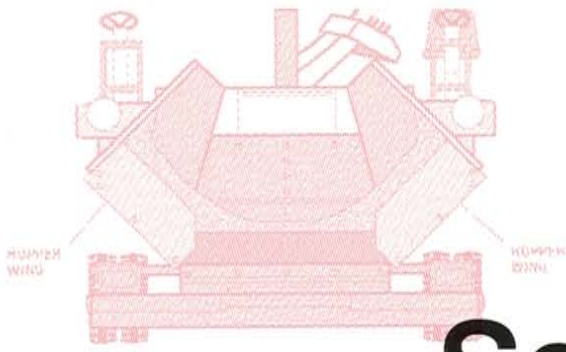
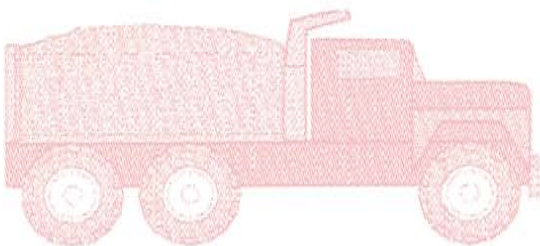
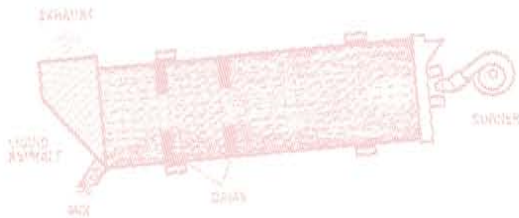




Segregation

Causes and Cures For Hot Mix Asphalt 1997



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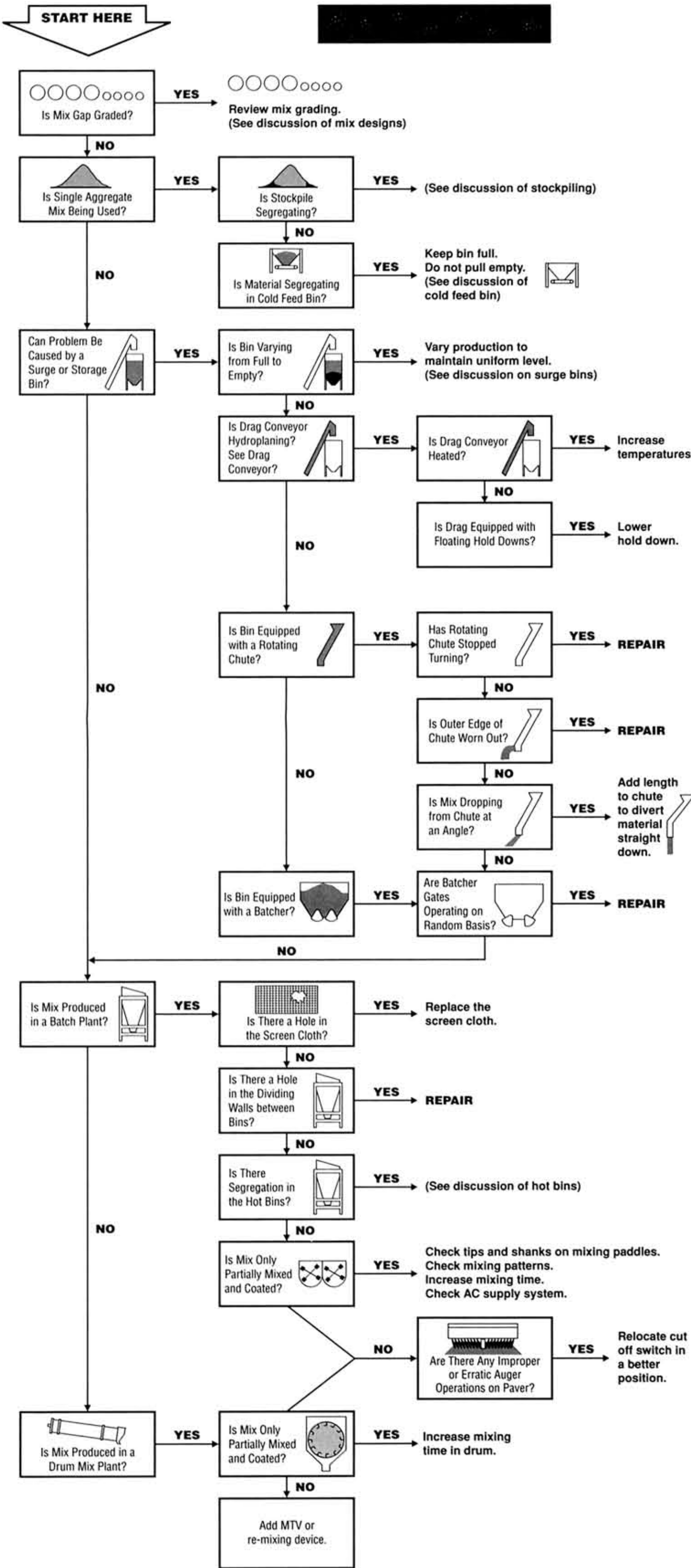


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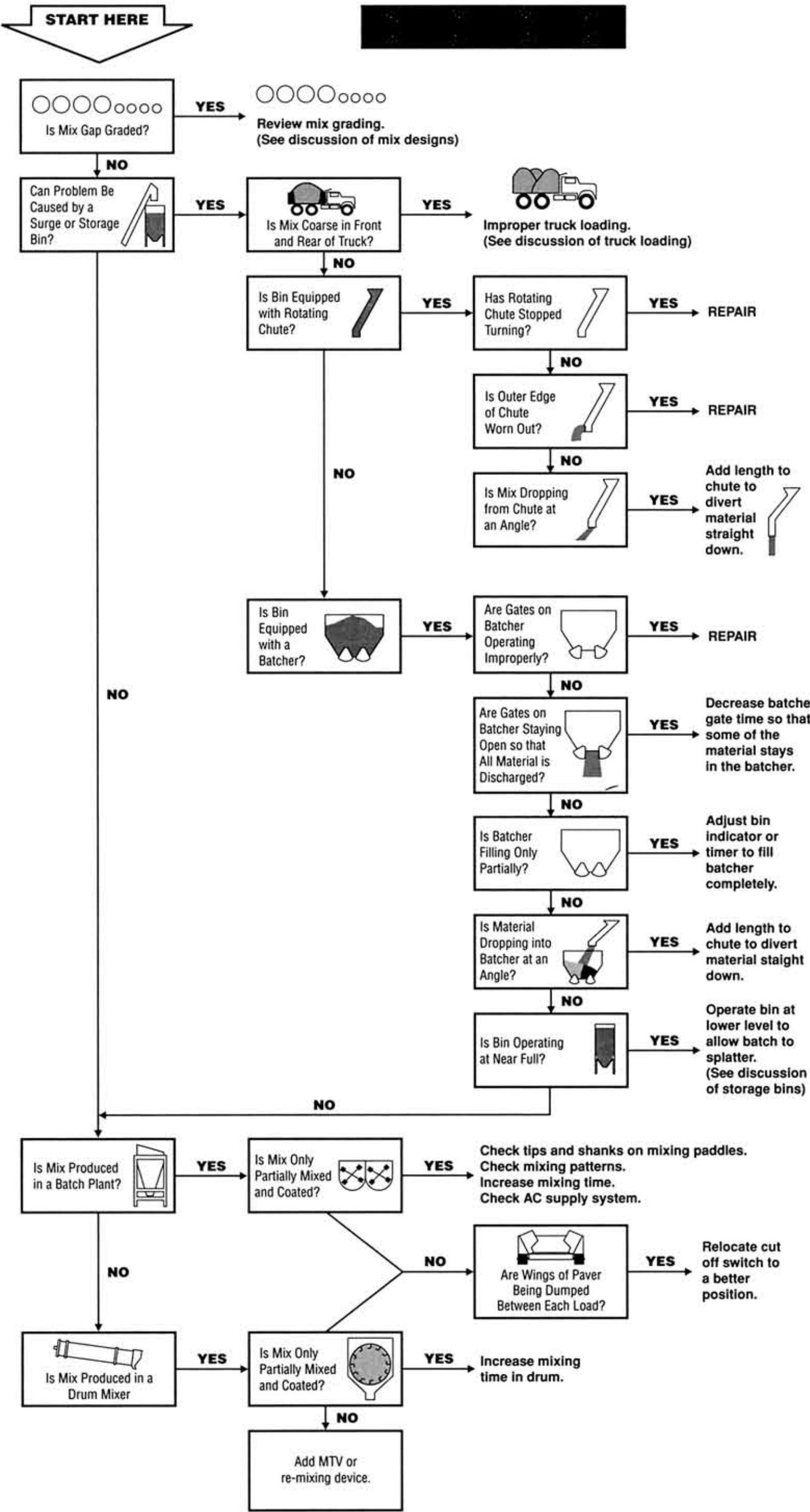
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SEGREGATION DIAGNOSTIC CHART

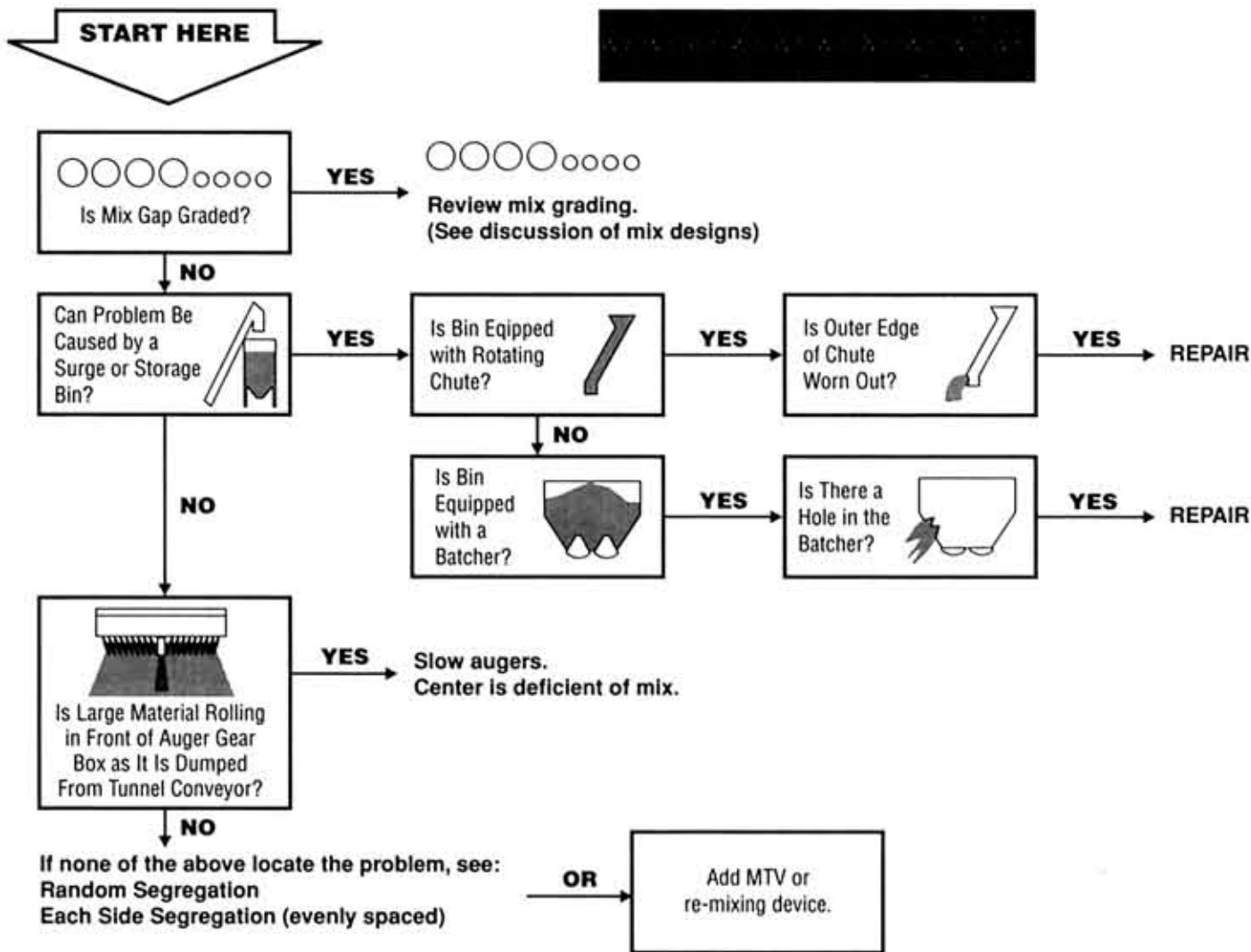
RANDOM SEGREGATION



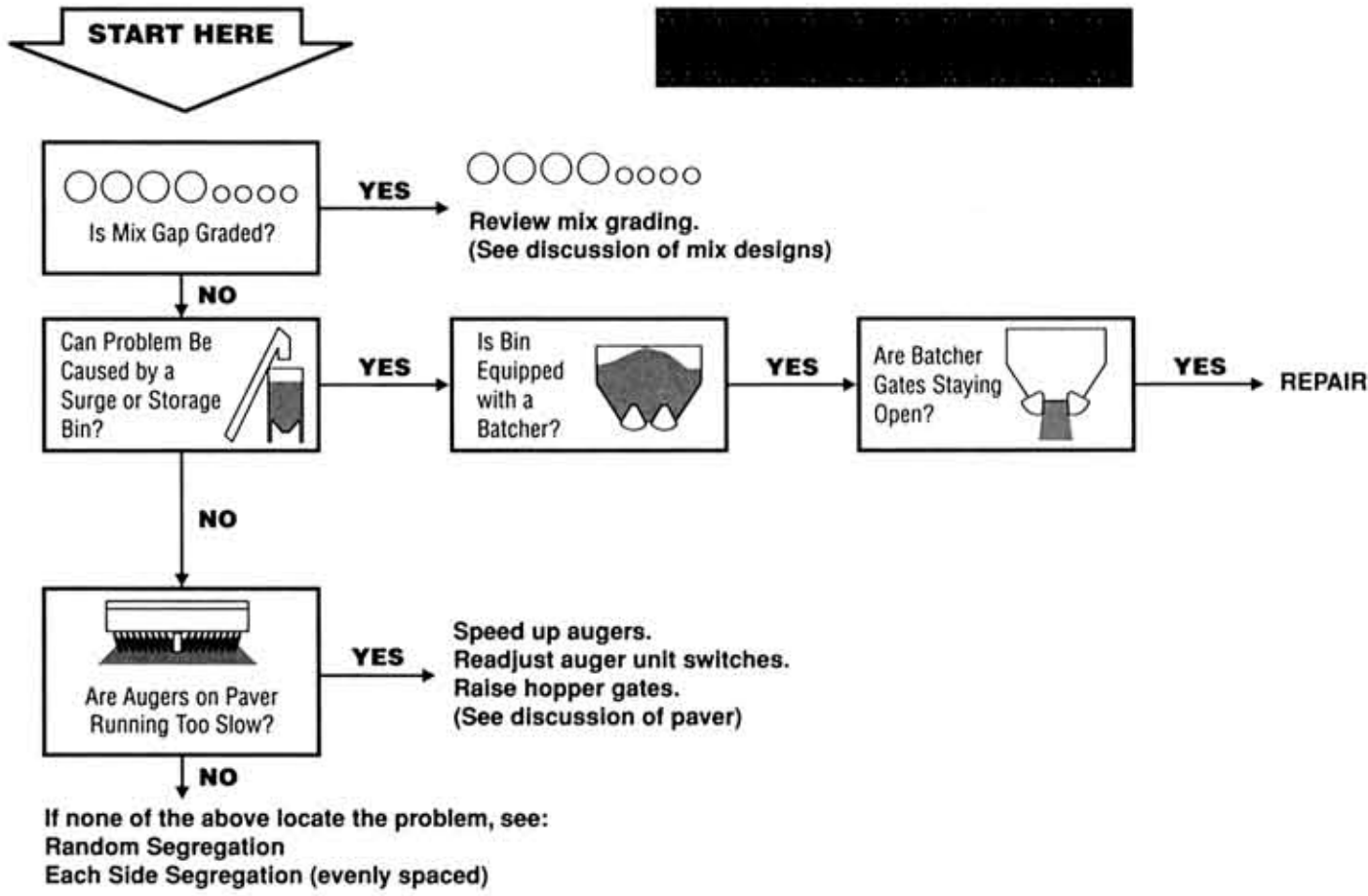
TRUCK END SEGREGATION



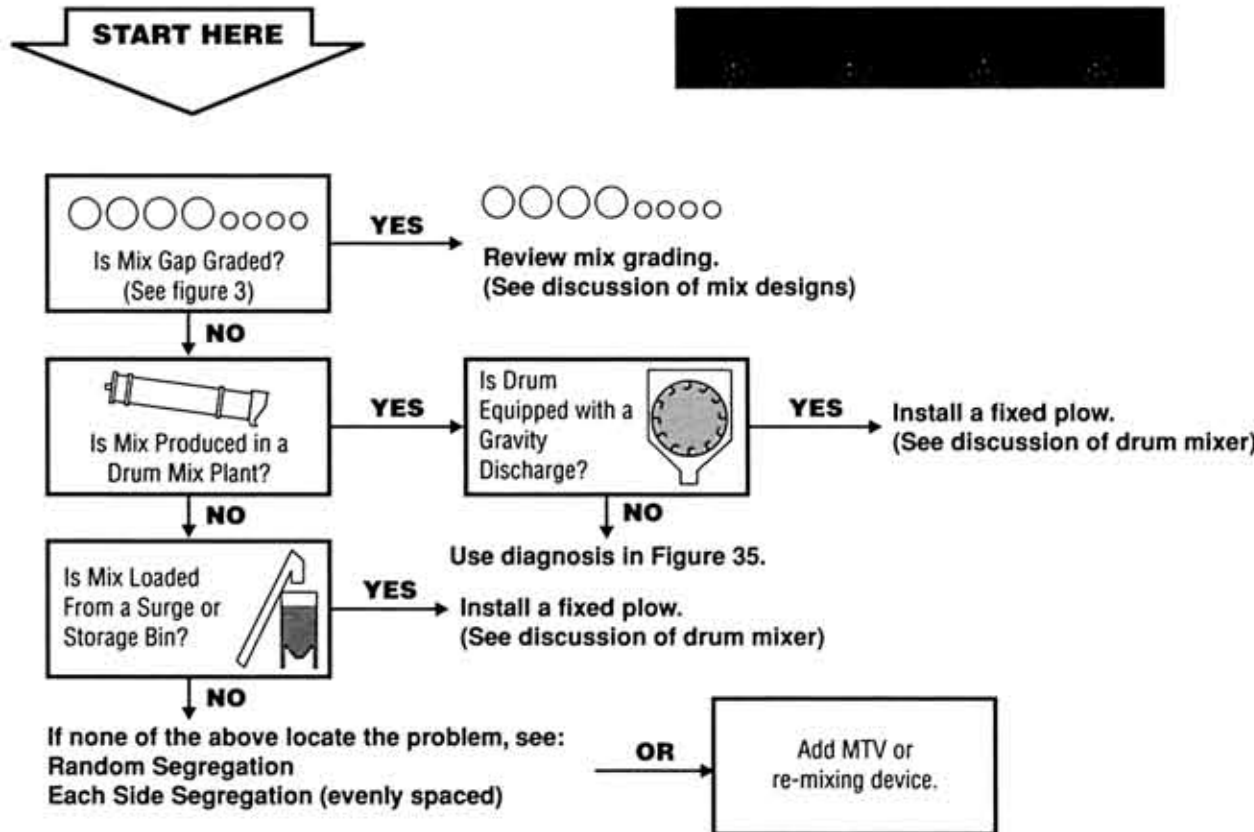
CENTERLINE SEGREGATION

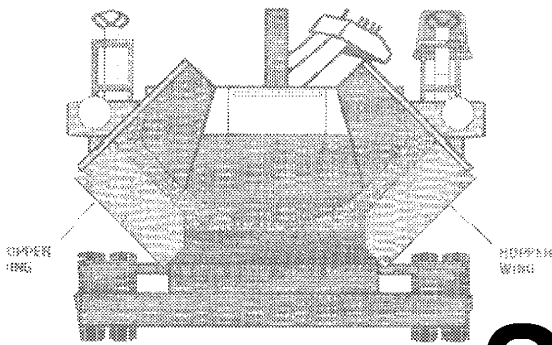


JOINT EDGE SEGREGATION



TRUCK END SEGREGATION/ ONE SIDE

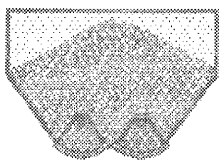
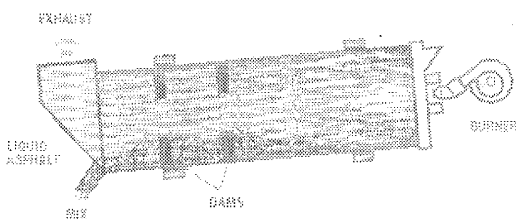




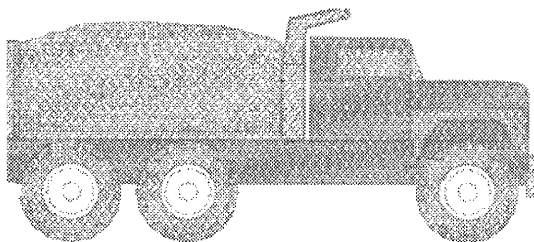
Segregation

Causes and Cures For Hot Mix Asphalt 1997

Prepared by Joint Task Force on Segregation of
AASHTO Subcommittee on Construction;
AASHTO Subcommittee on Materials; and
National Asphalt Pavement Association



WEIGH BATCHER



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Foreword

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For AASHTO purposes, this is a committee report, published under the joint sponsorship of the Highway Subcommittee on Construction and the Highway Subcommittee on Materials.

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Introduction

Hot Mix Asphalt (HMA) is a mixture of graded aggregate and asphalt cement designed to provide both strength and durability. It is unique in that it is also flexible, making it adaptable over a wide range of climatic conditions.

Considerable effort has been exerted over the last decade to improve the performance of Hot Mix Asphalt through better combinations of grading, the addition of polymers, fibers, and various other products. These products are intended to reduce rutting, add to durability, and lead to a longer life of the pavement. In order to ensure pavement performance, the HMA must be mixed, stored, transported, and placed uniformly and with the same gradation the lab designed. At each point during the manufacturing process from stockpiling, aggregate blending, mixing, conveying, storing, truck loading, and placement at the paver, the mix has an opportunity to segregate, creating non-uniform mixes. A segregated spot may be “the birth of a pothole.”

When segregation is present in a mixture, there is a concentration of coarse materials in some areas of the paved mat, while other areas contain a concentration of finer materials. Segregation creates non-uniform mixes that do not conform to the original job mix formula in gradation or asphalt content. The resulting pavement exhibits poor structural and textural characteristics,

provides poor performance and durability, and has a shorter life expectancy and higher maintenance costs.

Problems associated with segregation are serious. Their elimination is essential to the production of high quality paving mixtures. Elimination of segregation is the responsibility of those who produce and place HMA, organizations who design the mix, owners who inspect the final product, and manufacturers who design and market paving equipment.

There are basically five types of mix segregation that occur on the road. They are as follows:

1. **Truck End Segregation:** Figure 1 shows a roadway with segregated spots, often referred to as wings, occurring longitudinally and on each side of the lane being paved. These wings constitute spots of coarse aggregate separated from the uniform mixture. They are typically much more open graded than designed and, if severe enough, will deteriorate in a short period of time, leading to a pothole in the road. Less severe truck end segregation may not appear until the road has been under traffic for several months. Truck end segregation is usually caused by improper truck loading, silo segregation, improper truck unloading, or running the hopper empty between loads.

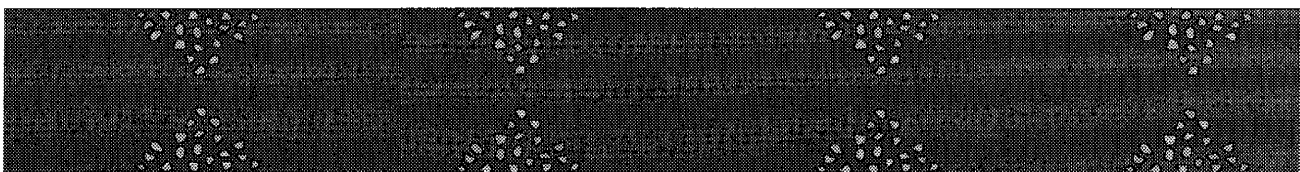


Figure 1. Truck End Segregation.

2 Segregation — Causes and Cures

2. **Centerline Segregation:** The second most common type of segregation is centerline segregation (shown in Figure 2). This normally occurs in the center of the lane and is primarily attributable to coarse aggregate as it is discharged from the conveyor system into the auger area. It then rolls underneath the auger chain drive or gearbox and concentrates in the center of the mat being laid.
3. **Joint/Edge Segregation:** Figure 3 shows that the next most prevalent type of segregation, which occurs at the outside or the outer edges of the pavement being placed. This commonly occurs from the augers not being run at sufficient speeds on the paver, allowing the coarse aggregate to roll to the outside of the mat.
4. **Truck End Segregation/One Side:** This type of segregation is shown in Figure 4. It is a special case of truck end segregation, but is most commonly caused by improper loading of the batcher on the hot storage bin.
5. **Random Segregation:** Random type segregation is shown in Figure 5. The cause of this type of segregation is the most difficult to find. Generally, this type of segregation occurs when improper mixing is taking place either in the batch plant or drum mixer, but can also occur in other places in the process.

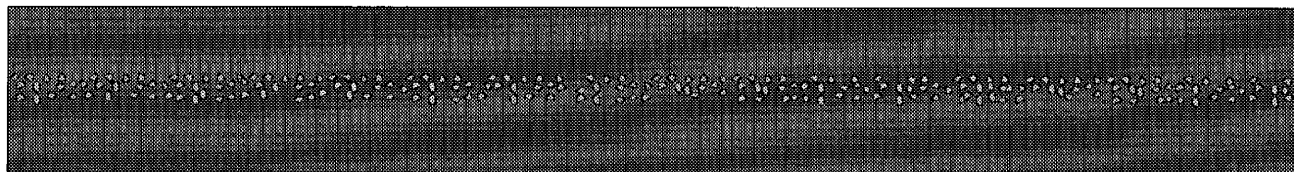


Figure 2. Centerline Segregation.

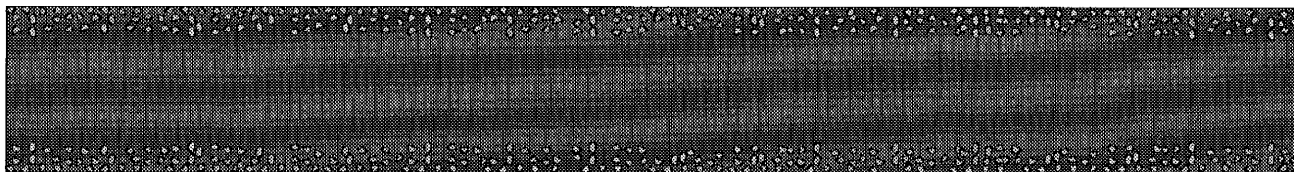


Figure 3. Joint/Edge Segregation.

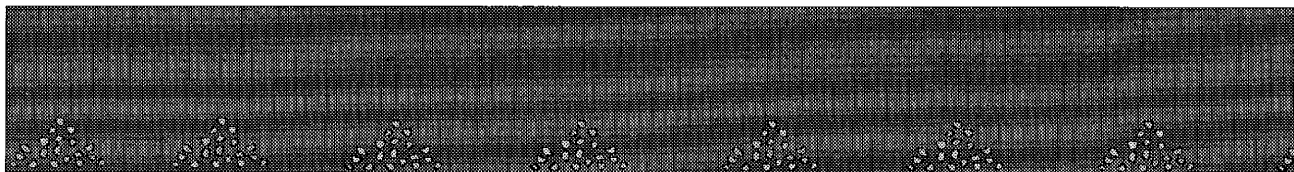


Figure 4. Truck End Segregation/One Side.

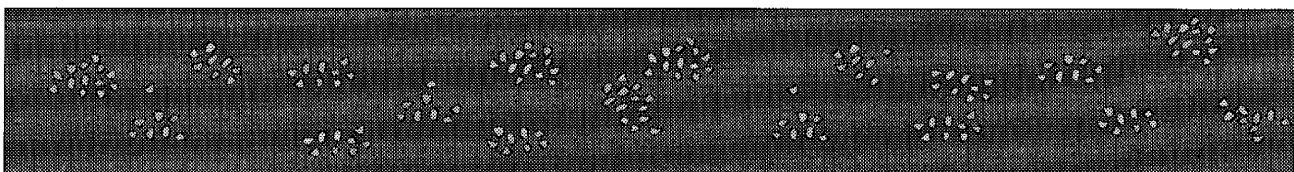


Figure 5. Random Segregation.

Measuring Segregation

Historically, segregation has been measured on a subjective basis with the inspectors making a determination based on visual information only. This becomes very difficult since, in many cases, particularly on surface mix, segregation may not appear for several months after the pavement has been opened to traffic. Visual observation can only identify surface segregation. Thus, segregation below the surface may be undetected.

The agencies that have been most successful in minimizing segregation have been extremely demanding of performance and have not allowed any visible type of segregation to occur. This places a very tough burden on both the inspector and the contractor placing the mix and can lead to disputes. In an effort to develop a non-destructive method of measurement, one state has written a specification using a nuclear gauge to measure density longitudinally along the pavement, looking for variations in density. A variation of more than 5 lb/ft³ (80 kg/m³) (highest to lowest) or 2.5 lb/ft³ (40 kg/m³) (drop from the average to lowest) has been considered to be unsatisfactory. This method has been found to be successful in detecting truck end segregation.

The National Center for Asphalt Technology (NCAT) is presently working with an equipment

manufacturer to try to determine if a more accurate measurement might be the use of the asphalt content, utilizing the longitudinal variation technique noted. At this writing, a fully validated, non-destructive segregation measurement test has not been developed.

Segregation frequently occurs to some degree. The aggregate particle sizes in Hot Mix Asphalt vary substantially in diameter. The large particles are as much as 10,000 to 12,000 times the diameter of the smallest particles. The largest particle can often weigh as much as 1,000,000 times as the smallest particle. To believe that total uniformity can always be achieved would be naive. However, variations of as much as 10% on the #4 (4.75 mm) sieve should be viewed as excessive.

The following sections give a road map to determine where the segregation is occurring and how to prevent it. A diagnostic chart included with this document shows the five different types of segregation. This information will assist in determining the type of segregation occurring and provide help in solving the problem.

