AUSTRALIAN ASPHALT PAVEMENT ASSOCIATION

advisory note 18

ASPHALT SEGREGATION

INTRODUCTION

This Advisory Note provides an outline of the causes and identification of segregation in asphalt mixes and suggests practices that may be used to minimise its occurrence.

Segregation usually refers to gradation variation seen as localised areas of excessive coarse or fine particles in the finished asphalt.

Areas with a greater proportion of coarse aggregate typically result in high air voids, reduced stiffness and fatigue life, and potential entry of moisture leading to accelerated pavement distress.

Areas of fine or binder-rich materials can result in low air voids and potential fatty spots or instability.

A further form of segregation is temperature variation during placement, resulting in non-uniform density and increased risk of localised areas of poor density (high air voids).

A detailed guide to identification and minimisation of segregation is provided in *"Segregation – Causes and Cures for Hot Mix Asphalt"* published by a joint task force of the American Association of State Highway and Transport Officials (AASHTO) and the National Asphalt Pavement Association (NAPA), USA in 1997. That publication is an update of an earlier NAPA (1993) publication, QIP No. 110 – *Hot Mix Asphalt Segregation: Causes and Cures*.

Both publications provide detailed explanation of the causes of segregation and correction measures as well as useful diagnostic charts. Copies of both publications are available from AAPA. The following is an outline of key points.

SOURCES OF SEGREGATION

Particle segregation tends to occur:

- In large size asphalt mixes;
- As a result of poor operation of surge storage and truck loading systems;
- At the start and end of truck loads;
- As a result of paver operation through uneven flow of material;
- As a result of poor handwork;
- As a result of binder drain-off in open graded and stone mastic asphalt mixes.

Temperature segregation tends to occur in a cyclic manner with each truckload and to be the result of:

- Loss of heat from the sides, top and bottom of the load during transport.
- Transfer of that cool material to the sides of the paver hopper.
- Uneven feeding of the cool material from the sides of the hopper, mainly when emptying the hopper after each load.

IDENTIFYING SEGREGATION IN MACHINE PLACED ASPHALT

The primary indicator of segregation is areas of non-uniform surface texture visible in the finished surface. There are basically five types of mix segregation that occur on the road as follows.

1. **Truck-end segregation**

   Segregation is seen as regular spots, each side of the lane being paved. It may be the result of one or more factors involving improper truck loading, hot bin segregation, poor truck unloading or running the hopper empty between each load.

2. **Truck-end segregation/One side**

   This is a special case of truck-end segregation and is most commonly caused by improper discharge of asphalt into hot storage bins.

3. **Centreline segregation**

   This normally occurs in the centre of the lane and is the result of aggregate rolling underneath the auger drive gearbox on the asphalt paver. It is generally controlled by use of deflector plates at the discharge end of the paver conveyor or the use of "kicker plates" fitted to the paver augers.

4. **Joint/edge segregation**

   Segregation at the outer edges of the paver run is usually an outcome of running augers at insufficient speed or extension of screed boxes beyond the end of the augers.

5. **Random segregation**

   Causes of random segregation can be the most difficult to identify. A likely cause is improper mixing, but it may also be a result of one or more other factors in the process.

See page 2 for diagrams of each type of segregation and page 4 for checklists.

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A Guide to the use of large stone asphalt mixes

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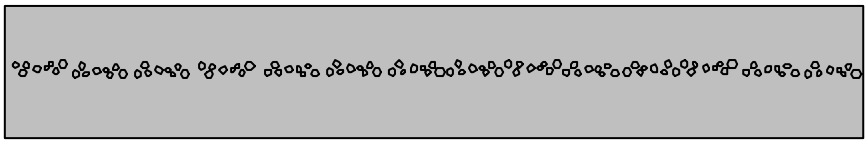

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MINIMISING SEGREGATION

Mix Design

Large nominal size mixes are more prone to segregation than smaller nominal sizes. Handwork is particularly susceptible. Smaller nominal size wearing coarse mixes should be used where considerable hand finishing is involved, such as car parks, footpaths and driveways.

Uniformly graded mixes are less prone to segregation than mixes that are gap graded, although the higher binder content in fine graded, gap graded and SMA mixes can counter segregation of coarse fractions.

Mixes with high binder content and coarse grading, such as open graded and stone mastic asphalt, can be prone to binder drainage. Binder drainage can be controlled by a combination of type and proportion of filler, type and proportion of binder, use of fibres, and mix temperature during transport and placing.

Aggregate handling and stockpiling

Graded aggregates are more prone to segregation in stockpiles and cold feed bins than single sized aggregates. Non-uniform feeding of cold feed bins due to blockages, etc. will influence uniformity of the final mix.

Mixing plant

Good design and maintenance of batch plants will minimise potential segregation of aggregates in hot bins or non-uniform return of dust collected from primary cyclones.

Drum mix plants should be designed to provide adequate uniform mixing and avoid segregation of materials being discharged from the mixer. Care should be taken in operation of drum mix plants to avoid segregated materials at start up and shut down through failure to adequately co-ordinate start/stop times of feeders and binder supply.

Asphalt production should be monitored to ensure uniform mixing as well as grading and binder content targets.

Surge storage systems

Surge bins and storage bins are the most sensitive area for segregation in hot mix plants. Asphalt must be charged into the bin using a rotating chute or batching hopper to avoid forming a cone that allows coarser materials to roll to the outside edges of the bin. Height of materials in the bin must also be monitored. Segregation is less likely to occur when material levels are maintained near the top of the bin, than when materials are falling through a greater distance.

Truck loading

Trucks should be loaded using rapid discharge from storage bins or pugmill mixers. Asphalt should never be dribbled slowly from storage bins. Several drops should be used to uniformly distribute material in preference to loading at a single point, which can result in coarser materials rolling to the extremities of the truck body. Particular attention must be applied to loading large nominal size mixes and other mixes that are sensitive to segregation.

Truck discharge into paver

Trucks should also discharge asphalt into the paver in a rapid mass rather than a slow dribble of material. Flooding the paver hopper with asphalt assists in reducing accumulation of coarse material at the outside of the paver wings.

Paver operation

The hopper should not be emptied between each truckload. Hopper wings should be dumped only as required to maintain material load in the hopper. Flooding the hopper with fresh material assists in uniform feeding of asphalt from the full width of the hopper.

Hopper gates should be opened as wide as possible to ensure that the augers are full. Lack of material at the outer edges of the augers should be avoided. Auger speed should be adjusted to ensure that the augers run at a steady speed and as nearly continuously as practicable. Baffle plates or kicker plates should be used and maintained to avoid centreline segregation from coarse materials rolling in front of the auger gearbox. Extensions should be balanced on each side of the paver to avoid the need to pull more material from one side of the hopper than the other.

The paver should be operated as nearly continuously as possible. Stop/starts should be avoided and a balance maintained between paving rate and plant production.

Hand broadcasting of asphalt mix behind the paver should be avoided.

Minimising segregation in handwork

Critical areas for handwork are transverse and longitudinal joints and completion of odd shaped areas that cannot be spread by paver. Handworking of asphalt can result in an excess of coarse particles on the surface. Care is required to avoid poor finished surface appearance, particularly where substantial amounts of hand finishing are required.

In general terms, handwork should be kept to a minimum. Handwork should be completed as quickly as possible to avoid excessive cooling, and should be done in a skilled manner to avoid accumulation of coarse segregated materials on the surface. Excessive raking should be avoided. All handwork and removal of coarse segregated particles from the surface should be completed before rolling – see also Pavement Work Tip No. 26.

REFERENCES

1. National Asphalt Pavement Association (1993) QIP No. 110. *Hot Mix Asphalt Segregation: Causes and Cures*, NAPA, Maryland, USA.

2. American Association of State Highway and Transport Officials and the National Asphalt Pavement Association (1997) *Segregation – Causes and Cures for Hot Mix Asphalt,* AASHTO, Washington, USA.

3. APRG/AAPA (2001) *Asphalt Handwork*, Pavement Work Tip No. 26, AAPA.

CHECK LISTS

RANDOM SEGREGATION

Origin of segregation	Possible checks and rectification
Is mix size, type or grading a factor?	Reselect/redesign mix
Are materials segregated in stockpiles?	Review stockpile management
Are materials segregated in cold feed bins?	Keep cold feed bins full
Are materials segregated in hot bins?	Baffle may be required to control material flow
Are materials properly mixed?	Check mixing time, condition of pugmill paddles or drum mixer flights
Is problem caused by segregation in storage?	Check discharge of asphalt from mixer to storage Check charging of storage bins Check control of level of asphalt in storage bin
Is problem caused by poor truck loading techniques?	Check truck loading equipment/procedure
Are paver augers operated erratically?	Adjust timing, speed or feeder gate openings

TRUCK-END (EACH SIDE) SEGREGATION

Origin of segregation	Possible checks and rectification
Is asphalt segregated in trucks?	Check operation of storage bins Check truck loading equipment/procedures See also random segregation factors
Are materials segregating on tipping into paver?	Ensure asphalt floods hopper with each tip
Are paver hopper wings being dumped between loads?	Keep paver hopper wings open and flood hopper with each fresh load of asphalt

TRUCK-END (ONE SIDE) SEGREGATION

Origin of segregation	Possible checks and rectification
Is asphalt segregated in trucks?	Check operation of storage bins Check truck loading equipment/procedures See also random segregation/ truck-end (each side)

CENTRELINE SEGREGATION

Origin of segregation	Possible checks and rectification
Is large material rolling in front of auger gearbox as it is being dumped from tunnel conveyor?	Slow augers or fit deflector plates

JOINT/EDGE SEGREGATION

Origin of segregation	Possible checks and rectification
Are augers being operated too slowly?	Adjust auger speed and flow gate openings
Do augers extend sufficiently to match screed width?	Extend augers