OHD L-46
METHOD OF TEST FOR
CHECKING VISIBLE SEGREGATION BY USE OF THE
NUCLEAR DENSITY GAUGE

OBJECTIVE.

The objective of these instructions is to give guidance on performing density profiles, as segregation checks, behind the laydown machine. This is accomplished by taking multiple readings within a 60 ft. section. Check the roadway profile location for visible segregation. Use the nuclear density gauge results to plot a density profile. Check the profile for a drop in density caused by segregation. Record the profile location to permit possible future evaluation of the segregated section. Segregation Checkpoints listed at the end of this method may provide insight into possible causes of segregation.

SELECTION OF PROFILE LOCATIONS.

It is intended that visibly identifiable segregated areas be profiled. Two basic types of segregation are encountered on the roadway. They are truck load segregation and longitudinal segregation.

- Truck load segregation (spot, chevron, or gull wing type segregation) has a visible pattern repeated with each truck load. These segregated areas are about the same longitudinal distance apart. This type of segregation will normally occur 10 to 25 ft.(3 to 7.6 m) from the screed stop point when trucks dump directly into the paver. The use of a material transfer vehicle (MTV) has been known to extend this further down the paving section.
- Longitudinal segregation (streaking) is normally caused by the paver. This streaking is parallel to the centerline of the project, and may occur continually, or may periodically start and stop.

If the laydown machine continues to progress without any stops, then the Engineer will establish profile starting points.

If the laydown machine periodically stops, then use the location where the screed stops as the "zero" point for the profile starting point. The Engineer should use caution on whether to run a profile if the laydown machine has been stopped for more than 10 minutes, due to cooling of the mix.

LOCATION OF DENSITY READINGS.

Take readings approximately every 5 ft.(1.5m) along the longitudinal direction. The first reading should be located approximately 10 ft.(3m) behind the screed (zero point). If a segregated location is visible between two locations, take an additional reading at that location.

- When checking for truck load segregation, the distance from centerline will remain constant (see figure 1).
- When checking for longitudinal streaking, the distance from centerline will vary. This is done so the profile will cross over the longitudinal streaks. Determine the transverse distance from centerline to the longitudinal segregation. Start the profile approximately 2 ft.(0.6m) farther transversely than the center of the longitudinal streak. End the profile approximately 2 ft.(0.6m) less transversely than the center of the longitudinal streak. The approximate distance 2 ft.(0.6m) from the center of the streak to start and end the profile will be determined by the Engineer (see Figure 1).

NUCLEAR GAUGE READINGS.

In backscatter mode, take 3 one minute readings and average. If one of the readings varies by more than 1 pcf (16 kg/m^3), then discard and take an additional reading to replace it. It is not necessary for the gauge to be calibrated to the mix.

Take a minimum of 10 locations along the profile section. It is not necessary to maintain a rigid longitudinal spacing of 5ft.(1.5m) as stated above. Remember to take additional readings if a segregated location is encountered along the profile.

PROFILE EVALUATION.

Density profiles may be performed anytime visible segregation is present.

The drop in density caused by segregation will be calculated by subtracting the lowest density obtained from the average profile density. The average profile density shall be calculated using all density determinations in the profile section. The density range will be calculated by subtracting the lowest from the highest profile density.

SEGREGATION CHECK FORM.

The SEGREGATION CHECK USING THE NUCLEAR GAUGE form provides the user a means of recording key information to pinpoint the location of the profile section. It also provides a chart for graphing the average recorded nuclear density readings.

Note the screed location is referred to as the zero point. When the paver is stopped, rollers are prevented from compacting all of the bituminous material that has been laid down. A portion of material has the chance to cool before being compacted. Recording the densities behind the screed provides the gauge operator a complete profile of possible low density locations.

On the right side of the chart is a location to place a different scale in case the left side does not fall in the density region of the material being profiled. If this side is used, cross out values on the left side to help eliminate any confusion.

DENSITY GAUGES AND TEMPERATURE.

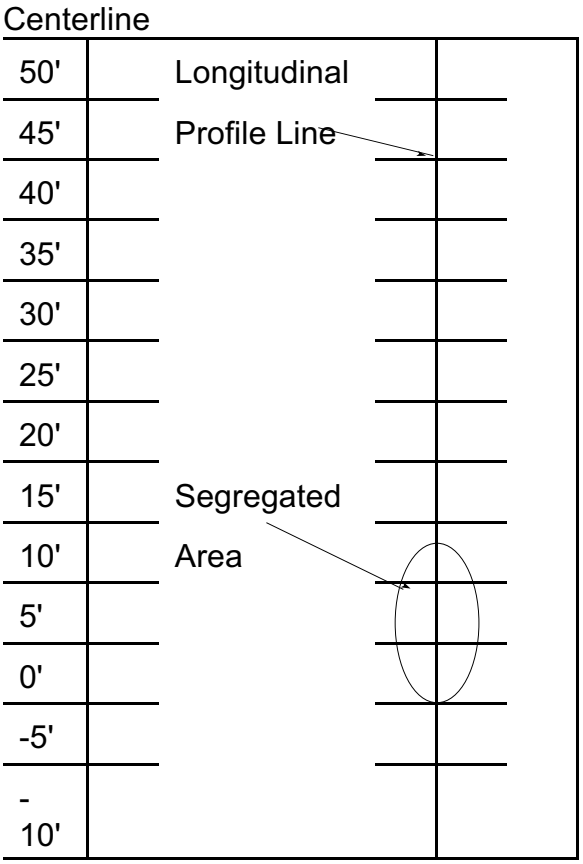
It is recommended to allow the compacted surface to cool for as long as possible prior to using the density gauge. Remove the gauge from the surface immediately after the readings have been taken.

Although the density gauge is designed for high surface temperatures 350°F (176.7°C), the ambient temperature inside the gauge is not to exceed 160°F (71.1°C). If the gauge remains on the surface for any length of time, the surface temperature becomes the ambient temperature inside the gauge. This occurs when the surface temperature penetrates up into the electronics. The electronics can experience temporary malfunction or permanent damage due to excessive heat.

ACCEPTABLE CRITERIA.

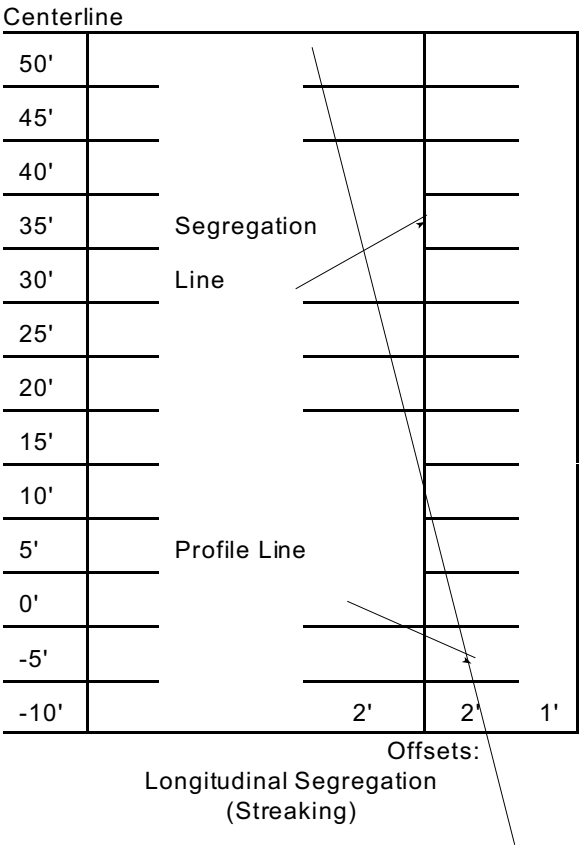
Unless otherwise required, the acceptable criteria for drop in density (average to lowest) must be less than 3 pcf (48 kg/m^3). The maximum density range (highest to lowest) must be less than 7 pcf (112 kg/m^3).

FIGURE 1: SEGREGATION PROFILE LOCATION



Truck Load Segregation
(Spot, Chevron, Gullwing)

Locate Profile as follows:
1) Mark location where paver stops.
2) Determine worst visible segregated area.
3) Take profile through area staying at least one foot from centerline or edge of pavement.



Longitudinal Segregation
(Streaking)

Locate Profile as follows:
1) Determine worst longitudinal segregated area.
2) Take profile at an angle (offset from each end by two feet).
3) Keep ends of profile at least one foot from edge of paved section.

SEGREGATION CHECK POINTS

STOCKPILES

- Avoid HIGH DRY CONES of coarse material. They guarantee segregation, it's just a question of how much..
- Low, flat piles or individual truck dumps are better.
- Visual inspection should detect stockpile segregation.

LOADING COLD BINS

- Some stockpile segregation can probably be corrected by the front end loader operation, but don't depend on it.
- The bins should be loaded evenly. Avoid the pile it high - run it dry syndrome. Cones and lop-sided loads will segregate just as they do in the stockpile.
- DO NOT allow material to slop over from one bin to the other.

COLD BIN OPERATION

- Bin openings should be high enough to prevent clogging. A large opening and a slow belt is the best combination.
- If one bin cannot properly handle the necessary material, you may have to split it into two bins.
- "Overworked" bins are prime sources of segregation.
- Gobs of wet material - for example: sand - should be smoothed out with a drag chain or other suitable means.

COLD FEED CONVEYORS

- Material coming off the end of a belt will segregate. The coarse material will be thrown out further than the fine.
- This is particularly obvious when one belt feeds another at an angle. Plates, baffles or other appropriate devices are necessary to prevent belt end segregation.
- Any segregation up to this point will show up on the cold feed belt going into the drum or dryer.
- Careful sampling at this point is very important - it can identify and/or isolate several potential sources of segregation.
- Remember, segregation can occur both along and across the belt. Proper sampling can detect either or both.
- Don't forget to look at the aggregate going off the belt into the drum or dryer. The coarse particles may be flying off by themselves. When you are recycling, there are two such points.

DRUM MIXER OR DRYER

- Don't expect the drum or the dryer to put segregated material back together again. They won't do it. In fact, they can be a source of segregation. Coarse material will pass through faster than the fine.
- Most drums are designed to operate at ½ inch to 3/4 inch drop per foot (42mm to 62mm drop per meter). The coarser the material, the flatter the slope should be. Don't overlook this item.
- Uncoated or partially coated material segregates worse than properly coated material. The location of the asphalt discharge in the drum is important. Moving the discharge point closer to the drum inlet may eliminate uncoated particles. Moving it too close can cause burning of the asphalt as evidenced by blue smoke.

HOT CONVEYORS (DRUM MIXER)

- The hot belt should be covered. Chilling the material on one side of the belt is a good way to promote segregation.
- Proper sampling of the material on the hot belt can determine whether segregation is occurring in the drum. (if you have previously determined that the material going into the drum is not segregated). Segregation can occur along or across the belt.

SLAT CONVEYOR (DRUM MIXER)

Slats should have enough capacity so material does not fall back down the conveyor after approximately the first 10 feet(3.0m).
The output of the drum should deposit the material uniformly across the slats. Segregation has been observed across improperly loaded slats.

GOB HOPPER (DRUM MIXER)

Check this one carefully and often. Check the following points:

- The material should be directed into the hopper so it is spread out uniformly, not coned in the middle or stacked against the side.
- The hopper should be loaded as full as possible before the gates open.
- The gates should close before the hopper runs dry.
- The gates should open and close quickly enough to produce a "GOB", not a gentle trickle.

HOT BINS (BATCH PLANT)

- If the dry aggregate going into the bin, or bins, is not segregated, and the mix out of the pug mill is segregated, then whatever configuration of screens and bins you are using is segregating the material so badly that good pug mill operation can't remix it.
- If operating with only one bin, it should only be large enough to hold one batch at a time and it should be close to the middle of the pug mill.
- There is an optimum size batch for each pug mill - use it.
- Worn, missing or improperly adjusted blades should be replaced and/or adjusted.
- Mixing time should be adequate.

HOT CONVEYOR AND GOB HOPPER (BATCH PLANT)

Batch plants, drag slat conveyors and Gob Hoppers may be incompatible. Here is a scenario observed at a plant:

When a batch was augered across to the drag conveyor, the slats would grab more than they could handle and coarse aggregate would come rattling back down the chute in a steady stream. The last to go up was a slug of coarse material.

Meanwhile, the Gob Hopper was opening and closing on a cycle which had no relation to the batch cycle. Sometimes it would open when almost full, sometimes when in contained a few pebbles and sometimes the material flowed directly through the open gates.

The resulting mix was severely segregated.

Segregation was appreciably -reduced when trucks were loaded directly from the pug mill and the project was completed this way.

Because of the "stop and go"-mode of batch plants, drag conveyors should be capable of conveying without spilling back, and gob hopper cycles should be determined by weight instead of time.

SURGE BIN

- The bin should be plumb. There is evidence that tilted bins do segregate.
- The bin should never be operated "out of the cone". Gates must be locked when material draws down to the cone. Bypass of this lock is for cleanout only.
- One experiment showed that the height of the material in the surge bin has some influence on segregation.
- When the level of the bin was between one-half full and the top of the cone, segregation was less than when the level was between full and one-half full. The apparent reason was the longer drop of the "Gob" caused the material to splatter and distribute evenly across the bin instead of making a cone in the middle.
- The gates on the surge bin should open and close quickly.

LOADING TRUCKS

- This is a place where a little care may pay big dividends.
- AVOID SINGLE CONES - coarse material runs down the cone and collects along the sides and ends of the trucks.
- Every time you add material to a single cone, you add coarse material to the collection.
- Every one of those bits and dribbles added to "sneak up" on full load adds its bit to segregation.
- If you are serious about reducing segregation, instruct your scalesperson to keep those little bits to a minimum and don't let truck drivers load their trucks. They tend to push the button just because it's there.
- Multiple dumps are better than one large one. Use three dumps - front - back, then middle for tandems - about 3 ft. (1 meter) apart. It's not necessary, nor advisable, to overload the back axle. Longer trucks may require four or more dumps.
- Uncovered trucks may add to segregation.

TRUCKS TO LAYDOWN MACHINE

Here is probably the worst possible scenario:

A truck has just finished unloading. The coarse material which was in the front of the truck came out last and was moved back to the augers as the hopper was emptied. While that truck was unloading, the coarse material along the sides of the truck trickled out through the gap between the truck bed and the tailgate and came to rest on the hopper wings. As soon as the hopper was empty, the wings were dumped and the material moved back to the augers. The tailgate of the next truck is then opened and the bed slowly raised allowing the coarse material which is in the back of the truck to join the coarse material which was in the sides and front of the previous trucks.

The result of this phenomenon, which may occur at regularly spaced intervals, is usually visible, sometimes audible, and always detrimental.

Try the following:

- DO NOT empty the hopper after each load.
- Raise the truck bed before opening the tailgate and flood the hopper. Then, slack off and try to maintain an even flow out of the truck and through the laydown machine. Every time this flow is interrupted coarse particles trickle out onto the wings.
- Do not dump the wings into an empty hopper. If the wings are loaded with coarse material, NEVER dump them into the hopper.
- DO NOT empty the hopper after each load.

LAYDOWN MACHINE

- In the interest of reducing segregation and enhancing quality workmanship in general -AVOID THE "HURRY UP AND WAIT" SYNDROME
- The longer a laydown machine sits between loads the colder it and the material get. Cool material segregates worse than hot material.
- Augers running too fast will segregate coarse material.
- Maintain an even flow through the machine, don't over or under feed the augers run them as much as possible - 90 percent is a good goal. This requires the right combination of gate openings and limit switch settings.
- Check the paddles in the center of the screed for wear - they put the split material back together.
- Check the crown - It should be approximately 1/4" (6mm) higher in front.
- Check for excess wear and looseness in adjusting screws.
- Check to see if the pull point on the screed is at the factory recommended height for the lift thickness.
- Check distance between screed and augers. Materials should feed down and not lay dormant.
- AND - don't segregate the centerline joint with rakes and lutes trying to correct for improper paver operation.