Description of Sprayed Seal Types

a) **Conventional Seal** is a single/single treatment where the bituminous binder is generally Class 170 bitumen. This type of seal coat is used on nearly all of the sprayed sealing work carried out in Victoria.

b) **High Stress Seal (HSS)** where the bituminous binder is a lightly modified PMB (S10E, S35E) or has 5% of crumbed rubber added. High Stress Seals are used in situations where improved aggregate retention and a more elastic binder is required such as the more heavily trafficked rural roads e.g. Hume Freeway.

c) **Extreme Stress Seal (XSS**) is a double/double treatment (i.e. two applications of binder an aggregate such as 14/7) where the bituminous binder is a heavily modified binder (S20E, S45R, S15RF). This type of seal is usually provided in areas of high loading and stress, e.g. intersections, steep and/or hilly country, very cold conditions, etc.

d) **Strain Alleviating Membrane (SAM)** where the bituminous binder is a heavily modified PMB (S20E, S45R S15RF). SAM seals have 20 parts of crumb rubber added to the binder. They are placed in high stress situations to reduce or suppress reflection cracking from pavements containing structural and/or environmental cracking.

e) **Strain Alleviating Membrane Interlayer (SAMI)** where the bituminous binder is a very heavily modified PMB (S25E, S18RF). The purpose of a SAMI seal is to provide superior resistance to ingress of water that may permeate through the thin asphalt surfacing and to delay resist the propagation of reflective cracking from the underlying pavement through the surfacing. It comprises a heavy application of highly modified binder followed by a and a light spread of a Size 10 aggregate.

f) **A Geotextile Reinforced Seal (GRS)** where the bituminous binder is reinforced by the inclusion of a needle punched geotextile paving fabric. Geotextile reinforced sprayed seals have been used in Victoria for many years to rehabilitate distressed pavements rather than the more costly reconstruction alternative. GRS is often undertaken as a double/double seal treatment.

g) **A Fibreglass Reinforced Seal (FRS),** where the bituminous binder is reinforced by the inclusion of chopped glass fibre fibreglass strands. A fibre reinforced seal is an alternative SAM type seal and mostly uses a polymer modified emulsion. The process uses a purpose-built sprayer which, with sprays two applications of binder and chopped fibre in a single pass.

Note on Crumb Rubber. Environmental Focus: The use of rubberized bitumen contributes to a circular economy by utilizing end-of-life tyres that would otherwise be landfilled or exported.

Comments on Specialised Sprayed Seals – Ross Paul

High Strength Seal (HSS)

John Bethune went on a study tour of the US in the mid 1970's where he witnessed the use of crumb rubber seals being undertaken in Arizona (I think). On his return, Asphalt Division set about developing our own Victorian procedures for mixing, designing and application of seals incorporating crumbed rubber than called scrap rubber seals (BSRS). This was a significant milestone in sprayed sealing and recycling of crumb rubber made from old tyres.

Note: The first trials of Crumb Rubber Sealing (then called BSRS) were undertaken in 1976 and supervised by Paul Donovan who was Dandenong Division's Bituminous Surfacing Overseer at that time. Click on the following link to download Paul's comments: Crumb Rubber Seal Trials

The concept of using a rubber-modified bitumen took place in Europe in the 1930s. Then in the 1960s, a process of blending crumb rubber (often derived from tires) into hot bitumen before mixing with aggregates was developed by McDonald in the USA, gaining popularity for creating high-viscosity asphalt-rubber.

The development work in Victoria involved:

- Specification of a particle size distribution for the crumb rubber.
- Development and manufacture of an inline rubber mixing box to facilitate addition of crumb rubber to the binder at the spray site without the need for a central mixing plant.
- New seal design procedures to increasing the binder rate of application to allow for the stiffening and bulking effect of crumb rubber.
- Procedures for mixing and digestion of rubber in the bitumen sprayer.
- Modified spraying procedures.

The earlier specifications defined treatment as BSRS (5 parts). John Oliver when undertaking research on modified seals in 1980's referred to scrap rubber as crumb rubber in his reports. This term caught on in the late 1990s when the term crumb rubber was adopted nationally by Austroads. The term HSS defining the treatment was not adopted until the early 2000's by Austroads after which SRA specifications followed suit.

Extreme Strength Seal (XSS)

Around the early 1990's NE Region started adding 10 parts crumb rubber instead of 5 parts crumb rubber to gain some enhanced performance in terms of resistance to flushing and aggregate retention on heavily trafficked projects particularly on braking and turning areas. This procedure was never adopted more broadly across the State at the time as it was seen to be unnecessary develop additional procedures where 5 Parts rubber seemed to produce adequate aggregate retention and the 20 parts Crumb rubber (SAM Seal) for treatment of cracked surfaces. There did not seem to be a condition that fitted something in between at the time.

However, with the specification requirements for various grades of PMBs by Austroads, some SRAs were finding that some of the moderately modified PMBs were offering superior performance in very high traffic including areas of braking and turning traffic. Austroads then documented these treatments as Extra High Strength Seals (XSS) around 10 years ago and SRAs incorporated these into specifications.

Strain Alleviating Seal (SAM)

This name was Adopted by Austroads in the early 2000's and came from the term SAMI (Strain Alleviating Membrane Interlayer) which was a seal highly modified seal treatment with a heavy rate of application then covered with a thin layer of asphalt. When highly modified binder was used as a final seal treatment, the name SAM seal was adopted.

The early SAM seals were Crumb Rubber seals developed by Asphalt Division in late 1970's at the same time as the 5 Parts rubber seals described above. In addition to the work above described for the HSS, larger capacity sprayer jets were used to deliver the high rates of application required for 20 parts crumb rubber. At same time, SAMI Australia developed elastomeric PMB's and these were used by some SRA's as alternative to 20 parts crumb rubber. Elastomeric PMBs could be sprayed in the same way as normal bitumen binder as the material was supplied from a central PMB mixing plant.

Strain Alleviating Membrane Interlayer (SAMI)

In the 1980's SAMI Australia promoted the use of SAMI's in locations where a thin asphalt overlay was being placed over a cracked surface. Its purpose was to delay the propagation of cracks reflecting through the asphalt overlay and also to achieve a high level of water resistance once the overlay began to crack sometime in the future. A few trials were done around this time, but it was not until the mid-1990's when the use of SAMI treatments became widespread due the abundant availability of highly modified PMBs. Highly modified PMBs were used not only for the SAMI but also incorporated into the asphalt overlay to obtain a high degree of flexibility when placed over a weak pavement.

It has been found that this treatment can extend the structural life of a pavement by another 10 to 15 years particularly in fixed level urban locations where thick structural overlays were impractical and funding limits for structural rehabilitation or reconstruction. Use of these treatments has been very successful.

Geotextile Reinforced Seal (GRS)

Geotextile Reinforced Seals were introduced around 1990. The first trial was undertaken over a cracked pavement on the Midland Highway at Elmore in Northern Region. The Geofabrics company had developed needle punched paving fabrics supplied in 4m wide rolls that could be rolled out on a pre-sprayed tack coat using a special truck attachment prior to heavy second application of bitumen that was largely absorbed into the fabric prior to spreading aggregate.

Whilst the Geofabrics Company provided an initial design procedure this was further developed and modified over several subsequent trials. The geotextile allowed an increased binder rate of application of about 1.0 l/m2 compared to a conventional seal.

The additional binder greatly assisted in bridging of severely cracked surfaces compared to conventional treatments.

The use of GRS's became fairly widespread particularly in SE Metro Region and then to other regions as well, A GRS was seen to be a step up from SAM seals for treatment of severely cracked pavements aimed at deferring reconstruction or structural rehabilitation.

Fibreglass Reinforced Seals (FRS)

The FRS was introduced Pioneer Road Services in the early 1990's as an alternative to a GRS but using bitumen emulsion rather than hot bitumen. The process was undertaken by a specially designed machine to spray a bitumen emulsion tack coat, chopping glass fibre into short lengths of about 50 to 100 mm long and randomly distribute the chopped fibre to the tack coat. A final application of bitumen emulsion was applied by the machine through a second spray bar and aggregate was spread over binder in the normal way.

The benefit of the FRS was that the process does away with the need to roll out a geotextile mat which can be more time consuming and unsuitable for sharp curves because of kinking of the fabric. I am not sure that this process has been widely used in Victoria. There was some doubt as to whether the process was as effective as a GRS as the binder application rates were lower than for a GRS - somewhere in between a SAM seal and a GRS.