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Table 7: Cost-benefit analysis different reinforcements
Note: for a 50'000 m² project

*country-specific

6. Tack coat underneath grid interlayer

On **hot summer days**, a special tack coat (polymer modified bituminous Emulsion) is needed under prebituminised S&P grids, the "S&P emulsion G", for example. Table 8 shows the technical characteristics of the "S&P emulsion G".

<i>S&P emulsion G</i>	Penetration index (EN12591) > 0.2	Softening point (SN EN 1427) 50 - 65° C (<i>country-specific</i>)
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Table 8: Technical data S&P emulsion G

A tack coat fulfilling the specifications in Table 8 is suitable for high daytime temperatures. Before being applied to large areas the S&P emulsion G should ideally be heated to a temperature of 50 – 60 °C.