

October 2003

## SURFACE "BLISTERING" AND SOIL "FLUFFING"

1. This Construction Note gives some general information rather than policy on possible ways of reducing the incidence of surfacing failures of the type locally referred to as bitumen 'blisters' and soil 'fluffing'.
2. This type of failure is usually first noticed as a series of raised dome shaped ruptures or blisters in the primer or primerseal. Cracking of the uplifted patches is usually evident, and the soil within these blisters is fluffy and unstable.

The appearance of these failures is usually confined to the outer 0.3 to 0.5 metres of a prime or primerseal, although they can occur across the full width of a road. It is thought that the action of traffic usually kneads any blisters or fluffy soil back into place across most of the surfacing, and that the failure remains manifest down the edges because these areas are not normally trafficked.

Fluffing which usually only affects the top 5 to 10 mm of the once compacted base material, often extends beyond the blistered areas and frequently occurs without blistering being evident. Where fluffing is widespread, extensive cracking of the bituminous layer usually occurs. Even occasional traffic will then rapidly lead to disintegration and total edge failure.

3. The highest risk of the problem occurring is when the following conditions are present:
  - (a) Semi arid - arid climate.
  - (b) Calcareous gravel base materials.
  - (c) Fine grained low void content base materials.
  - (d) Significant quantities of soluble salts in the road formation.

The same type failure has been observed on occasions in wetter areas over a wide range of base materials including laterite gravels and bitumen stabilized soils. Past experience with similar materials in the area is the most valuable guide as to probable occurrence.

4. The cause of the phenomenon cannot be adequately explained. There are many theories and it is obvious that a combination of factors is responsible for the failure. The practical solution lies in modifying material and construction factors that are known to aggravate the problem.
5. Soluble salts are not necessarily the sole agents causing the problem, rather they contribute in combination with other factors. Under some circumstances saline soils and seawater has been used without giving problems. However there is evidence that failure have resulted from the use of saline materials and it is therefore advisable to restrict their use to a minimum.
6. Blistering of the surfacing may occur regardless of the presence of soluble salts, provided the other necessary conditions are present. Therefore it is not always practical to commit extra funds to obtaining fresh water in the hope that the problem will be avoided.

**7.** On construction jobs where the high risk factors mentioned in paragraph 3 cannot be avoided, or when past experience indicates a likely problem, the following measures can reduce the incidence of failure:

**7.1** Seal the surface immediately, omitting the usual primerseal stage. Where finance permits, a double coat seal will give greater protection, however this is usually not necessary, as single coat seals have been used to give adequate protection on many miles of road suffering from this problem.

Where a light prime coat is necessary to prepare the road surface for the seal coat, this can be used provided sealing follows soon after. In areas prone to this type of surface failure, blistering has occurred within 24 hours of priming, hence the application rate and type of primer needs to be selected so that subsequent sealing can follow within a day.

A useful device for overcoming the need to prime with bituminous materials is the use of a light spray of distillate to lay dust and ensure compatibility to get a good bond between the base and a subsequent seal.

Where the priming stage is omitted altogether a greater amount of bitumen absorption will take place from the seal coat into the base, and allowance will have to be made for this.

**7.2** Use open graded sound granular materials for the base layer. The high void content within the base layer will prevent vapour pressures from building up and lifting the bituminous coating. Also any salt concentrations that occur are not liable to close up the voids or have as great a detrimental effect on the compacted soil structure.

**7.3** Through salt lake crossings a coarse rubble sub-base layer will give added protection against this type of failure.

**7.4** Within practical limitations the use of compaction water should be kept to a minimum and as much water as possible dried out of the formation prior to applying any bituminous coating.

**7.5** Avoid construction during the hottest months of the year, when the difference between maximum and minimum temperatures is greatest. Having relatively large thermal gradients within the pavement can cause significant moisture movements. Previous experience should serve as a guide to estimate the effect of temperature on the incidence of failures.

**7.6** Where saline water and a high water table occur together, priming the subgrade to form a water-proof layer will reduce the capillary rise of the salt solution. Another suggested method is to use a layer of coarse sand placed above the level of saturation and with appropriate design adjustments, build the base layer on top of this.