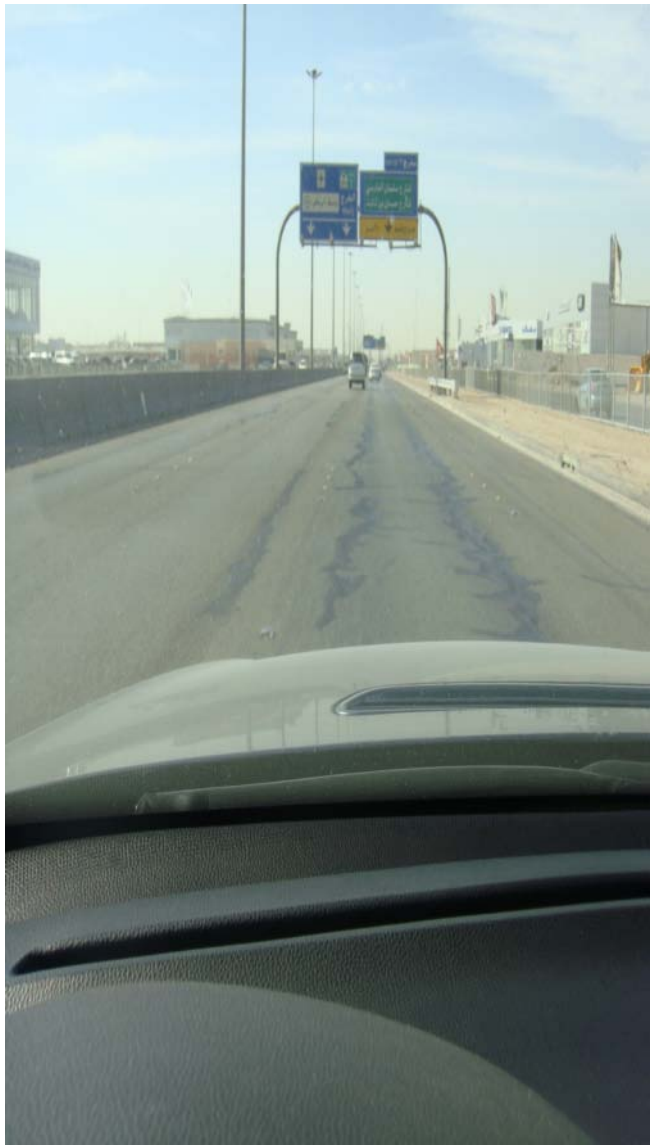

Best Practice in
Producing and Placement
of Superpave Mixes
المركز المتطور للهندسة
Advanced Engineering Center

Good pavement

- **Acceptable performance for 20 years:**
  - No fatigue cracking
  - No rutting
  - No low (thermal) temperature cracking

- **No major maintenance:**
  - Minimize LCC
  - Minimize Traffic interruption

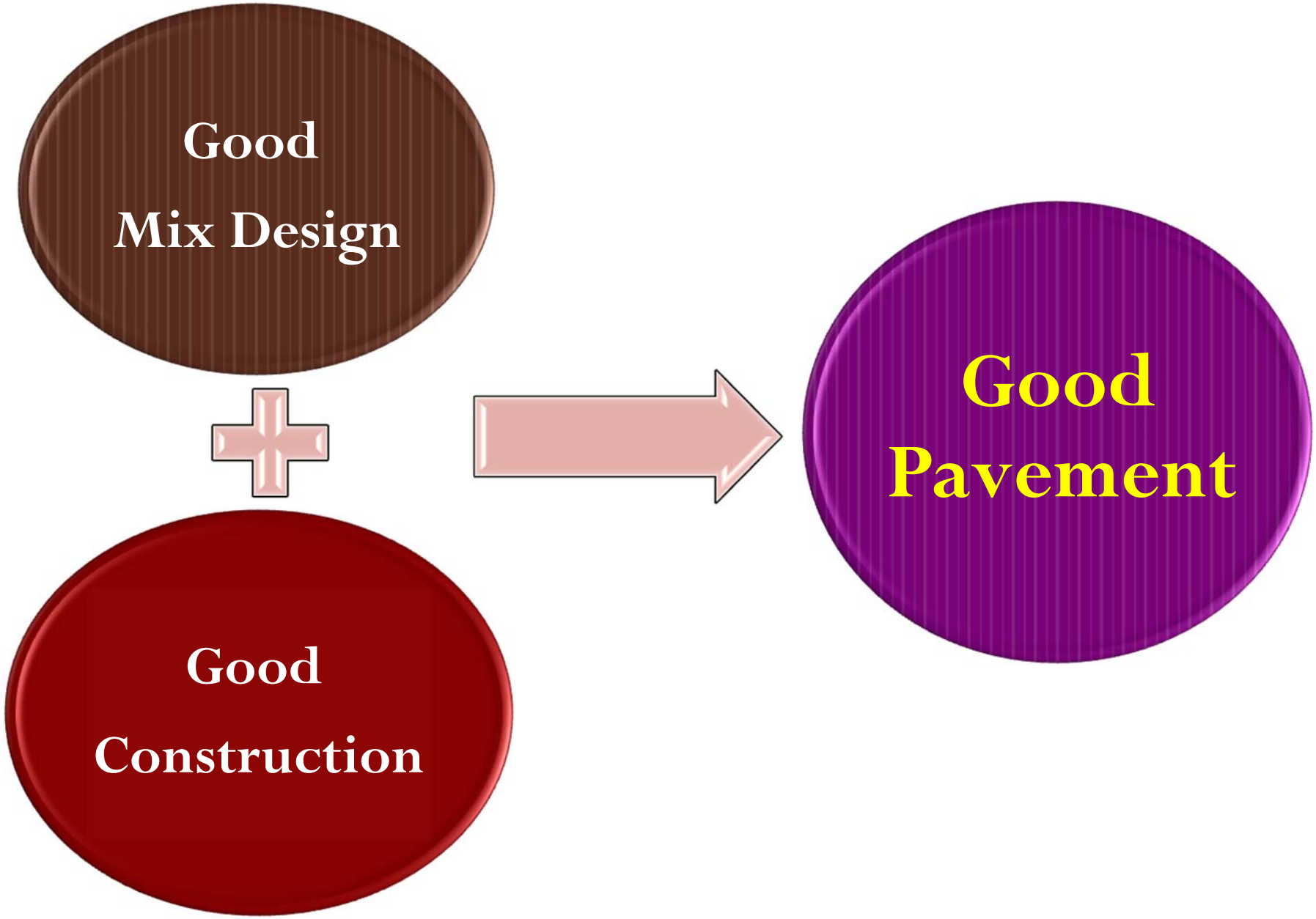
Fatigue Cracking



Temperature Cracking

Rutting

How can we avoid this??



أذن .. الرصفيات الناجحة الجيدة لا تحدث بمحض الصدفة ولكنها نتيجة للتخطيط والتصميم والتنفيذ الصحيح.

Successful good pavements do not happen by accident; They are the result of careful planning, design and implementation


First Superpave pavement in Saudi
Jeddah-Alleath
2006/03/01


Jeddah-Alleath
2006/03/01


Jeddah-Alleath
2006/03/01


Jeddah-Alleath
2006/03/01


2006
Jeddah-Alleath
2006/03/01

How can we get good Mix Design ??

Superpave target is good pavement, so requirements for the design of the mix are:

- PG matching the project site environment.
- Project level ESAL for 20 years .. !!
- Critical Speed on the road !!
- Pavement thickness design .. !!
- Volumetric properties (initial, design and max.)

Is Good Mix Design Enough ?

NO .. Why?

Analogy … Doctor and Patient !!

- Doctor
  - Diagnosing
  - Selecting suitable medicine
  - Providing Instructions
- Patient
  - Implementing the treatment plan to produce a health body

In our Case .. Who is the Doctor and who is the patient?

- Doctor is mix designer.
  - Diagnosing → Defining the mix parameters
  - Selecting → Selection of materials & %s
  - Instructions → JMF, temperatures, $\%G_{mm}$, …
- Patient is mix construct, objective is to **produce**, **haul** and **place** a mixture meeting the specified design requirements
  - Quality
  - Volumetric
  - Mechanical

Mix Production .. What is wrong?

- **Failure to maintain aggregate quality at the whole course of production:**
  - At the beginning everything is ok until the "good" material is all consumed and in the later part of production, "not so good" or even sometime "bad" material is being fed to the production line.

- **Hot bin aggregates are randomly checked <u>only</u> for gradation just to meet the JMF requirements:**
  - Often, contractors "ignore" the aggregate quality tests (such as fine aggregate angularity), the mentality is that FAA is not being checked in the handing over

Mix Production .. What is wrong?

- **Same mix design although new source of aggregate is being used:**
  - Although the old aggregate and the new have the same color and texture and comes from the same location, checking all the properties of the new aggregate must be done. Aggregates changes its properties as you go deeper in the quarry site.
- **Asphalt binder is "under modified" or less than the PG required:**
  - homogeneity is questionable due to inadequate agitators (specially crumb rubber modified binder)
  - improper storage which causes unnecessary alteration of asphalt "freshness"
- **Less frequency of tests in the daily production of mix:**
  - Test is done mostly on a one time/batch basis.
  - Neither the contractor (QC) nor consultant (QA) do sufficient checking

Mix Hauling

- **Truck drivers often neglect the importance of covering the asphalt, Exposure of the mix to the atmosphere for long travel / hauling time (even on summer days) effect the mix:**
  - Loss of temperature
  - Lumps of cooled HMA will develop
  - Specified density and smoothness of the finished pavement can only be achieved when the mix temperature is uniform.
- **load truck properly**
  - Paver pulls up to meet the truck
  - DON'T BUMP THE PAVER!
  - Break the load before opening tailgate
  - Charge the hopper before it's empty

Mix Hauling

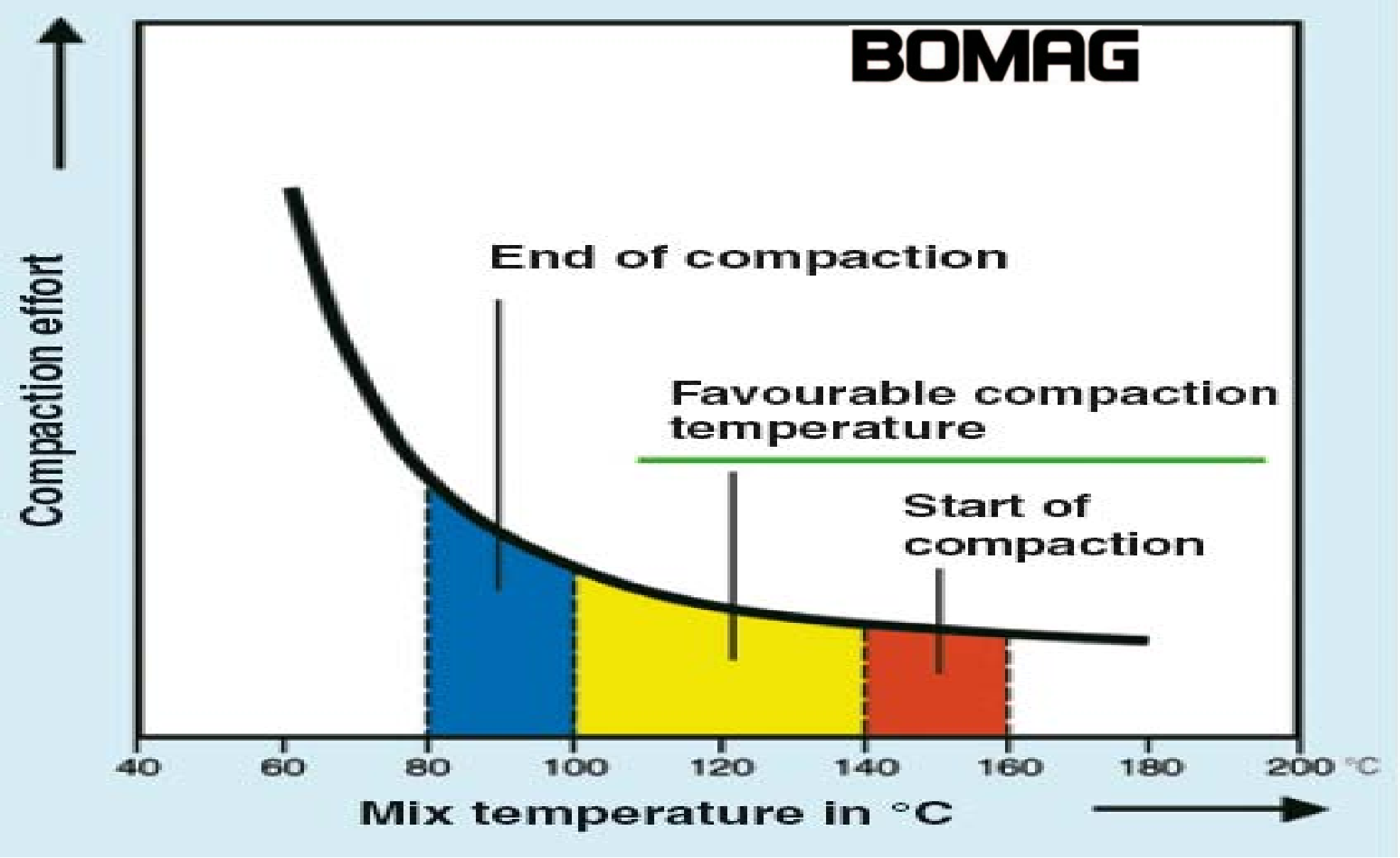
- **Regardless of the type and capacity of the haul vehicles, the delivery of HMA from the plant to the paving project requires consistency and regularity so that the mix being placed is of uniform temperature.**
- **Temperature segregation tends to occur in a cyclic manner with each truckload and is 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.

Mix Placement and Compaction

Use Shuttle Buggy to have a consistent mat temperature, there are three main things the Shuttle Buggy gives us:

- First, it helps us meet smoothness specifications.
- Second, it cures our segregation problems.
- And third, it gives us good compaction numbers

Effect of Compaction temperature on compaction effort



Mix Handling and Placement

Avoid segregation:

- "Segregation is the lack of homogeneity in the hot mix asphalt constituents of the in-place mat of such a magnitude that there is expectation of accelerated pavement distresses" .. In other wards it is the non-uniform distribution of coarse and fine aggregate components within the asphalt mixture."
- A quantitative aggregate segregation definition is less certain. Since coarse segregation is generally accepted as most destructive, a general quantitative definition is a sample 10% coarser than the JMF on the 2.36-mm or the 4.75-mm sieve.
- The chief detrimental effects of segregation on HMA performance are: reduced fatigue life, rutting, raveling, and moisture damage. These effects can cause a severe reduction in pavement life.

There are two basic types of aggregate segregation:

- **Coarse segregation.** Occurs when gradation is shifted to include too much coarse aggregate and not enough fine aggregate. Coarse segregation is characterized by low asphalt content, low density, high air voids, rough surface texture, and accelerated rutting and fatigue failure (Williams et. al.,1996b). Typically, coarse segregation is considered the most prevalent and damaging type of segregation; thus segregation research has typically focused on coarse segregation. The term "segregation" by itself is usually taken to mean "coarse segregation.

- **Fine segregation.** Occurs when gradation is shifted to include too much fine aggregate and not enough course aggregate. High asphalt content, low density, smooth surface texture, accelerated rutting, and better fatigue performance characterize fine segregation (Williams, Duncan and White,1996).

Sources of Segregation

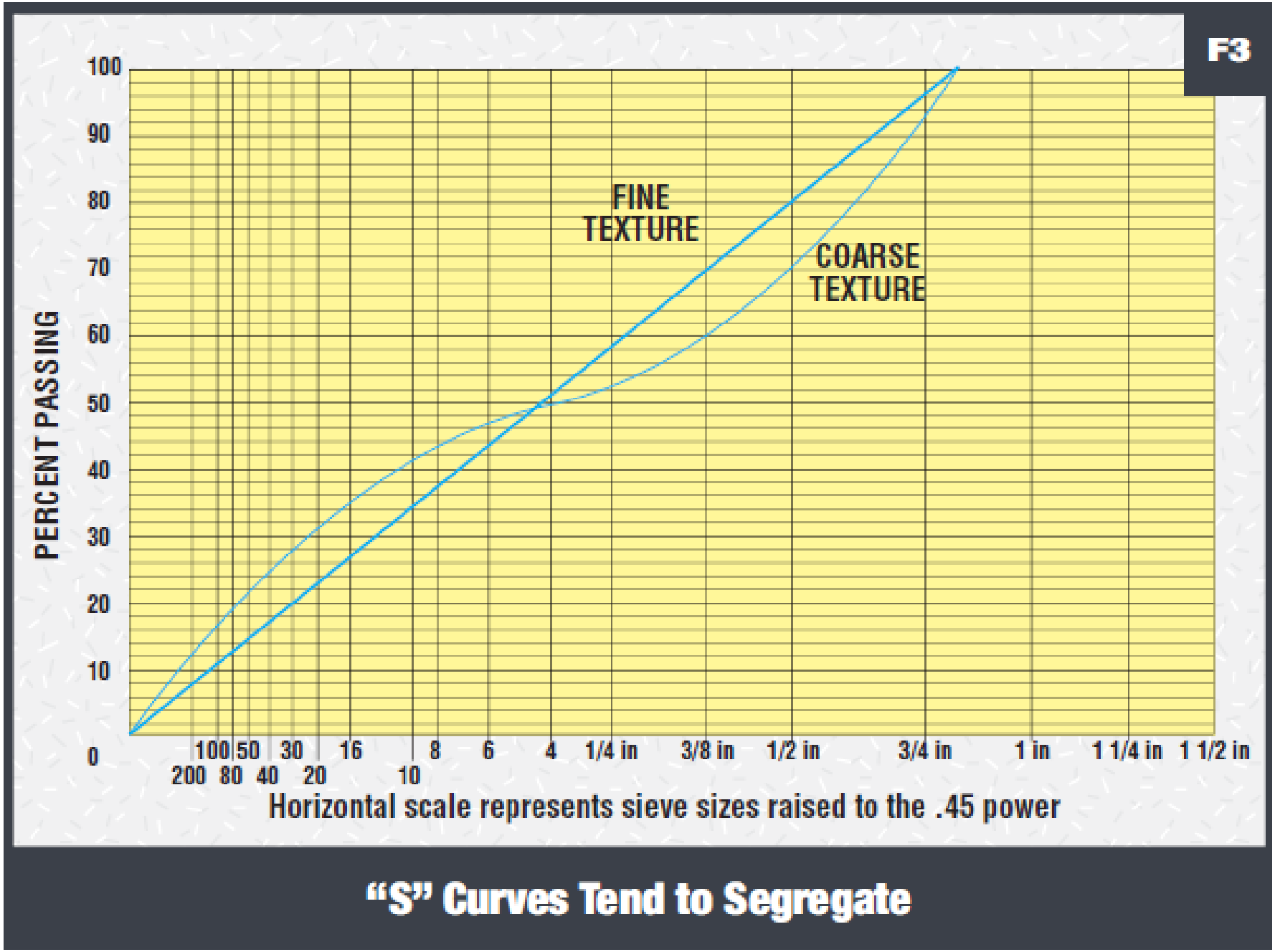
- Large size asphalt mixes (coarse)
- Poor operation, poor storage and truck loading systems (use shuttle buggy)
- Start and end of truck loads
- Paver mechanical and operation through uneven flow of material
- Poor handwork
- Asphalt binder drain-off in open graded and stone mastic asphalt mixes

The Joint Task Force on Segregation from the American Association of State Highway and Transportation Officials (AASHTO) and NAPA (1997) identified five major segregation sources:

1. **Mix design:** The key mix design parameters in determining segregation susceptibility are gradation and asphalt content (AASHTO, 1997). Specifically, open-graded mixes and low asphalt binder content mixes are particularly prone to segregation.

   A mix design that makes an "S" across the maximum density line, as shown in **Figure 3**, can result in segregation problems.

2. **Stockpiling:** If aggregate is loaded on top of a conical stockpile then larger aggregate sizes are more likely to roll to the outside and bottom.



"S" Curves Tend to Segregate

3. **Asphalt plants:** Key portions of the plant generally concerned are :
   - Cold feed bins, bins may not feed uniformly.
   - Batch plant hot bins, dust may collect on the wall and discharge in large concentrated slugs.

4. **Truck loading and unloading:** Loading trucks in one large dump may cause the larger aggregate sizes to roll to the outside and bottom.

5. **The asphalt paver:** Segregation occurs as a result of hopper operation, auger speed, and disruptions in paver movement.

More information can be found in AdEC website under

Segregation Causes and Cures

Compaction.. Be careful !!

- Test Strip is often neglected:
  - Establish rolling pattern for compaction Speed and lap pattern for each roller
  - No. of passes for each roller, there is no "counting of number of passes" to reach the desired compaction being done
  - Minimum temperature by which each roller must complete pattern
- Equipment versus the area
  - Adequacy of compaction equipment specially on winter days must be observed.
  - TAC (Time available for compaction)10 to 20 min.
  - Compaction must end before the temperature goes down below 90°C for NAB and 115 C for PMB or when you see signs or appearance of broken aggregates.

Compaction.. Be careful !!

- Equipment control
  - operators must know and be trained on how to treat the pavement "nicely".
  - Swerving, over vibration and sudden stops must be avoided
  - Right setting of frequency and amplitude.
- Equipment condition (efficiency)
  - There is segregation after the paver. The vibration is not enough to deliver the initial compaction
- Cycle time
  - One of the most neglected method of construction.
  - The supply of mix must be continuous to avoid cold joints
  - Coordinate mixture delivery, paver speed and compaction operations *IMPORTANT:*Paver speed must not exceed that of the compaction operation!!!

Compaction.. Be careful !!

- Stability of the underlying structure (aggregate base course)
- Strength of the adhesive material used
  - MC1 and RC2 must be correctly, evenly and properly sprayed
  - Always check its cleanliness and freshness (recommended curing time and expiration)

Compaction.. Be careful !!

- Weather factor
  - Weather limitations must always be observed.
  - In case of saturated aggregate base course surface, ensure that it is totally dried up and the MC1 must be removed and re-sprayed.
- Construction Joints (side and longitudinal)
  - should be totally watertight to avoid water seepage. Joint treatment by saw-cuting joints after completion before next day's production
  - stagger transverse joints
- Equipment Parking
  - Avoid parking of compaction equipment on the fresh asphalt pavement during delay of supply or while spreading, because it creates "depression" on the area.
  - Overnight parking on the newly finished pavement also must be avoided

Balance the paving operation

- Balancing the operation is the key to effective placement of HMA
- Balance between placement & production and between mix delivery & production yield the best results.
- Careful control of the paving speed enables efficient laydown and compaction of the mix at consistent temperatures.
- The best paving projects find balance between each of these elements.

Concluding Remarks

- Good Superpave mix design needs good input.
- Good mix design is not enough.
- Good construction practice of HMA accounts for a major part in achieving an acceptable pavement performance.
- Avoid mix segregation because it effects HMA performance, segregation will result in: reduced fatigue life, rutting, raveling, and moisture damage. These effects can cause a severe reduction in pavement life.
- Successful good pavements do not happen by accident; they are the result of careful planning and implementation.