GEOTEXTILE REINFORCED SEALS

INTRODUCTION

Geotextile Reinforced Seals (GRS) incorporate a layer of geotextile fabric in a sprayed seal treatment to provide a tough, flexible membrane for use in Strain Alleviating Membrane (SAM) applications (a sprayed seal that is intended to resist cracking and becomes the wearing surface of the road), and Strain Alleviating Membrane Interlayer (SAMI) applications (a sprayed seal placed as a crack inhibiting layer prior to the application of an asphalt wearing surface). GRS may also be used as an Initial Treatment in specific applications where a particularly tough sprayed seal treatment is required. This Technical Note provides a description of GRS and their applications in road surfacings.

The concept of geotextile seals was first developed in the 1930s in America when the reinforcing fabric was often a hessian or similar material. Later, during the Second World War these types of seals were sometimes used as the surfacing for temporary landing strips for military aircraft.

Since being introduced into Australia in the 1970s, GRS has found particular application in the rehabilitation of cracked and weak pavements by reducing the incidence of reflection cracking and provision of a high level of performance as a waterproofing membrane. Also as an initial treatment, it has been used to inhibit reflective cracking of cemented base materials or for surfacing of low quality granular pavement materials.

In Victoria GRS has been used as SAM treatments on distressed pavements of many types, and as a SAMI on many roads including major metropolitan freeways.

GRS has also been used for a range of applications including as an initial treatment on very lightly trafficked rural roads (sometimes with little or no pavement material) and on pavement widenings and bike lanes.

DESCRIPTION

The role of the geotextile fabric in GRS is twofold. Firstly, it reinforces the binder film to maintain integrity and resist cracking under limited tensile forces. Secondly, it acts a binder reservoir thus enabling greater binder application rates for improved strain alleviating and waterproofing capabilities. Allowance for the additional binder retained by the fabric is an important element in the design procedure. The fabric may also reduce aggregate embedment when used on lightly flushed and softer surfaces such as low quality granular base materials.

GRS are constructed by, application of a sprayed bond coat initialy, then spreading the fabric and lightly rolling to hold it in place. A sprayed seal, using conventional techniques, is then placed over the fabric.

MATERIALS

Geotextile Fabric

VicRoads Standard Specification Section 408 provides for two grades of fabric to be used in GRS treatments. The lighter grade, with a minimum weight of 135g/m^2 is used for all normal SAM and SAMI applications. Use of the heavier grade, with a minimum weight of 175g/m^2 is confined to initial treatments and specialist applications such as severely cracked pavements, or to reduce the risk of puncturing of the fabric when larger sized aggregates (eg 20mm) are used.

Non-woven needle punched fabrics are preferred to woven ones as they perform better, have non-directional elongation, better resistance to tearing and superior bitumen/fabric adhesion.

The most common fabric material types used for bituminous sprayed seals are polyester and polypropylene. Polypropylene fabrics may have a melting point as low as 165°C and should not be used where binders are to be sprayed at temperatures above 155°C. Polyester fabrics have a higher melting point (typically 250°C) and may be used with all binder types.

Bituminous Materials

Class 170 bitumens are the most common bitumen type used in GRS applications. However Polymer Modified Binders (PMB) and bitumen emulsions may be used for specific purposes.

PMBs (including crumb rubber and bitumen emulsion binder types) may be used to improve performance in both SAM and SAMI applications. However, PMBs should not be used in the bond coat because the higher viscosity of the PMB may reduce absorption into the fabric, and some PMBs have a tendency to form a skin which may reduce the adhesion of the fabric. Bond coat materials for retreatments are commonly Class 170 bitumen. For initial treatments, a primerbinder may be used as the bond coat.

When applying two coat (double/double) GRS seals PMB should only be used in the first binder application (ie on top of the fabric). This will then allow the second coat of less viscous conventional binder to flow into the texture of the first seal coat and hold the smaller sized second application of aggregate to create a strong stable seal coat.

Risks associated with retention of cutter oils in GRS treatments must be recognised, and include:

- Cutter oils should not be used in the bond coat except where necessary to achieve penetration and pavement adhesion as a primerbinder;
- Where cutter oils are used in a primerbinder the proportion used should be reduced to the minimum necessary to achieve adequate bond to the underlying pavement;
- Cutter oils in the first application of a two coat (double/double) seal should be limited to about two parts per 100 parts of bitumen, with standard cutting practice for the second binder application; and
- Cutter oils should not be used in the binder for SAMI applications.

The use of bitumen emulsions for binder applications avoids the use of cutter oil. Evaporation of water, however, requires careful consideration, particularly in the bond coat.

Aggregate

The aggregate used should be clean and pre-coated in accordance with normal good practice appropriate for the road being treated.

SELECTION

SAM - Retreatments

GRS treatments may be used to provide more robust waterproofing and resistance to reflection cracking on pavements that are cracked due to ageing of asphalt or sprayed seal surfaces, shrinkage of cemented base materials or high deflections on weak pavements.

Fabric with a minimum weight of 135g/m^2 is generally recommended for these treatments.

Two coat (double/double) seals (14/7) are preferred. They provide a robust treatment with good resistance to turning traffic.

Where a particularly strong GRS is required, a heavier fabric with a minimum weight of 175g/m^2, combined with a 20/7 aggregate combination, is recommended.

Single coat seals are generally restricted to 10mm aggregates as excessive embedment into the fabric may occur with smaller aggregate sizes and aggregate retention may be more difficult with larger sizes. Expert advice should be sought before using a single coat seal.

A GRS may assist in reducing aggregate embedment into flushed surfaces but GRS should not be used on smooth surfaces in situations of high shearing turning or braking forces, such as heavily trafficked intersections, tight curves or steep grades. This is to reduce the possibility of slippage of the fabric over the existing smooth surface.

A GRS should not be applied directly to very coarse textured surfaces due to the bridging effect that may leave voids below the fabric, and consequent retention of moisture or unsupported fabric. In such cases, a corrective treatment comprising a small sized aggregate sprayed seal, asphalt or slurry surfacing should be applied as a pre treatment. Significant incidence of large cracks (greater than about 3mm) should also be pretreated using either a corrective treatment or individual crack filling. A suitable curing period, typically a minimum of six weeks, should be adopted for corrective and crack filling treatments.

SAM - Initial Treatments

A GRS may be used as an initial treatment where there is a risk of:

- Reflection cracking from shrinkage of cemented base materials; or
- Excessive embedment and/or high deflections on weak base materials.

A GRS can enable the use of low quality pavement materials on road shoulders, bicycle paths and other lightly trafficked pavements. A specific use of GRS as an initial treatment is in surfacing of a clay formation. On lightly trafficked roads satisfactory performance can be obtained using a GRS without the placement of a pavement layer provided that a stable moisture content is maintained in the clay formation. This has been found to be effective in remote areas where high quality granular base materials are unavailable. In these cases a fabric with a minimum weight of 175g/m^2 is generally recommended. Also it is good practice to extend the GRS well beyond the traffic lane to improve waterproofing of the trafficked area.

SAMI - Rehabilitation and combination treatments

The use of a GRS as a SAMI provides a tougher membrane than that obtainable with a conventional unreinforced

SAMI constructed using a polymer modified binder. This has particular application in combination treatments with asphalt or ultra thin asphalt surfacing on cracked and/or weak pavements, and where a high standard of waterproofing is required.

SAMI treatments are generally applied using a fabric with a minimum weight of 135g/m^2 and a single coat seal using 10mm aggregate.

DESIGN

The design of GRS follows standard practice as set out in Austroads AP-T68 – Update of the Austroads Sprayed Seal Design Method, with the addition of a fabric retention allowance to the binder application rate and minor variations to pavement texture allowances.

Fabric allowance

The typical binder retention allowance for 135g/m^2 (min.) fabric is 0.9L/m^2 of residual binder. This allowance is apportioned between the bond coat and the first application of binder in the seal coat. The bond coat must be sufficient to hold the fabric in place without bleeding through the fabric and adhering to the tyres of the fabric spreading and rolling equipment. Typically, the bond coat application rate is around 0.6L/m^2 of Class 170 bitumen or (total volume sprayed), but may be increased for heavier fabrics or by a separate allowance of up to 0.3L/m^2 for pavement absorption when used as a primerbinder. The balance of the fabric retention allowance (typically 0.3L/m^2) is added to the seal coat on top of the fabric.

Surface texture allowance

It is not usually necessary to make any allowance for either embedment or surface texture in the design of the GRS binder application rate. The fabric will reduce the influence of embedment on soft bases while the additional binder associated the fabric allowance will occupy a limited amount of the texture in the underlying surface. The application of GRS to very coarse textured surfaces (generally in excess of 2-2.5mm texture) should be generally avoided without the application of a pretreatment to reduce the coarse texture.

AP-T68 provides additional guidelines for design of GRS as well as specific advice for the design of two coat seals. Where practicable, two coat seals should be designed and constructed using the techniques applicable to both seal coat applications being applied on the same day.

EQUIPMENT

Apart from a special geotextile fabric applicator, no additional plant is required to that normally used for bituminous sprayed surfacing operations. The fabric applicator is usually a purpose built frame that can be readily attached to an existing item of plant used by the sealing crew, such as a multi wheeled roller (Figure 1).

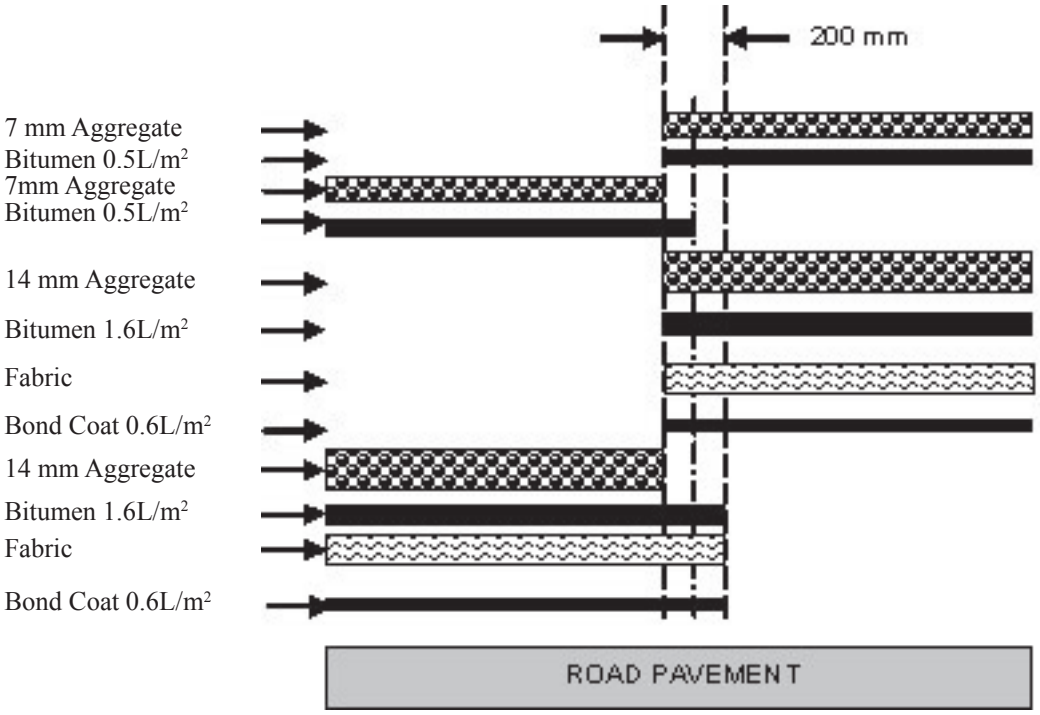
Figure 1 Fabric spreader attached to multi wheel roller

CONSTRUCTION

The placing of GRS should preferably be carried out at the peak of the spraying season and in good weather with a recommended minimum ambient temperature of 20°C. High ambient temperatures reduce the amount of cutter required and consequent risk of the bitumen bleeding over the summer months. Warmer weather also assists in the binder being absorbed into the fabric, whereas in cooler to cold conditions the binder may not be adequately absorbed with a consequent reduction in effectiveness of the treatment. Saturation of the fabric may be particularly difficult when using high viscosity, heavily modified PMBs.

Figure 2 shows typical placing sequence for 14/7 two coat GRS. It is difficult to construct a GRS with butt joins of the fabric, and joins should be overlapped by about 200mm. Where practicable, joins should be placed outside of the wheelpaths, i.e. on the road centre line or between wheelpaths. The outer 200mm of the first lane of fabric should be left uncovered by the first coat of aggregate to ensure that the overlapped area of fabric receives a double application of binder.

Fabric can be placed on large radius curves without cutting and joining the fabric, but on smaller radius curves wrinkling may occur in the fabric on the inside of the curve. Minor wrinkles do not usually cause problems for the final GRS, however in some cases, and if practical, it is good practice to hand spray additional bitumen to these areas to ensure saturation of the fabric. In cases where larger flaps (in excess of 25-30mm) are created theses should be cut and removed to form butt joins.



Note 1: The application rates shown above are by way of example only. A detailed seal design should always be carriedout taking into consideration traffic volumes, existing surface type, fabric type, binder type, etc.

Note 2: Where practicable, joins should be placed outside of the wheel paths.

REFERENCES

- *Austroads (2006) Update of the Austroads Sprayed Seal Design Method AP-T68/06*
- *VicRoads, Standard specifications Section 408-Sprayed Seal Treatmeants.*

OTHER READING

- *Austroads/AAPA (2001) Pavement Work Tip No 25 –Geotextile Reinforced Seals*
- *Austroads (2005) Geotextile Reinforced Seals AP-T37/05*

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