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Mixture Type Selection

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Asphalt Institute

- International association of petroleum asphalt producers, manufacturers, and affiliated businesses, established in 1919
- Promotes the use, benefits and quality performance of petroleum asphalt through engineering, research and educational activities.
- HQ office-Lexington, KY
- Seven US Field Engineering offices
  - Portland, OR; West Lake Village, CA; San Antonio, TX; Sioux Falls, SD; Gohanna, OH; Franklin, TN; Dillsburg, PA

Presentation Topics

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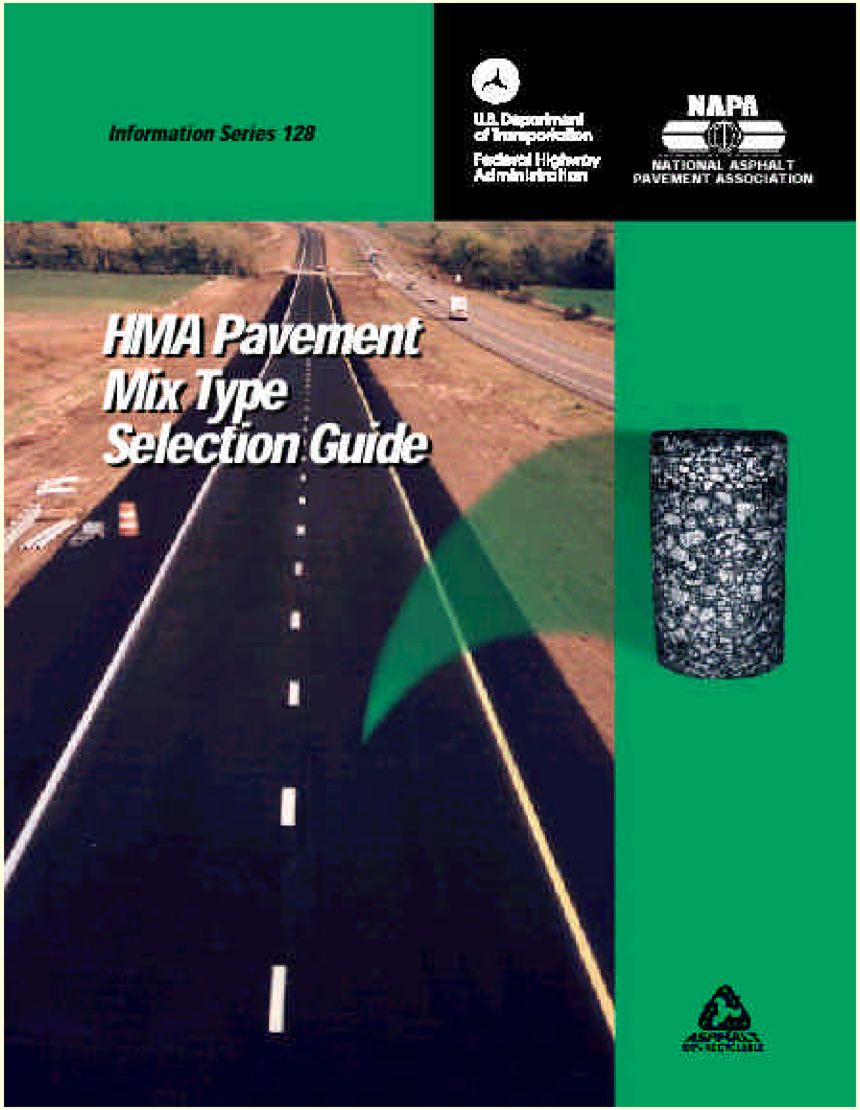
- Background
- Define mixture classifications, characteristics
- Guidelines for selecting mixtures
- Questions, discussion

Reference: FHWA Guide / NAPA IS 128



- Developed by national Expert Task Group in 2000
  - Current State DOT / local government practices
- Provide guidelines for selecting mixtures for various application
  - Not intended to cover every situation

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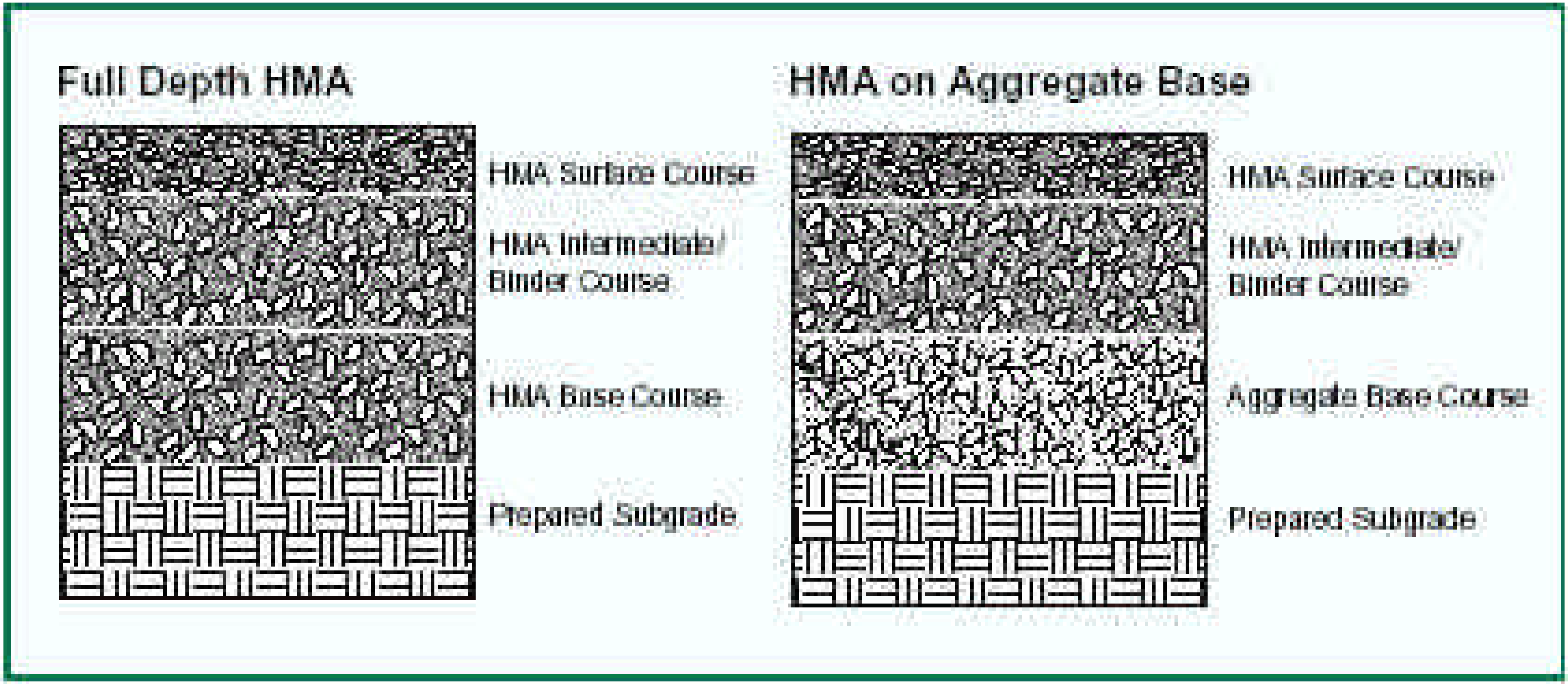
Why was this Guide developed?

- Survey of FHWA State/Division offices
  - 83% confirmed need
  - Problems cited with how pavement structure affects surface mixture performance, construction problems
- ETG wanted to provide guidelines for applying “new” mixture classifications such as OGFC and SMA, as well as dense-graded mixes

Pavement Layer Definitions

- Surface Layer
  - Must consider functional characteristics (comfort, safety-related)
  - Usually requires highest quality materials
- Intermediate (Binder) Layer
  - Structural HMA that must resist permanent deformation and distribute loads
  - Facilitates construction of surface layer and provides an opportunity to improve profile/smoothness
- Base Layer
  - Principal structural element
  - May consist of HMA, graded aggregate, or other material
- Leveling Course
  - Usually, a thin layer used to correct profile prior to HMA overlay

MTSG, Figure 1



Traffic Levels

- Simplified categories, based on 20 year ESAL
  - Table 1, MTSG
- Low: < 300,000 ESALs
  - Local roads, county roads, limited trucks, recreational sites
  - Minimal truck/bus traffic
- Moderate: < 300K to 10M ESALs
  - Medium to heavy trafficked streets, state routes
- High: > 10M ESALs
  - Interstates, other highways receiving heavy truck traffic, major arterial streets in urban areas

Mix Types

- Dense Graded
  - Coarse
  - Fine
- Stone Matrix Asphalt
- Open Graded
  - Surfacing mixtures: OGFC, PEM/PFC
  - Subsurface: asphalt-treated permeable base (ATPB), crack-relief layer

Mix Types

- Dense Graded
  - Coarse
  - Fine
- Stone Matrix Asphalt

Dense Graded Mixes

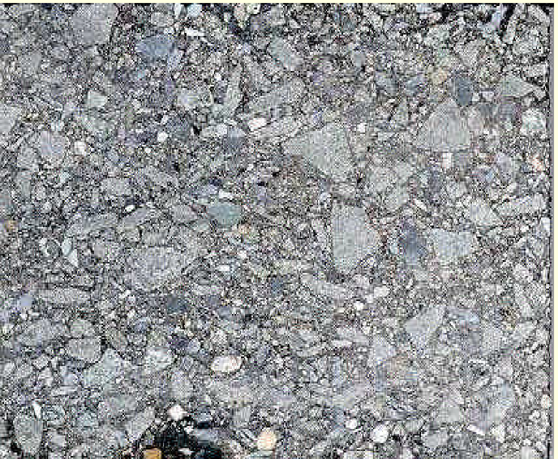
- Well-graded aggregates
- Design Methods: Superpave, Marshall, others
- Mixtures classified according to:
  - Nominal maximum particle size
  - Coarse- or fine-grading


4.75 (#4)


9.5 (3/8 in)


12.5 (1/2 in)

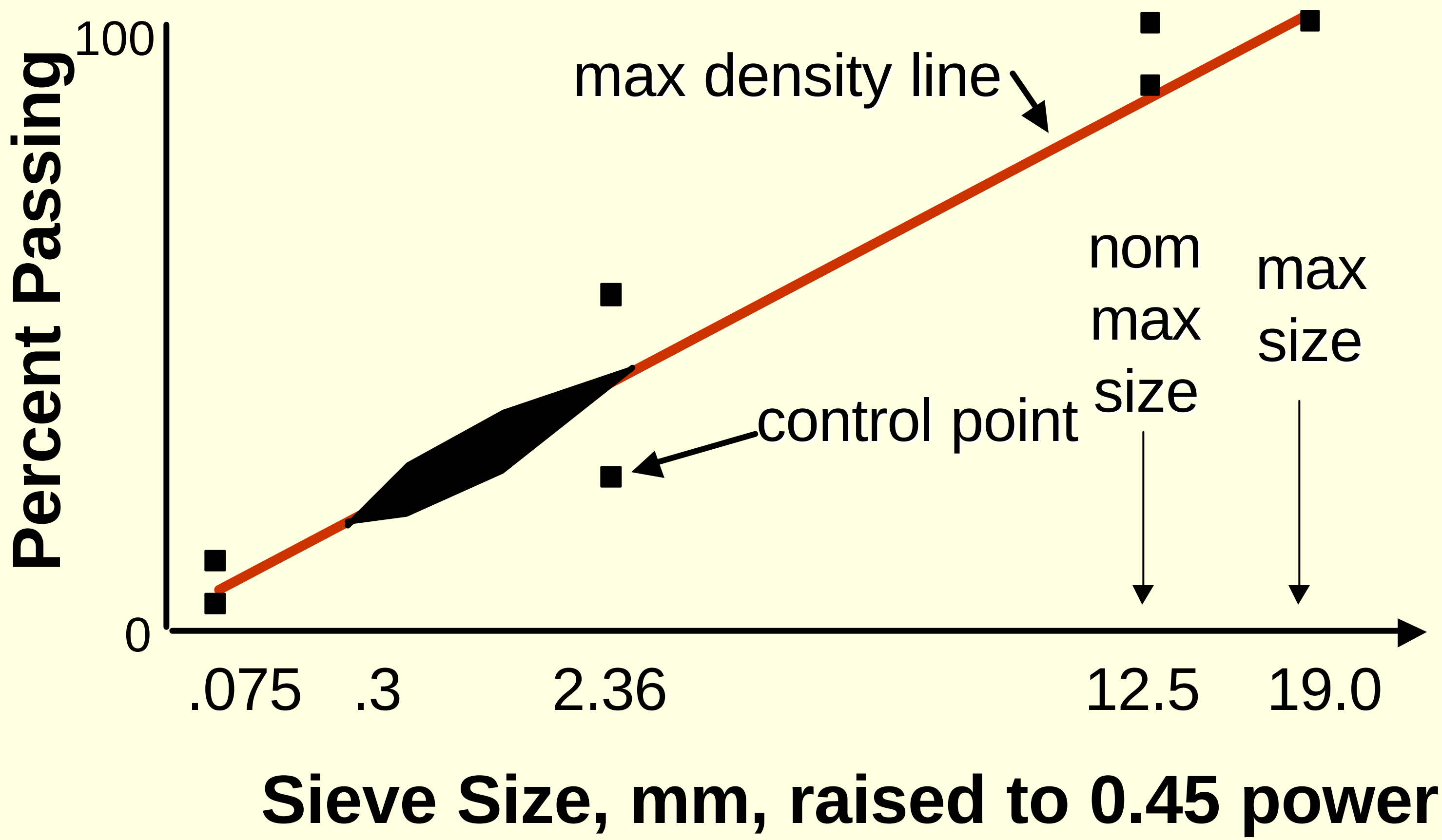
Dense Graded Mixes

19.0 (3/4 in)


25.0 (1 in)


37.5 (1½ in)


Aggregate Gradation, 0.45 power



Fine-/Coarse-Graded Criteria per ETG Recommendation

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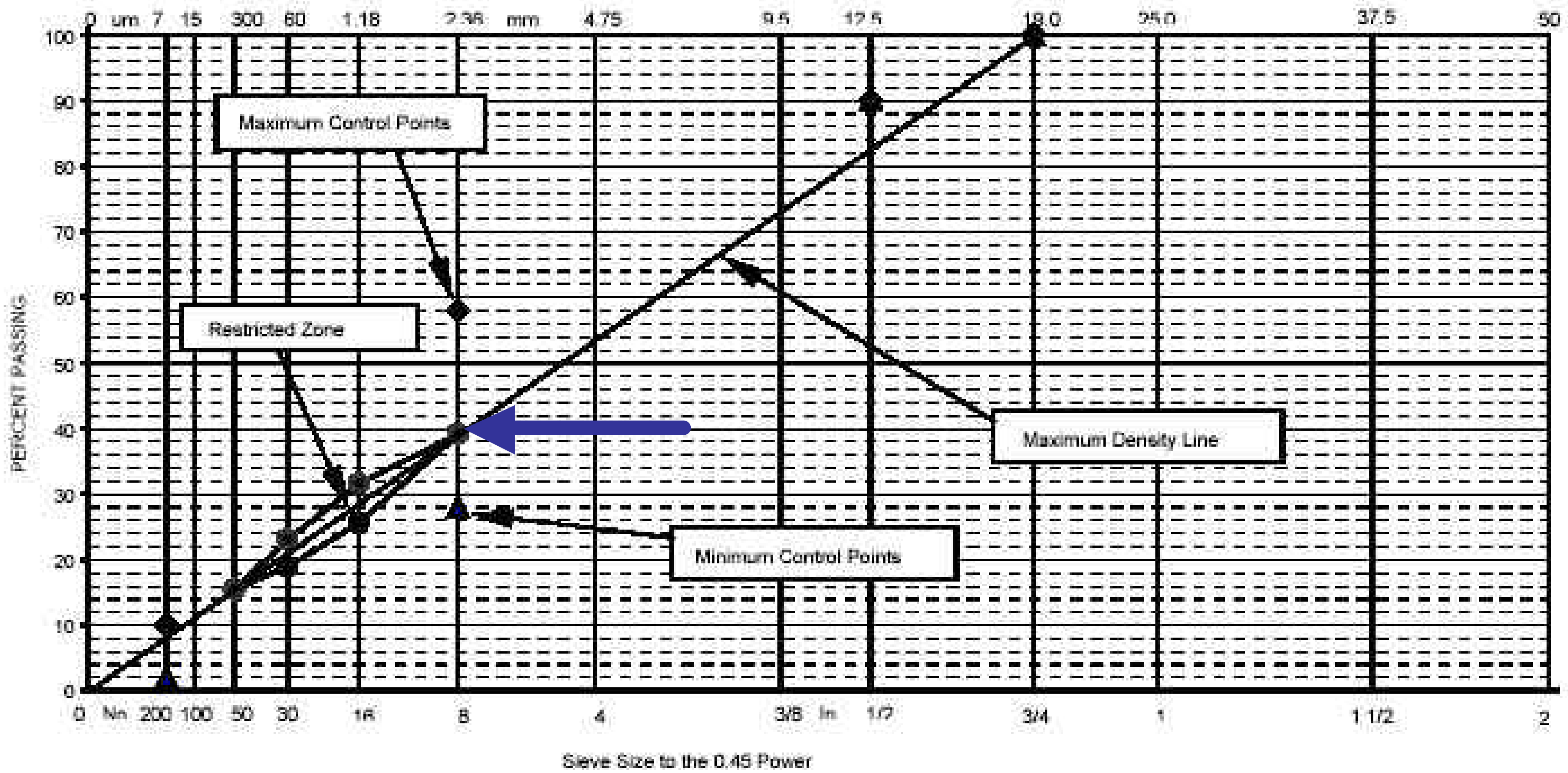
Mixture	Control Sieve	Breakpoint
9.5 mm	2.36	47%
12.5 mm	2.36	39%
19.0 mm	4.75	47%
25.0 mm	4.75	40%
37.5 mm	9.5	47%

Note: These differ from what is shown in MTSG Table 2

12.5 mm (1/2 in) NMS



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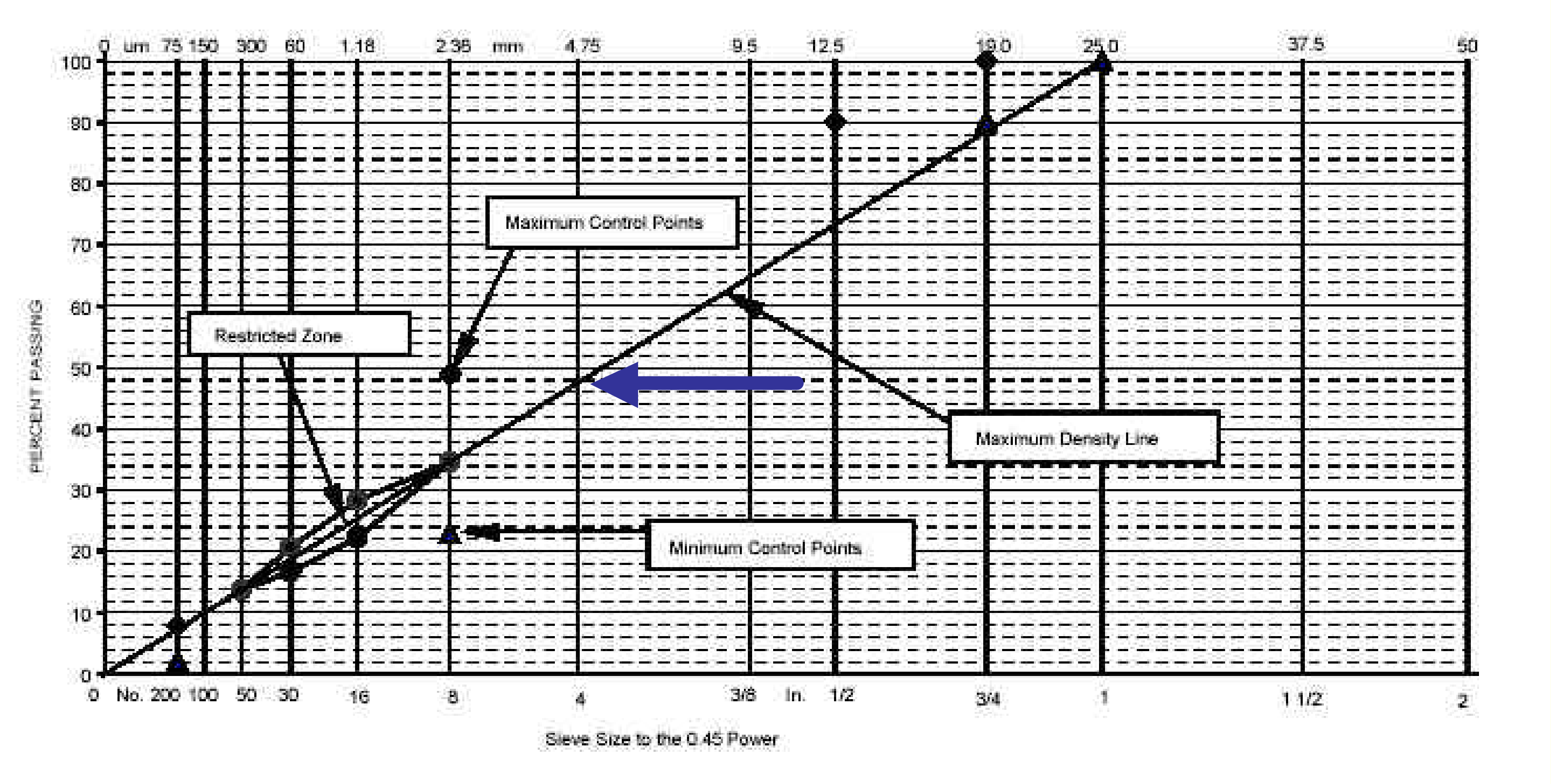
19 mm (3/4 in) NMS



Subclassification of Dense Graded HMA

- Laboratory compaction level
  - Superpave, N_{des}
  - Marshall, # blows
- Aggregate quality requirements
  - Course aggregate angularity
  - Fine aggregate angularity
    - Limitations on natural sand
  - Coarse aggregate polish resistance (wearing courses only)
- Ultimately controlled by anticipated traffic loading

Characteristics of Coarse- and Fine- Graded HMA

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- Fine-Graded
  - lower permeability, greater workability, greater durability, smoother texture, allows thinner lifts
- Coarse-Graded
  - increased macro texture, allows thicker lifts, greater resistance to rutting???

Characteristics of Coarse- and Fine- Graded HMA

- Fine-Graded
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- Coarse-Graded
  - increased macro texture, allows thicker lifts, greater resistance to rutting?

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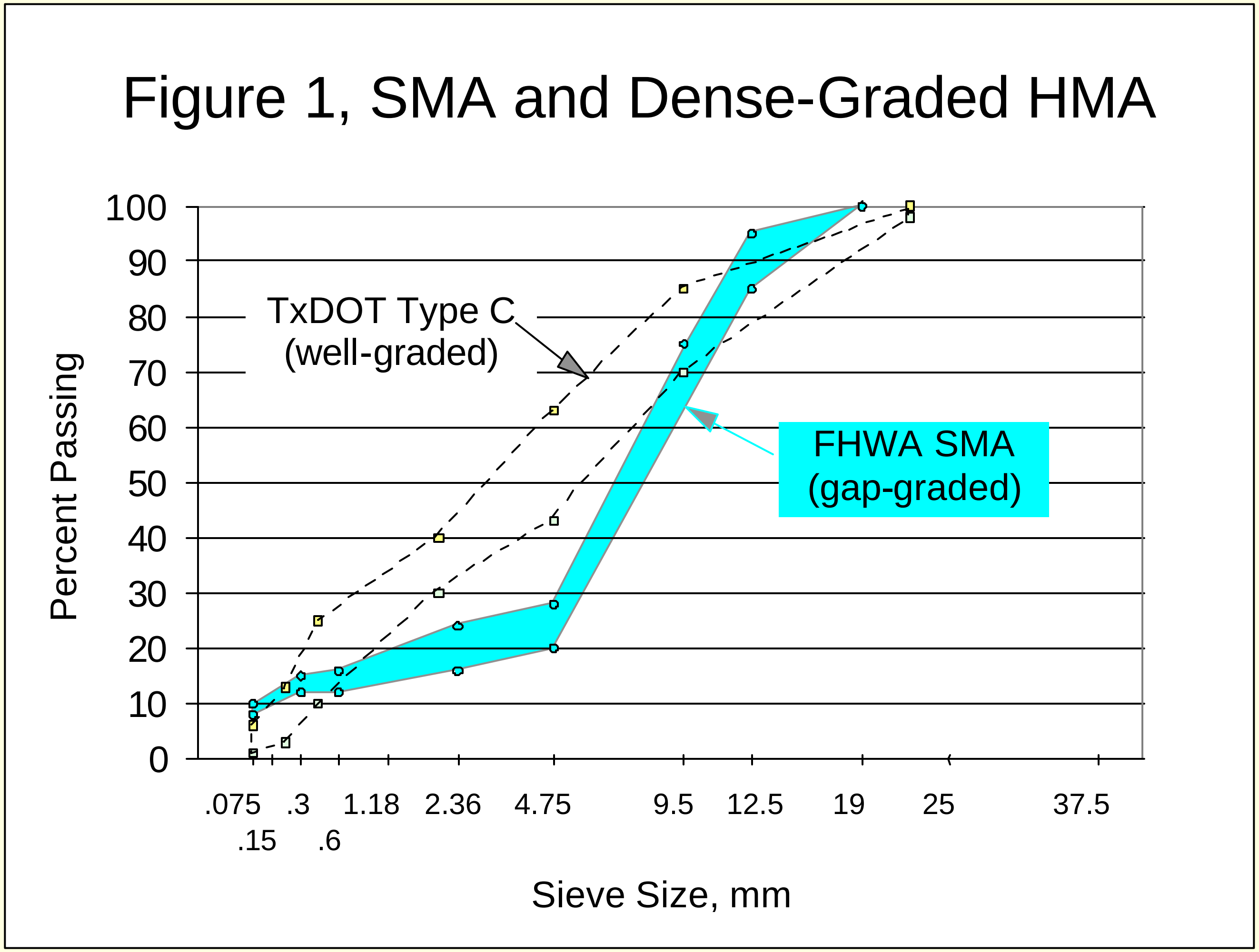
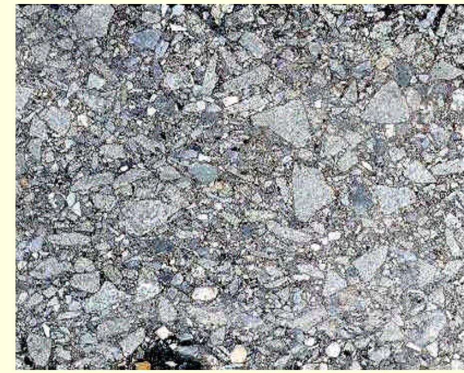
Stone Mastic Asphalt (SMA)

- Gap-graded surface or intermediate layer mixtures
- Design Procedure: NCHRP Report 425
- Resists plastic deformation (stone-on-stone)
- Resists cracking (rich w/ AC mastic)
- More expensive than dense-graded mixes

SMA, Conventional HMA



Dense-Graded



SMA

Lifts/Layers

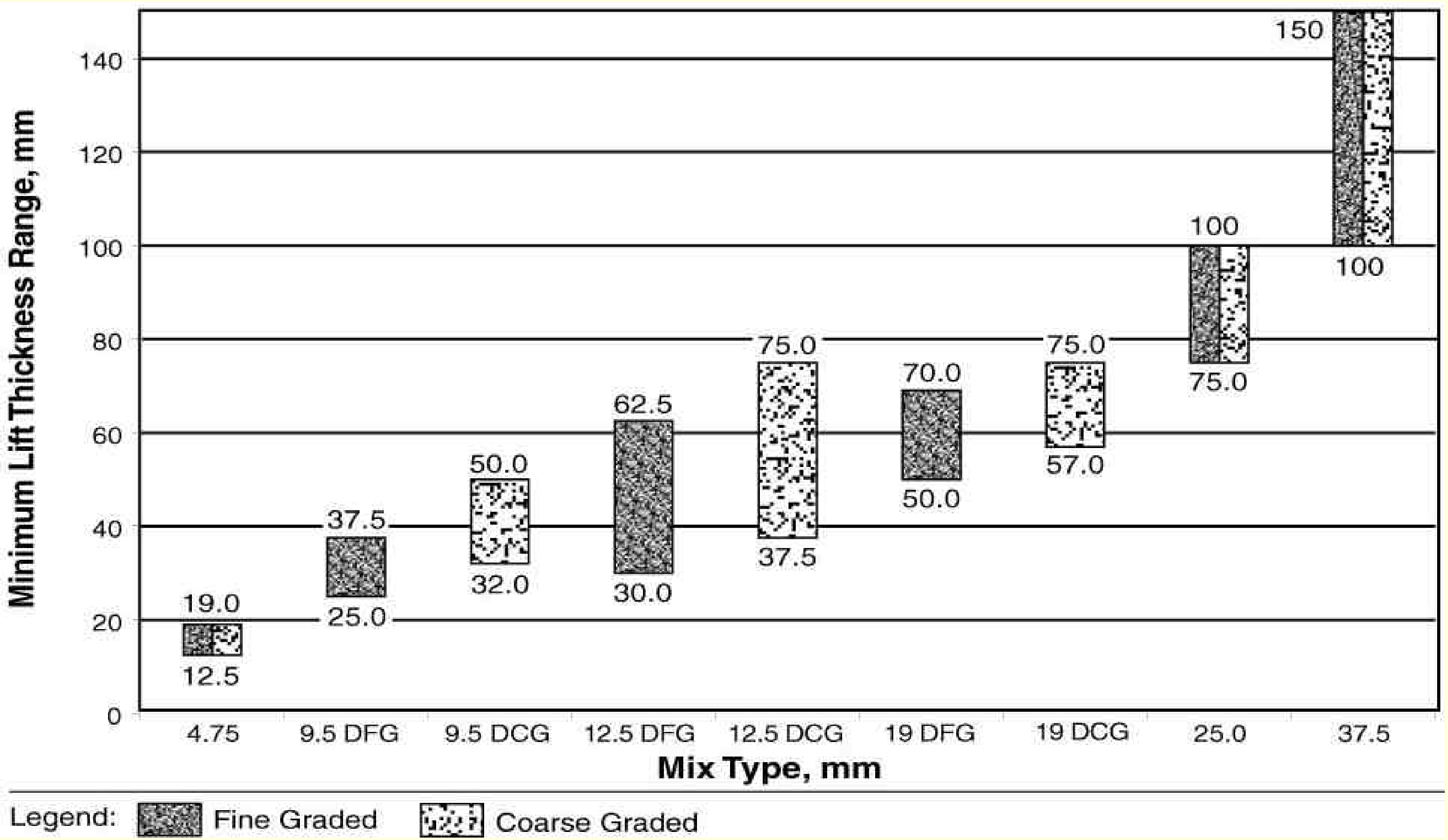
- A “lift” is the application of a individual mat of material
- A “layer” is the total thickness of like material
  - A layer may consist of one or more lifts

One, six-inch layer
Two, three-inch lifts

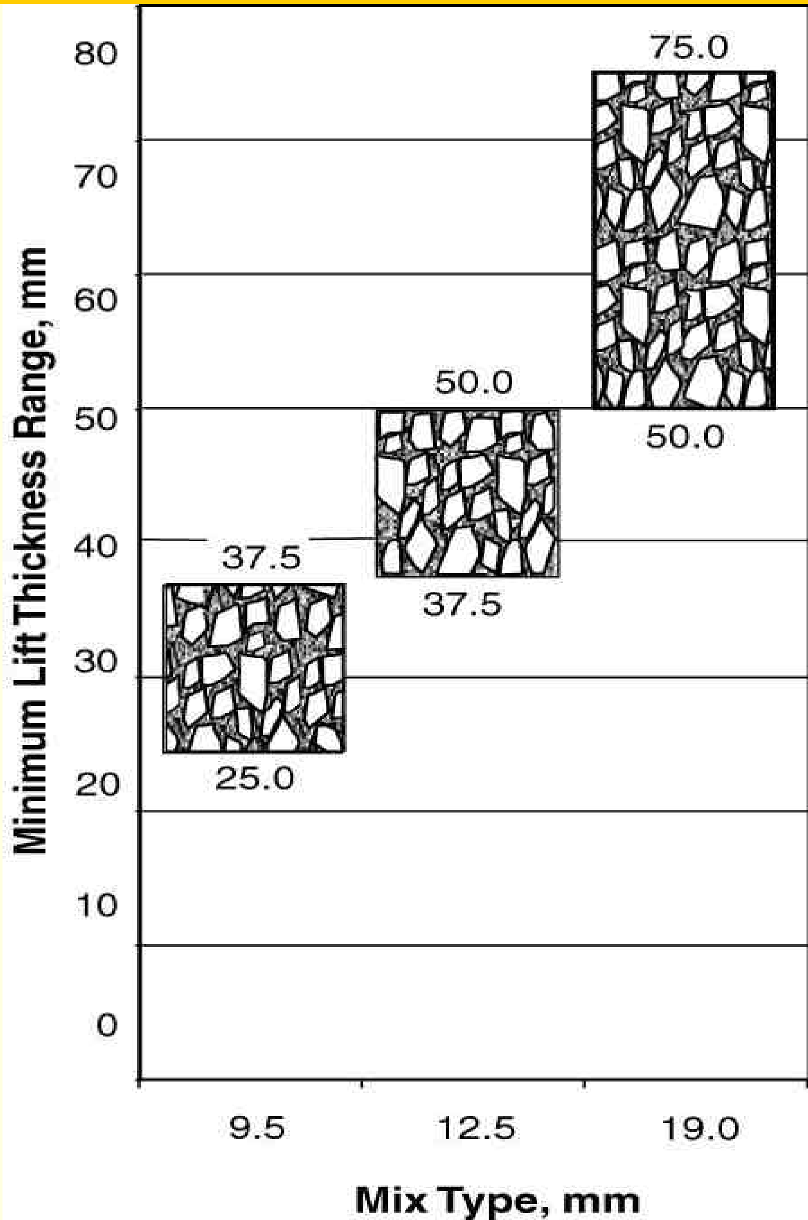
Lift Thickness

- Coarse-graded mixtures, mixtures using modified asphalts
  - 4 – 6 X NMS
- Fine-graded mixtures
  - 3 – 5 X NMS
- Why the difference?
  - Ability to compact to in place air void level where the mixture is relatively impermeable to water

Lift Thickness Ranges (see Figure 5)



Lift Thickness Range for SMA



- Classifications defined according to mixture NMS
- Suggested lift thickness:
  - 3 to 5 X NMS

Types of Asphalt-Surfaced Pavements

- Thin-surfaced “flexible” pavement
- Composite pavement
  - Asphalt surface over cement-stabilized base or concrete pavement
- “Deep Strength” asphalt pavement
- “Full-Depth” asphalt pavement

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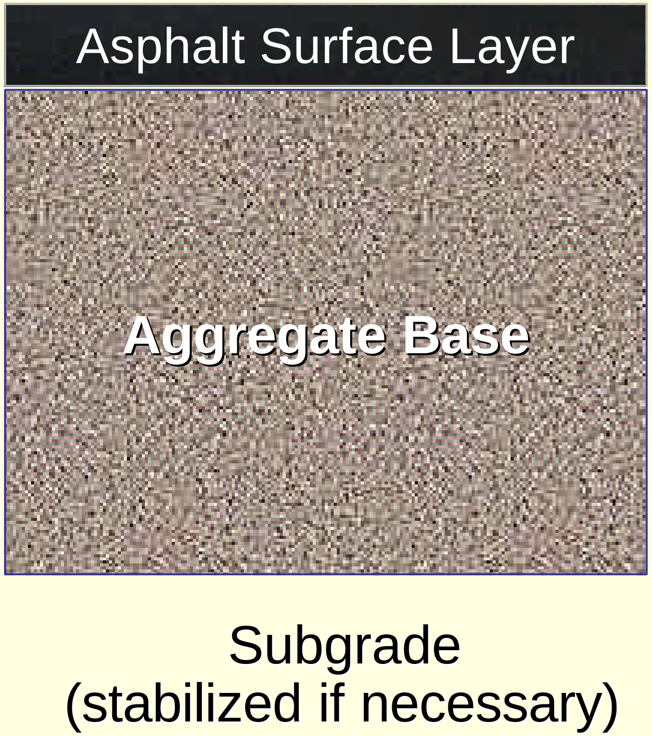
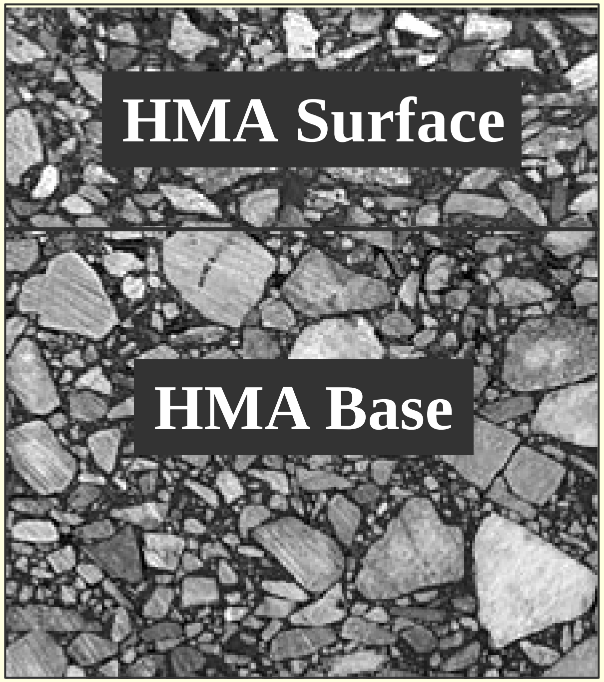
“Flexible” Pavements

- Thin (< 3 inch) asphalt surface placed on an unbound aggregate base layer
- Load is carried by base course, asphalt surface provides wearing surface and protective cover for base
- Prefer dense, fine-graded mixtures to seal the base and resist cracking



Asphalt Pavements

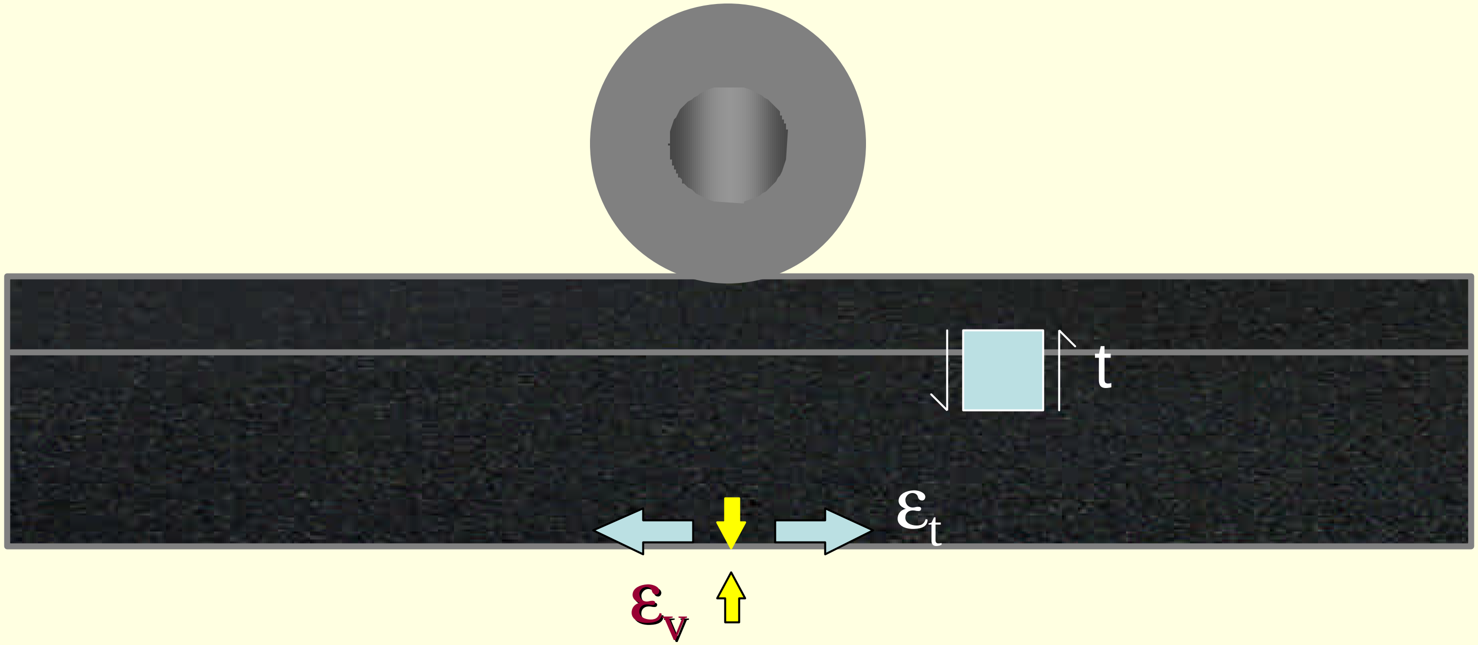
- Deep Strength requires multiple courses of HMA
- Full-Depth uses asphalt mixtures for all courses above prepared or improved subgrade
- Prefer stiff, rut-resistant mixtures



Subbase or subgrade
(subgrade stabilized if necessary)

Asphalt Pavements rely on asphalt mixtures as the major load-bearing component in the pavement system.

Asphalt Pavements:
How they work



An asphalt pavement develops flexure, minimizing compressive strain on subgrade

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Mixture Selection Considerations

- Total thickness of HMA required
  - Determined by pavement structural design
- Type of pavement structure
  - Deflecting structure vs. stiff pavement structure
- Desired surface characteristics
  - Traffic, surfacing thickness, texture
- Construction traffic considerations
- Practical considerations
  - Don’t use more separate mixture designs on a single project than necessary
- Local conditions/experience

Surfacing Mixtures

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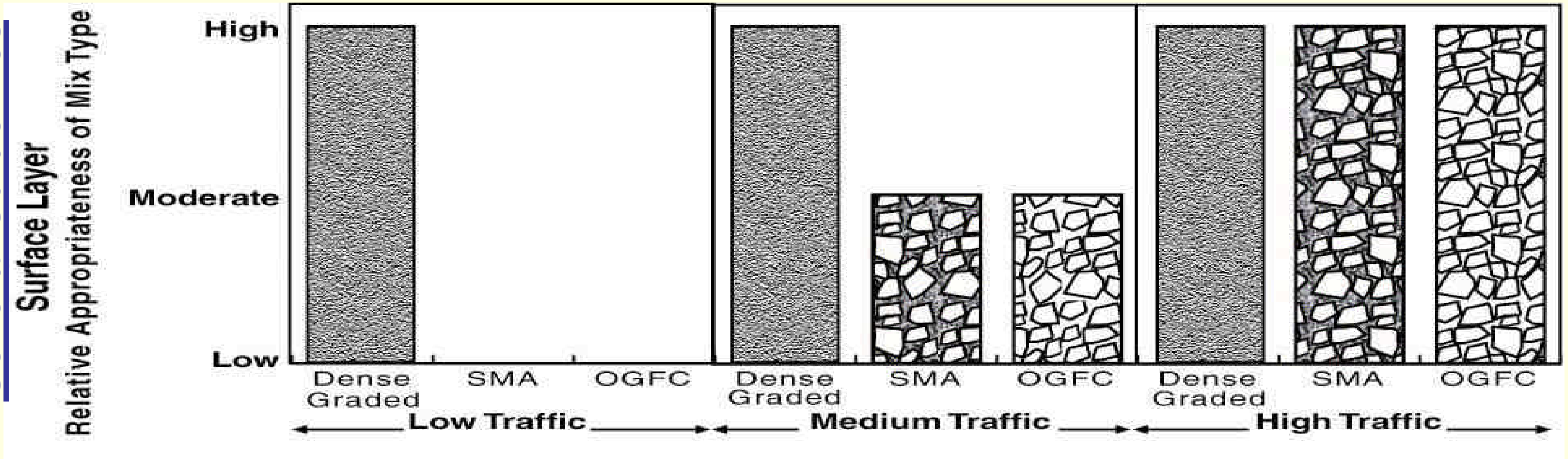
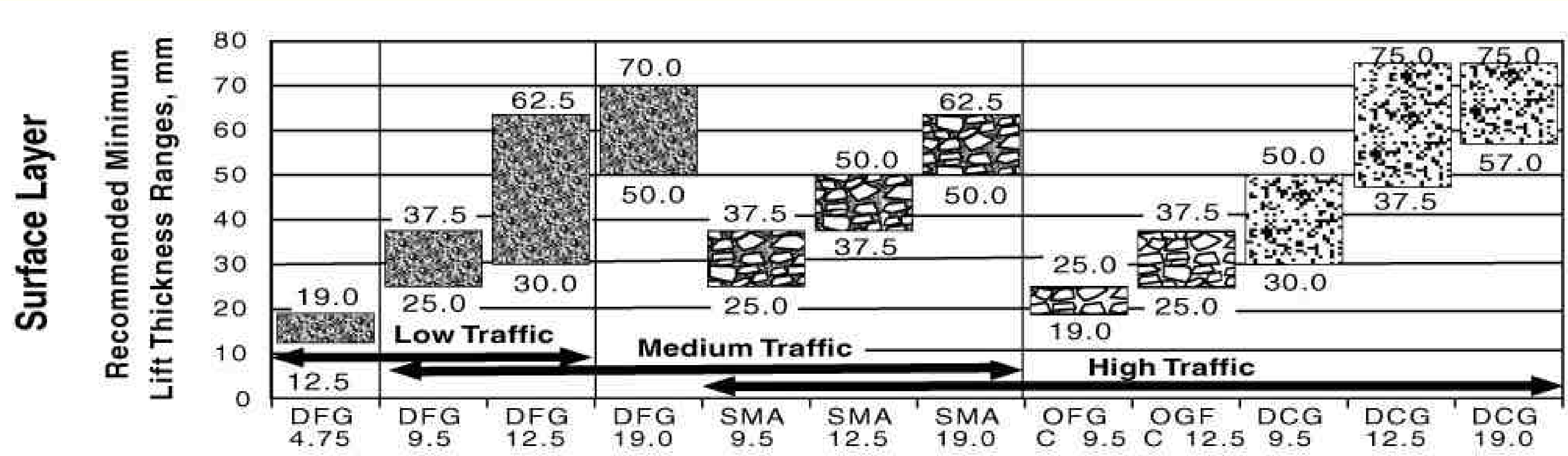
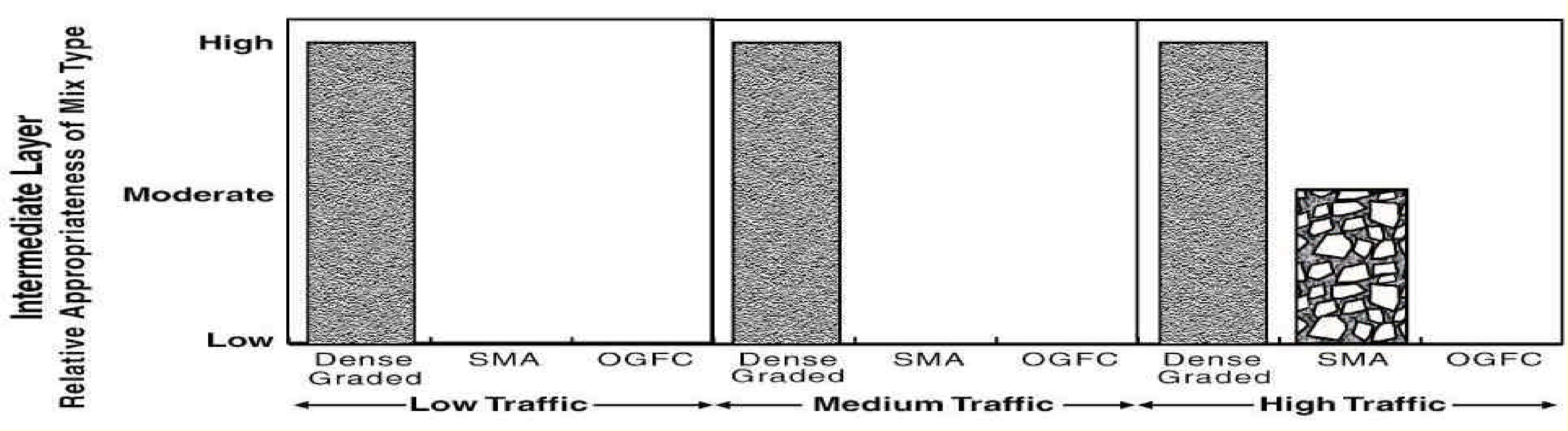
General Guidelines

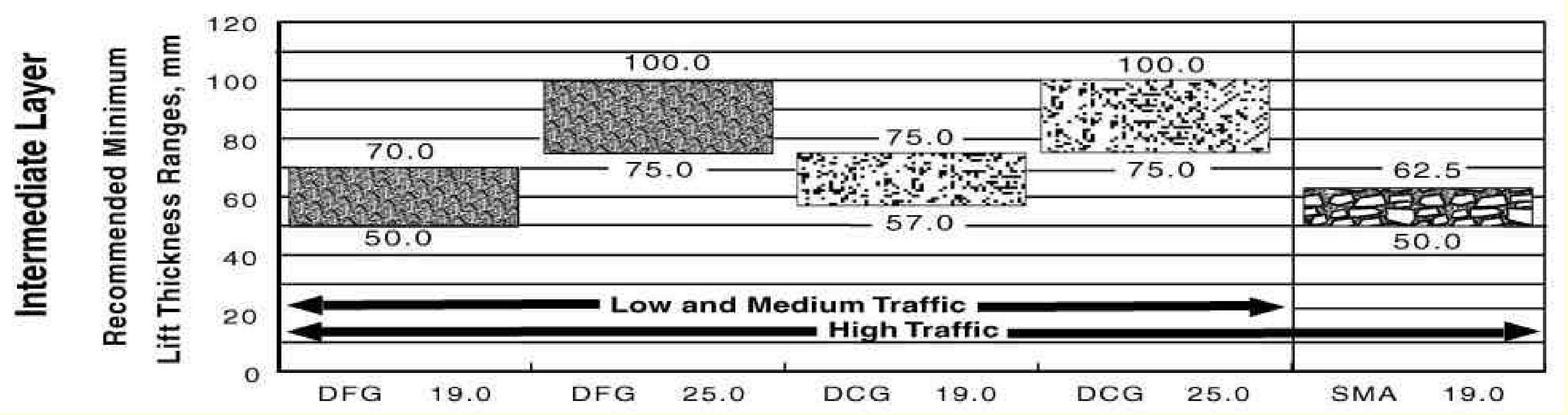


Specific Guidelines

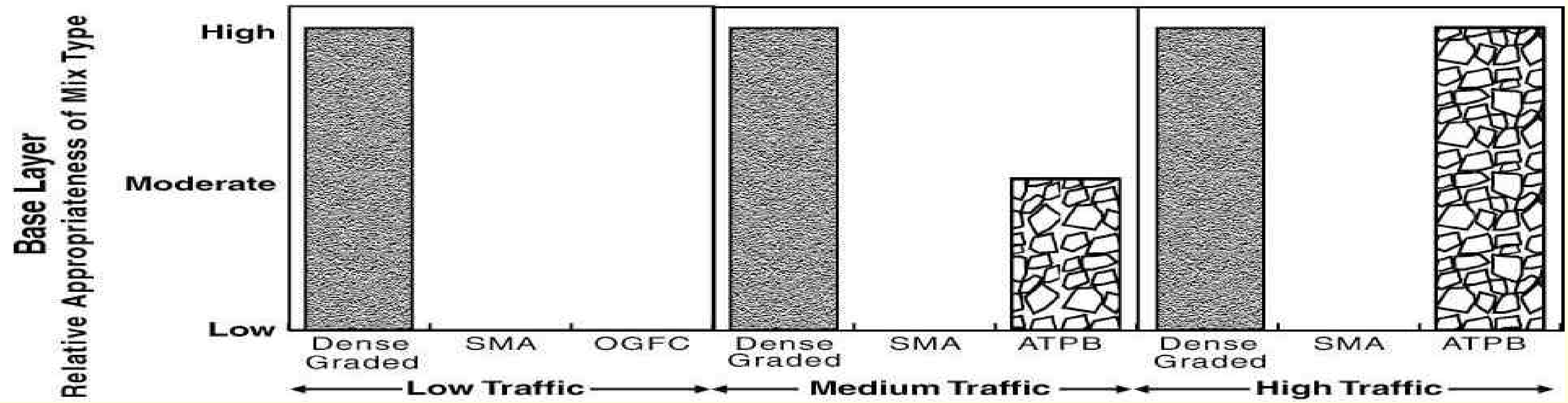


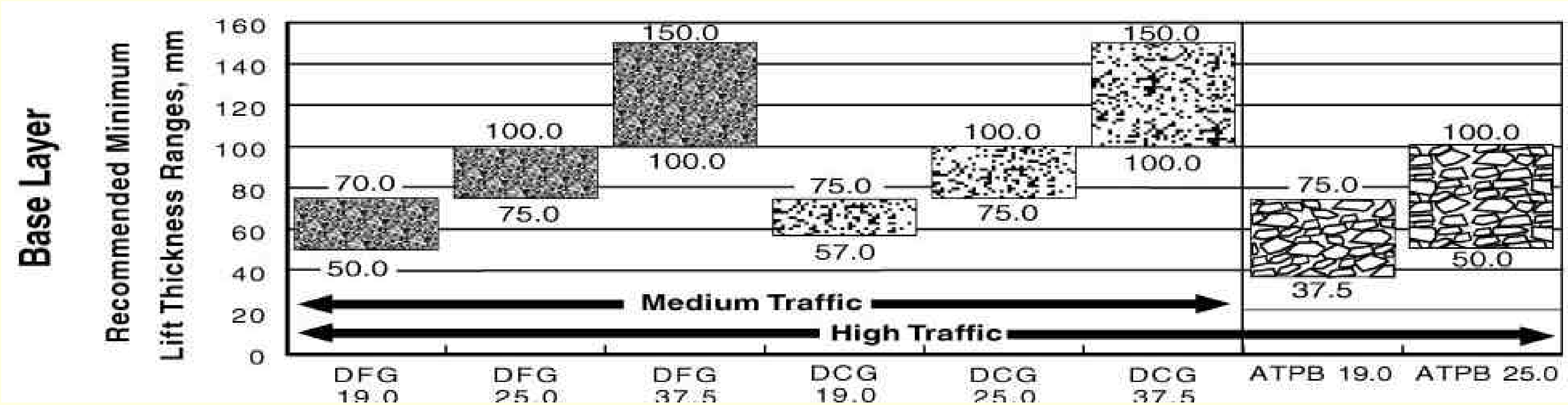
Intermediate Mixtures





Base Mixtures





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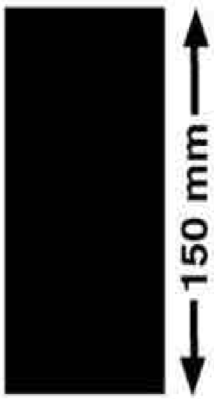
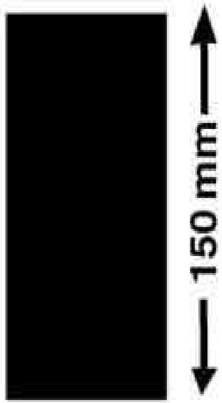
Example

STEP 1: Determine Total Thickness:



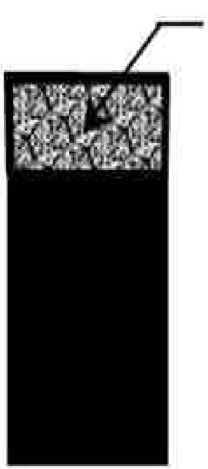
Project A: A city street is being reconstructed as part of a downtown redevelopment project. Performance and appearance are both important.

The total thickness of HMA required for this project is 150 mm (6"). Traffic loading is classified as moderate.



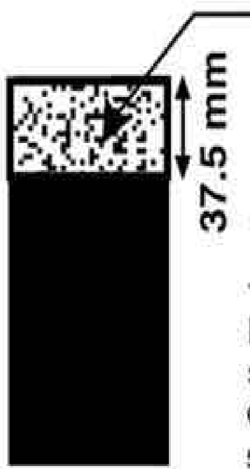
Project B: An industrial park is being put in at the end of an existing rural road. An increase in truck traffic requires a 150 mm (6") overlay. Traffic loading is classified as moderate to high.

STEP 2: Determine Surface Course Mix Type and Thickness



9.5 mm DFG, 37.5 mm thick

Project A: Referring to Figure 2 and then Figure 3, a dense fine-graded (DFG) is the most highly recommended mix type for this traffic level. While SMA may be used in this situation, the traffic level may not warrant the added expense, and DFG mixes have performed well in this area in similar situations. A 9.5 mm DFG mix is selected, partially for appearance. The mix will be placed 37.5 mm thick.



12.5 mm DCG, 37.5 mm thick

Project B: Referring to Figure 2 and then Figure 3, all mix types are considered appropriate for this traffic. Because traffic speeds are low, OGFC is not considered. Resistance to rutting is a major concern due to a high percentage of trucks, therefore a larger stone mix may be used for the surface since appearance is not an issue. A 12.5 mm dense coarse graded mix is selected for the surface. The mix will be placed 37.5 mm thick.

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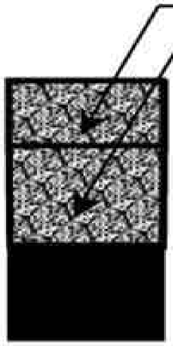
Example – *cont.*

STEP 3: Determine Intermediate Course Mix Type and Thickness



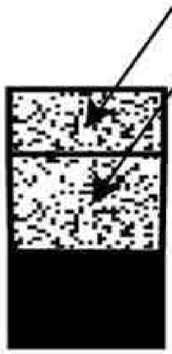
9.5 mm DFG, 37.5 mm thick

19.0 mm DFG or DCG, 57 mm thick

Project A: Referring to Figure 2 and then Figure 3, either a 19.0 mm or a 25.0 mm dense, fine-graded (DFG) or a coarse-graded (DCG) mix is appropriate for this traffic loading and layer. The total remaining thickness is (150 mm–37.5 mm), 112.5 mm.

If a 25.0 mm mix is used, it would be best to place it as a thick single lift since the minimum lift thickness (75 mm) is greater that half the total remaining thickness.

19.0 mm DFG and DCG can both be placed at about 1/2 the total remaining thickness. A 19.0 mm DFG or DCG is selected since either will provide the necessary performance. The lift thickness is specified 57.0 mm to facilitate compaction of the DCG mix.



12.5 mm DCG, 37.5 mm thick

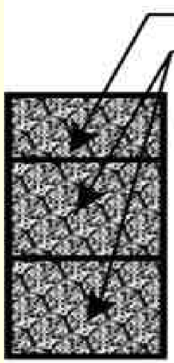
19.0 mm DCG, 57 mm thick

Project B: Referring to Figure 2 and then Figure 3, either a 19.0 mm or a 25.0 mm dense, fine-graded (DFG) or a coarse-graded (DCG) mix is appropriate for this traffic loading and layer. The total remaining thickness is (150 mm–37.5 mm), 112.5 mm.

If a 25.0 mm mix is used, it would be best to place it as a thick single lift since the minimum lift thickness (75 mm) is greater that half the total remaining thickness.

19.0 mm DFG and DCG can both be placed at about 1/2 the total remaining thickness. A 19.0 mm DCG is selected because of rutting concerns. The lift thickness is specified 57.0 mm.

STEP 4: Determine Base Course Mix Type and Thickness



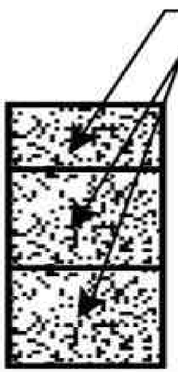
9.5 mm DFG, 37.5 mm thick

19.0 mm DFG or DCG, 2 lifts, 57 mm thick each lift

Project A: Referring to Figure 2 and then Figure 3, either a 19.0 mm or a 25.0 mm dense, fine-graded (DFG) or a coarse-graded (DCG) mix is appropriate for this traffic loading and layer. The total remaining thickness is (150 mm–37.5 mm), 112.5 mm.

A 25.0 mm mix cannot be used since the remaining thickness is less than the minimum lift thickness (75 mm).

19.0 mm DFG and DCG can both be placed at the remaining thickness. A 19.0 mm DFG or DCG is selected since either will provide the necessary performance. The lift thickness is specified 57.0 mm to facilitate compaction of the DCG mix. The total pavement thickness will be slightly greater than the the required thickness (151.5 mm vs. 150 mm) which is acceptable.



12.5 mm DCG, 37.5 mm thick

19.0 mm DCG, 2 lifts, 57 mm thick each lift

Project B: Referring to Figure 2 and then Figure 3, either a 19.0 mm or a 25.0 mm dense, fine-graded (DFG) or a coarse-graded (DCG) mix is appropriate for this traffic loading and layer. The total remaining thickness is (150 mm – 37.5 mm – 570 mm), 55.5 mm.

A 25.0 mm mix cannot be used since the remaining thickness is less than the minimum lift thickness (75 mm).

19.0 mm DFG and DCG can both be placed at the remaining thickness. A 19.0 mm DCG is selected because of rutting concerns. The total pavement thickness will be slightly greater than the required thickness (151.5 mm vs. 150 mm) which is acceptable.

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Suggestions

- Customize guidelines for individual agency, subdivisions
  - Reference current specifications
- Develop decision tree to illustrate policy for training purposes
- Provide instructions for approval when exceptions are required
  - Impossible to cover all conditions that an agency will likely face


The Right Mix
in
The Right Place
THANK YOU