

***The Right Mix  
at  
The Right Place***





From Bike path...



...to Local Road



...to Interstate

# For each there are:

◆ Good mixes



● Bad mixes



*Information Series 128*



U.S. Department  
of Transportation  
Federal Highway  
Administration



NATIONAL ASPHALT  
PAVEMENT ASSOCIATION



# *HMA Pavement Mix Type Selection Guide*



# Mix Type Selection Factors

- ◆ Traffic
- ◆ Environment
- ◆ Subsurface Pavement Structure
- ◆ Existing Pavement Condition and Preparation
- ◆ Economics

# Mix Types

- ◆ Dense Graded
- ◆ Open-Graded
- ◆ Stone Matrix Asphalt (SMA)



*How to select mix  
for optimum  
performance &  
economics?*

# What's in the Guide

- ◆ Pavement layers and traffic level definitions
- ◆ General surface preparation recommendations
- ◆ Mix Types
  - Definitions
  - Purpose
  - Materials
- ◆ Procedure for selecting mixes
- ◆ Examples

# Recommended General Mix Types

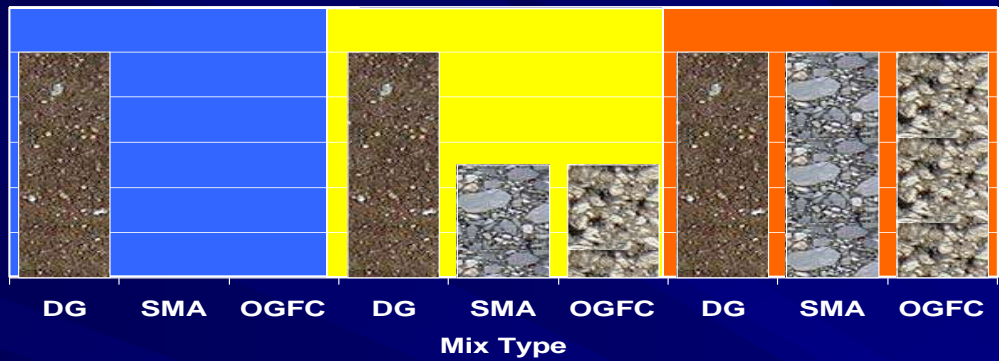
Low  
Traffic

Medium  
Traffic

High  
Traffic

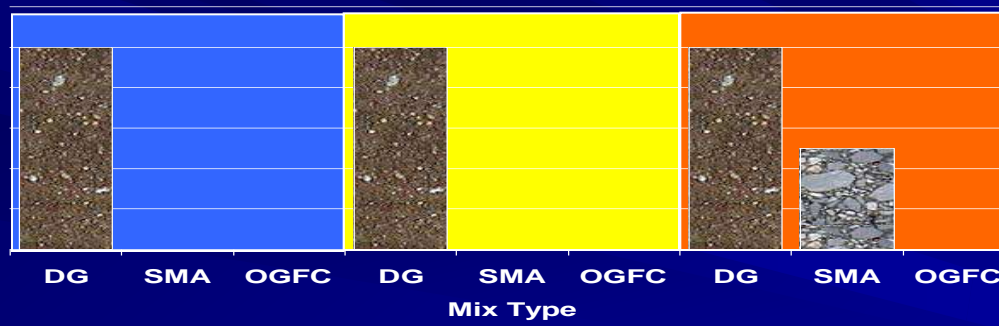
Relative  
Appropriateness

Surface



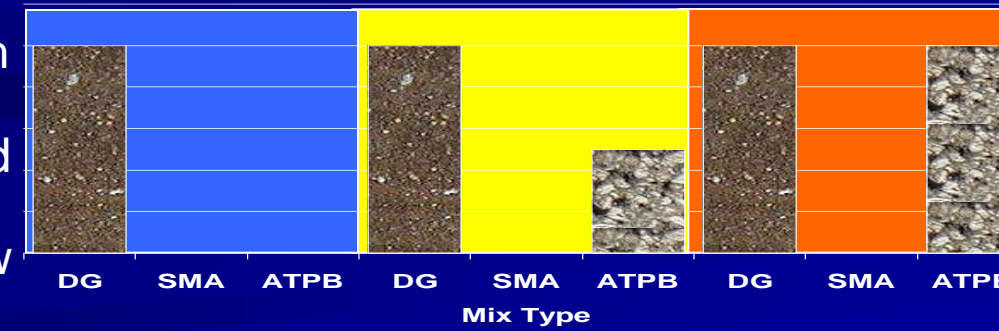
Relative  
Appropriateness

Binder



Relative  
Appropriateness

Base

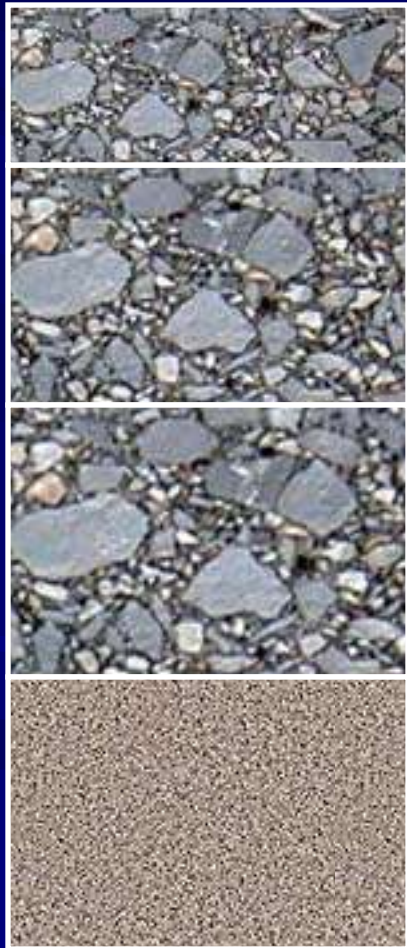




# Pavement Layers

**Full Depth HMA**

**HMA on Agg Base**

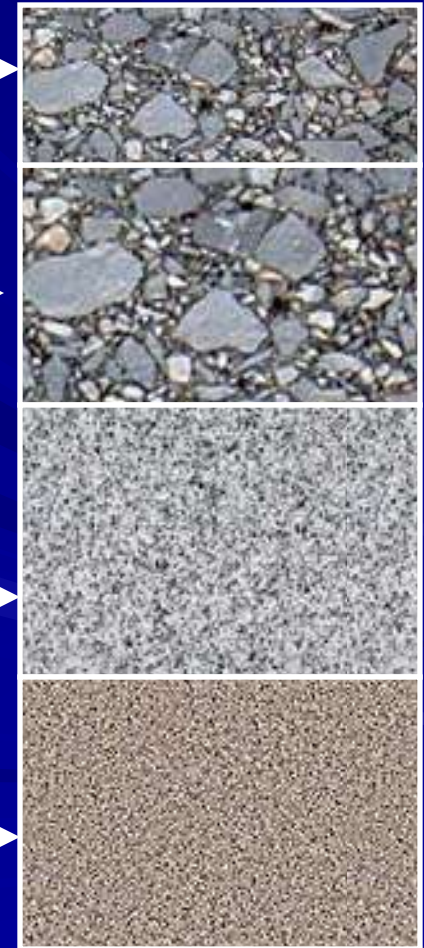


← HMA Surface Course →

← HMA Intermediate/Binder Course →

← HMA Base Course  
Aggregate Base Course →

← Prepared Subgrade →

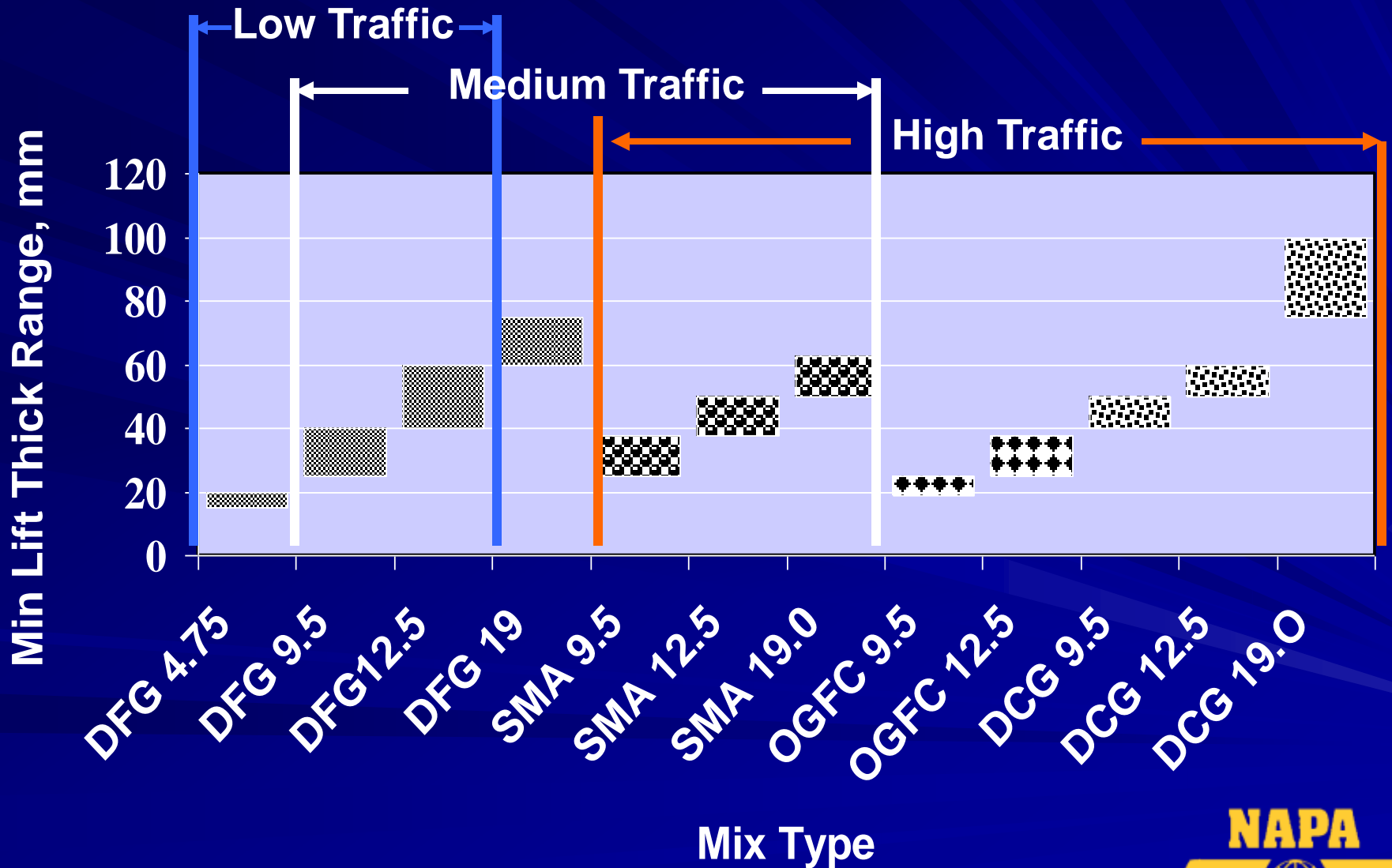


# Traffic Definitions

<i>Traffic</i>	<i>ESAL's</i>	<i>Applications</i>
<b>Low</b>	<b>&lt;300,000</b>	<b>Local roads Low truck traffic</b>
<b>Moderate</b>	<b>300,000 to 10,000,000</b>	<b>Med to high traffic City streets/roads Rural interstates</b>
<b>High</b>	<b>&gt;10,000,000</b>	<b>High traffic High % trucks</b>

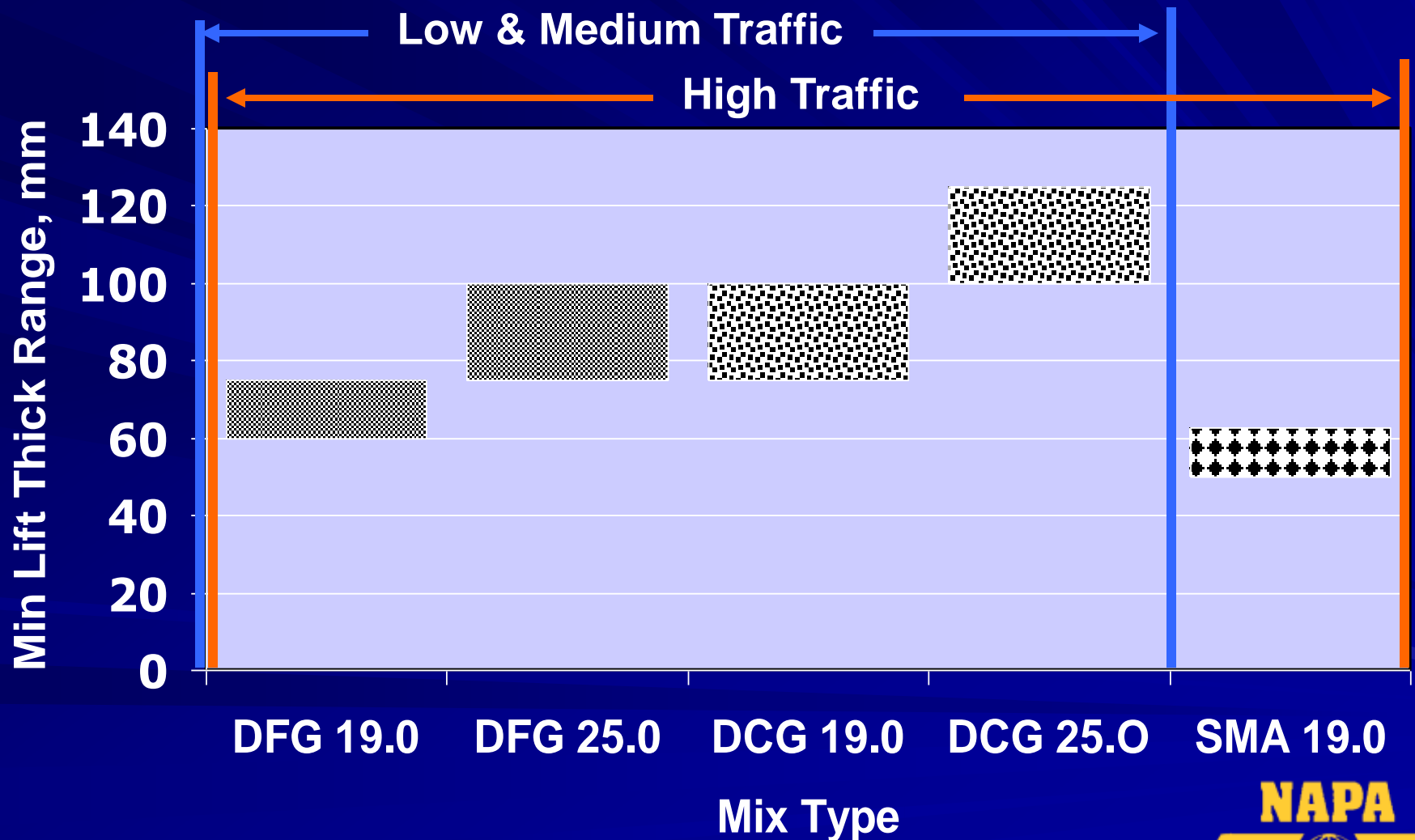
# Recommended Mix Types

## Surface Courses

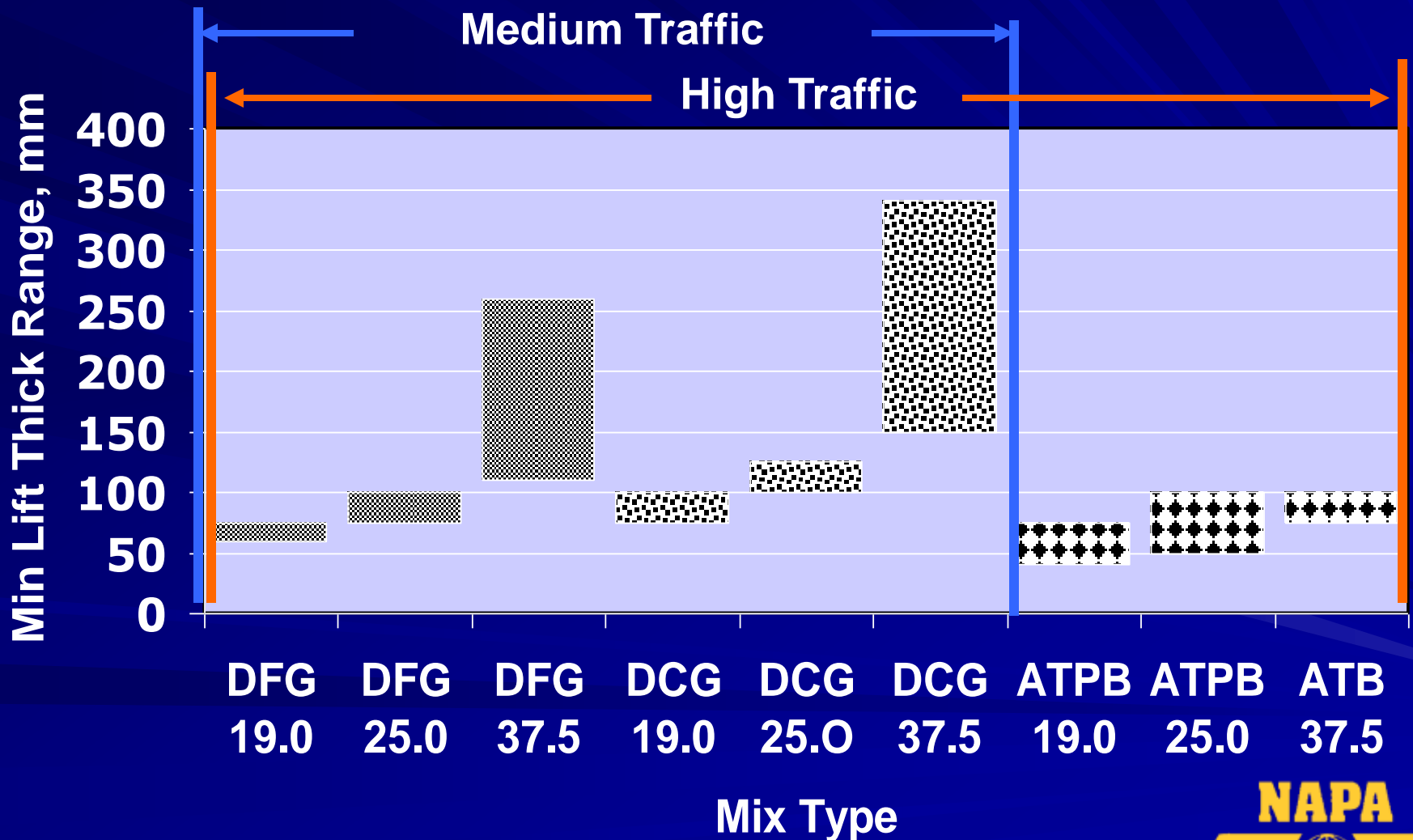


# Recommended Mix Types

## Intermediate Courses



# Recommended Mix Types Base Courses



# Fine v. Coarse Dense Mixes

Fine-Graded	Coarse-Graded
Lower Permeability	Allows thicker lifts *
Workability *	Increased macrotexture *
Thinner lifts *	
Greater durability *	
Smooth texture *	

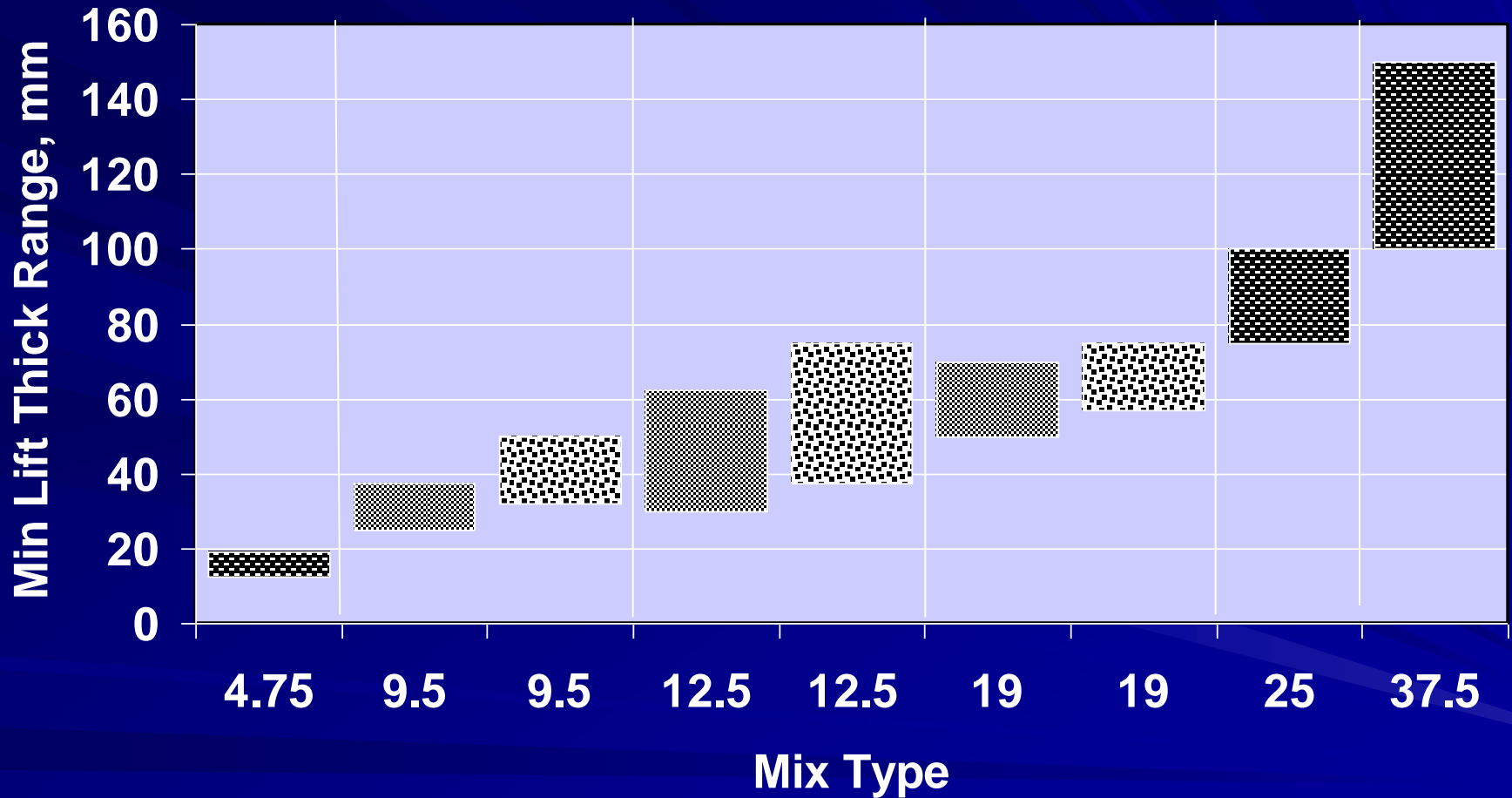
\* < 1" (25 mm) NMS



# Dense Graded Materials

Material	Low Traffic	Med Traffic	High Traffic
Agg.	<ul style="list-style-type: none"> <li>◆ Gvl (limited)</li> <li>◆ Crushed Gvl. &amp; Stone</li> <li>◆ Mfg. &amp; Nat Sand</li> </ul>	<ul style="list-style-type: none"> <li>◆ Crushed Gravel &amp; Stone</li> <li>◆ Mfg. &amp; Nat Sands</li> </ul>	
Asphalt	<ul style="list-style-type: none"> <li>◆ Unmodified</li> </ul>	<ul style="list-style-type: none"> <li>◆ Unmodified</li> </ul>	<ul style="list-style-type: none"> <li>◆ Mod. Likely</li> <li>◆ Unmodified local experience</li> </ul>
Other	<ul style="list-style-type: none"> <li>◆ RAP</li> <li>◆ Antistrip by testing</li> </ul>		

# Recommended Minimum Lift Thicknesses Dense Graded Mixes



■ Fine & Coarse Graded ■ Fine Graded ■ Coarse Graded

**NAPA**





# Dense-Graded Mix Layers

	Nominal Max Size Aggregate			
Layer	4.75 & 9.5 mm	12.5 mm	19 mm	25 & 37.5 mm
Surface	<ul style="list-style-type: none"> <li>◆ Wear</li> <li>◆ Friction</li> <li>◆ Smooth</li> </ul>	<ul style="list-style-type: none"> <li>◆ W, F &amp; S</li> <li>◆ Structure</li> </ul>	<ul style="list-style-type: none"> <li>◆ Friction</li> <li>◆ Structure</li> </ul>	<ul style="list-style-type: none"> <li>◆ N/A</li> </ul>
Binder	<ul style="list-style-type: none"> <li>◆ Leveling</li> <li>◆ Smooth</li> </ul>	<ul style="list-style-type: none"> <li>◆ Structure</li> <li>◆ Smooth</li> </ul>	<ul style="list-style-type: none"> <li>◆ Structure</li> </ul>	
Base	<ul style="list-style-type: none"> <li>◆ N/A</li> </ul>			



# Example Mix Selection Process

# Selection Process Step 1: Determine total thickness

## ◆ Example

- Reconstruction for downtown redevelopment.
- Performance and appearance important

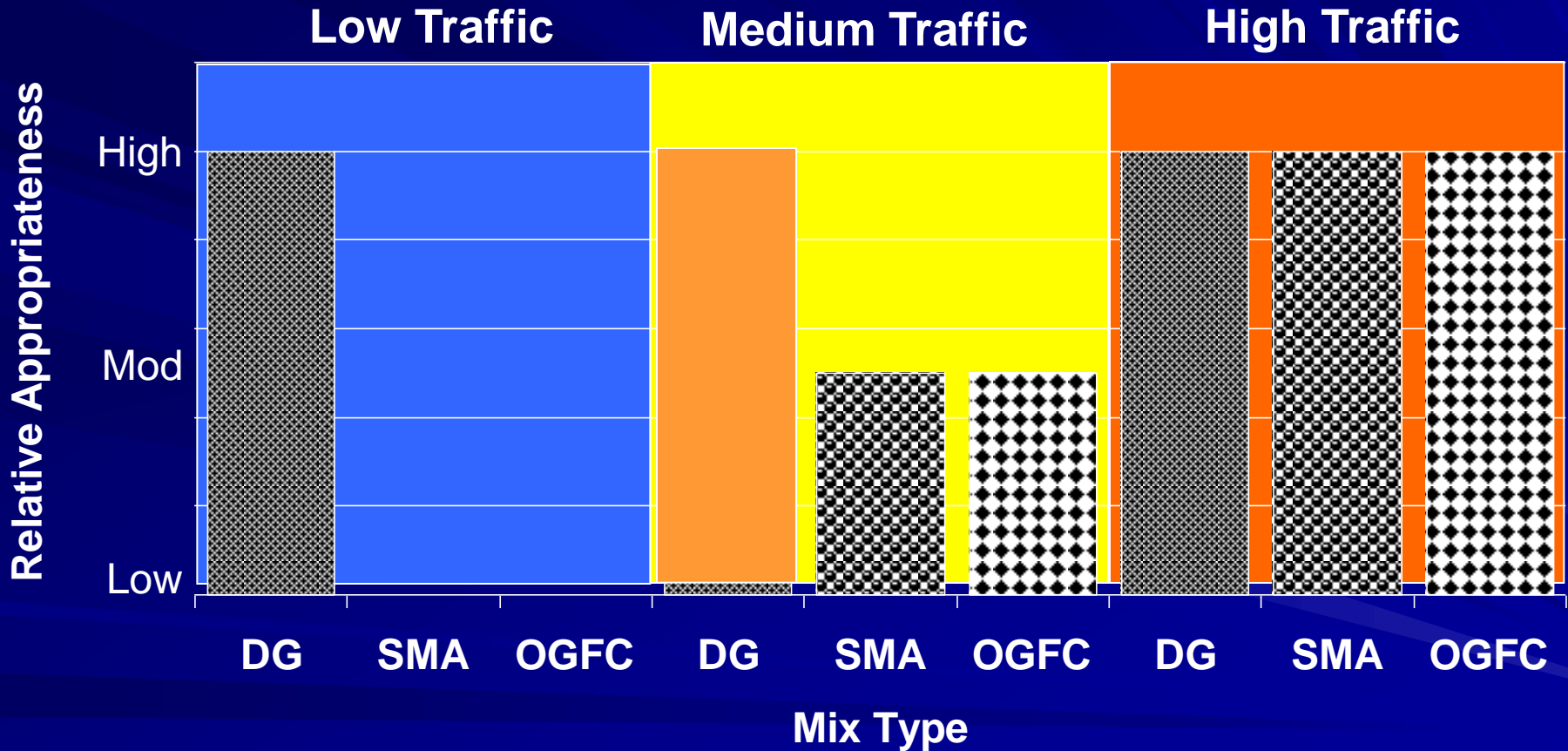


**6"  
(150 mm)**

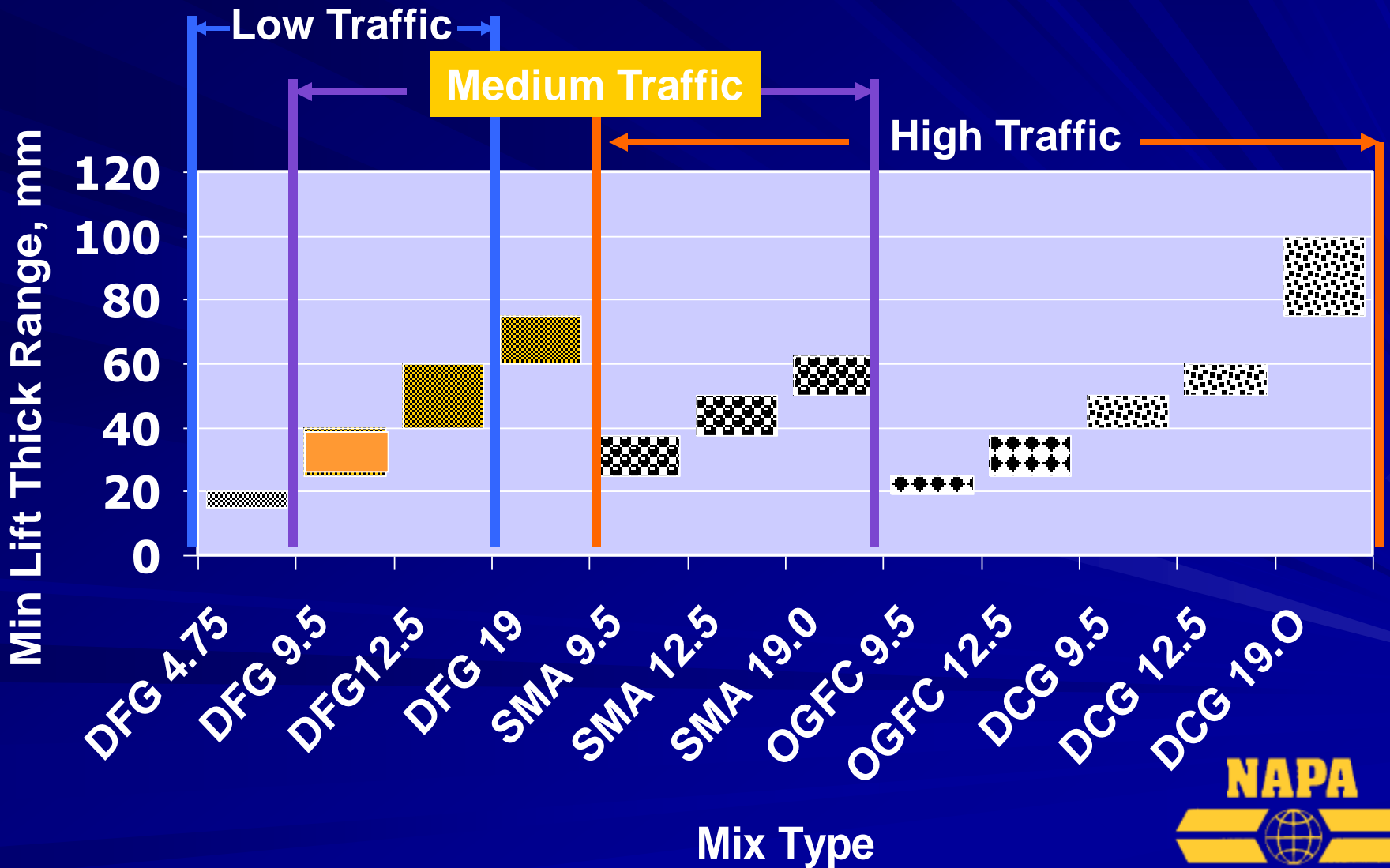
# Step 2: Select surface course mix type & thickness

- ◆ Traffic loading
- ◆ Aggregate size
- ◆ Appearance
- ◆ Traffic Flow

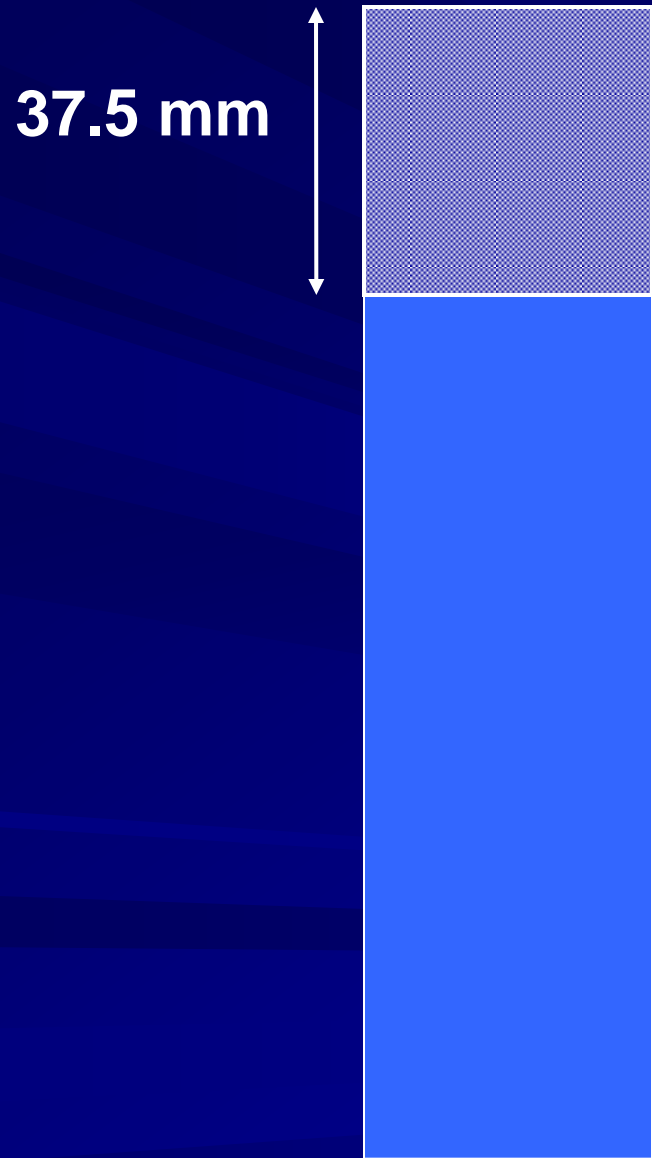
# Step 2: Select surface type & thickness



# Step 2: Select surface type & thickness



# Step 2: Select surface type & thickness



◆ Mix - 9.5 mm DFG

◆ Thickness - 37.5 mm

150 mm

112.5 mm

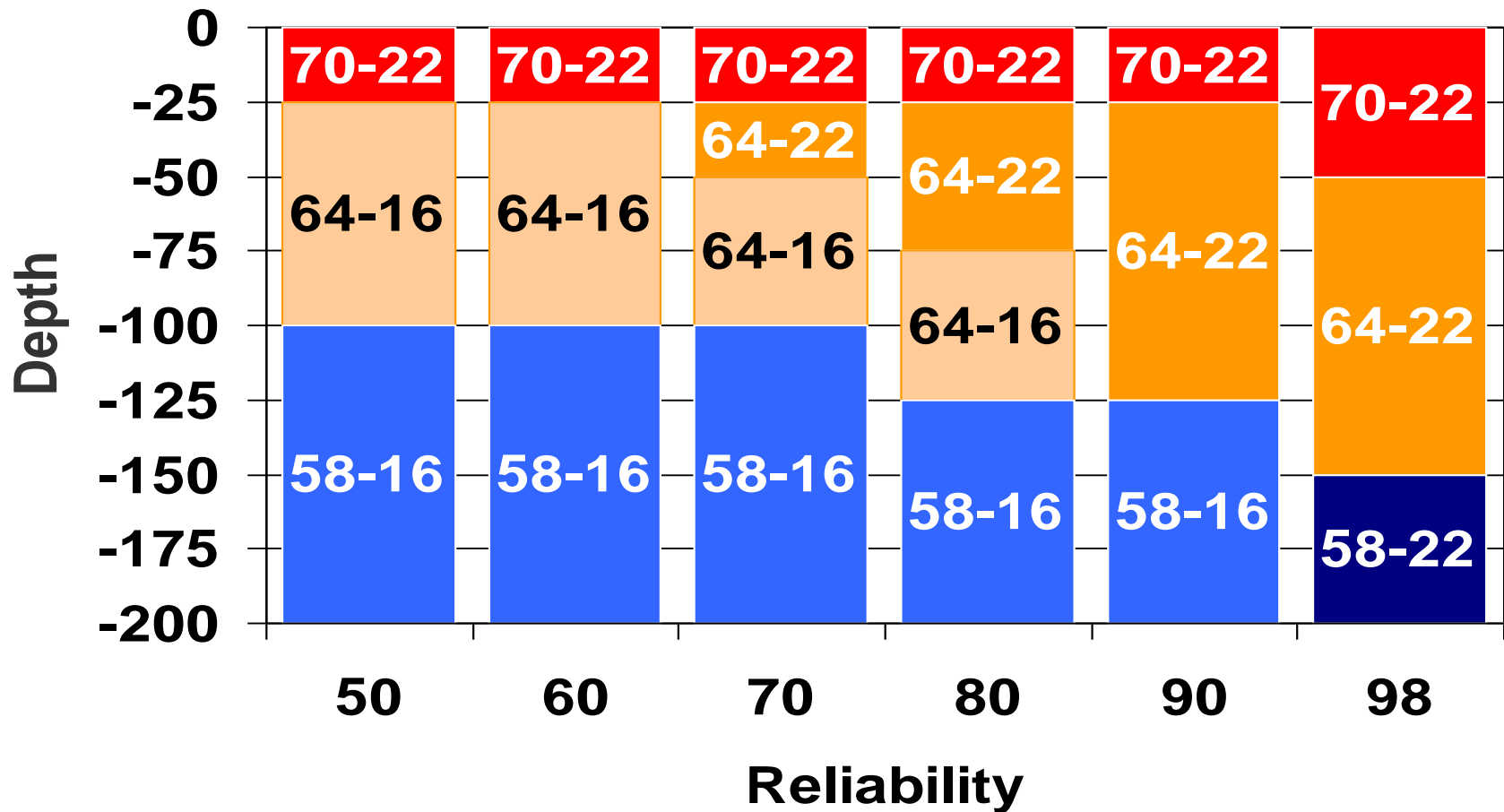
# Binder Grade vs. Depth

- ◆ Example: Indianapolis, Medium Traffic, Slow
  - LTPPBind Software
  - Grade varies with
    - Location/Environment
    - Traffic level
    - Traffic speed
    - Reliability
    - Depth



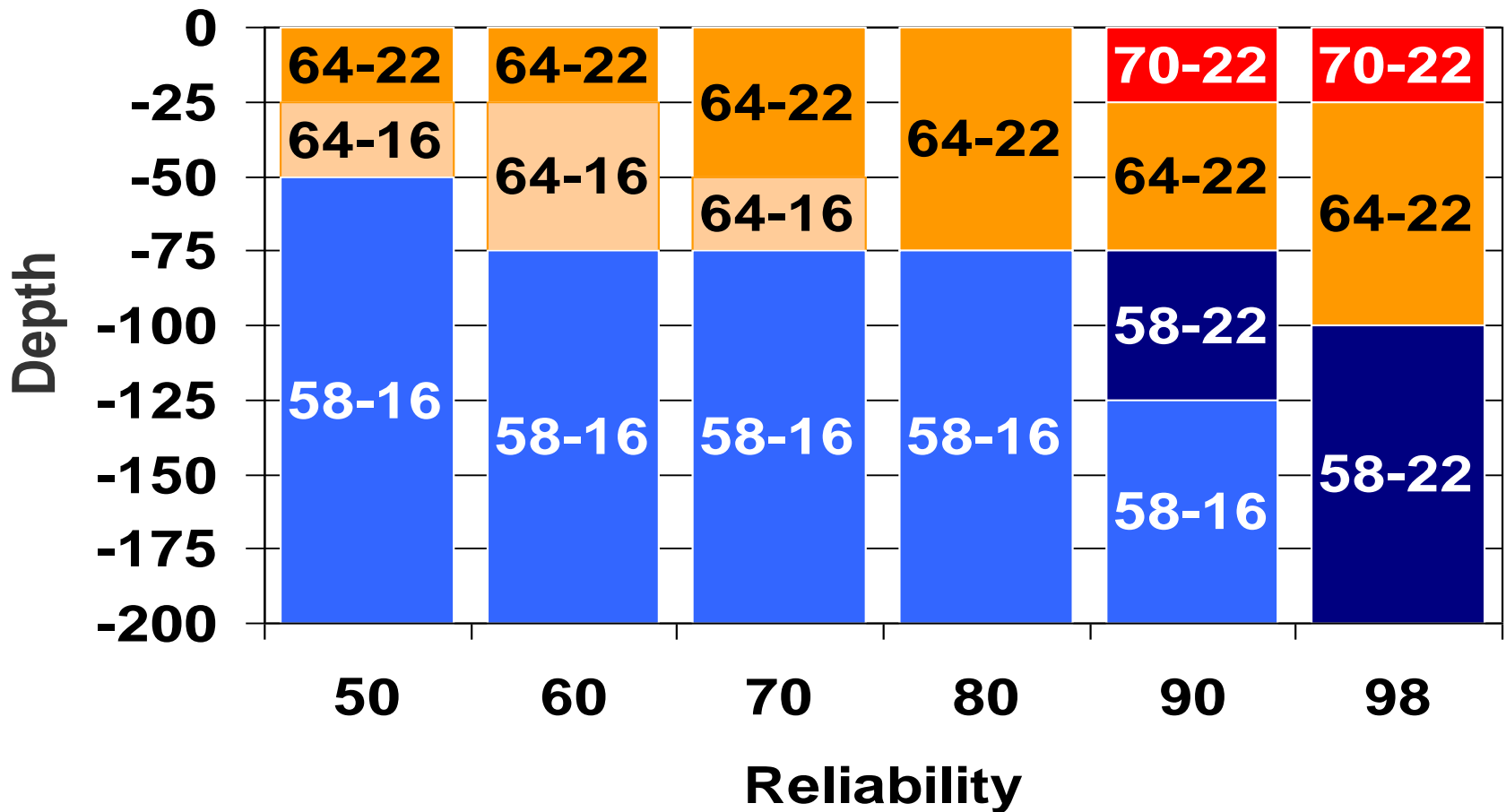
# PG vs. Depth

## 3-10 MESAL, Slow



# PG vs. Depth

## 3-10 MESAL, Fast

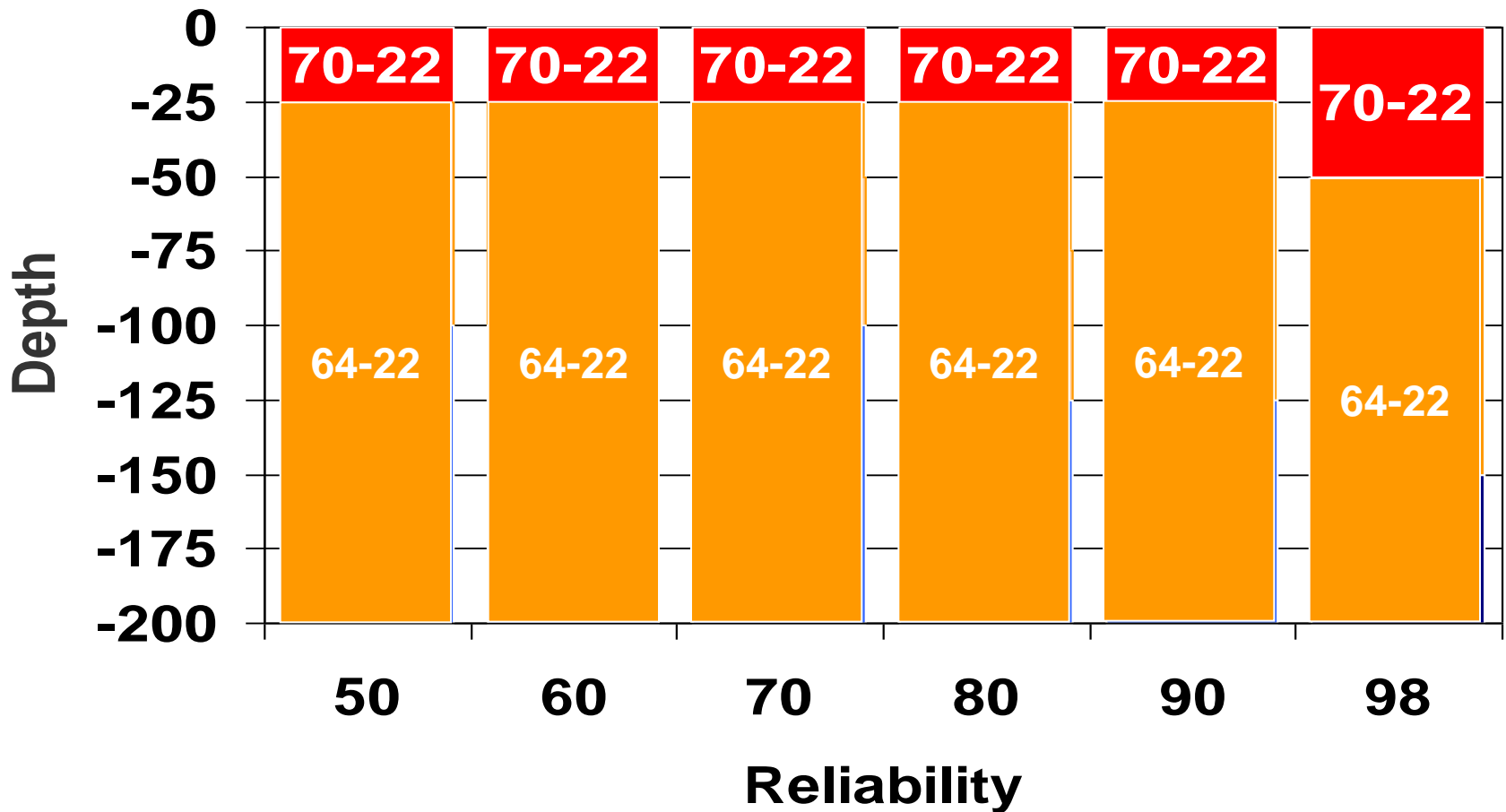


# What Binders are Available

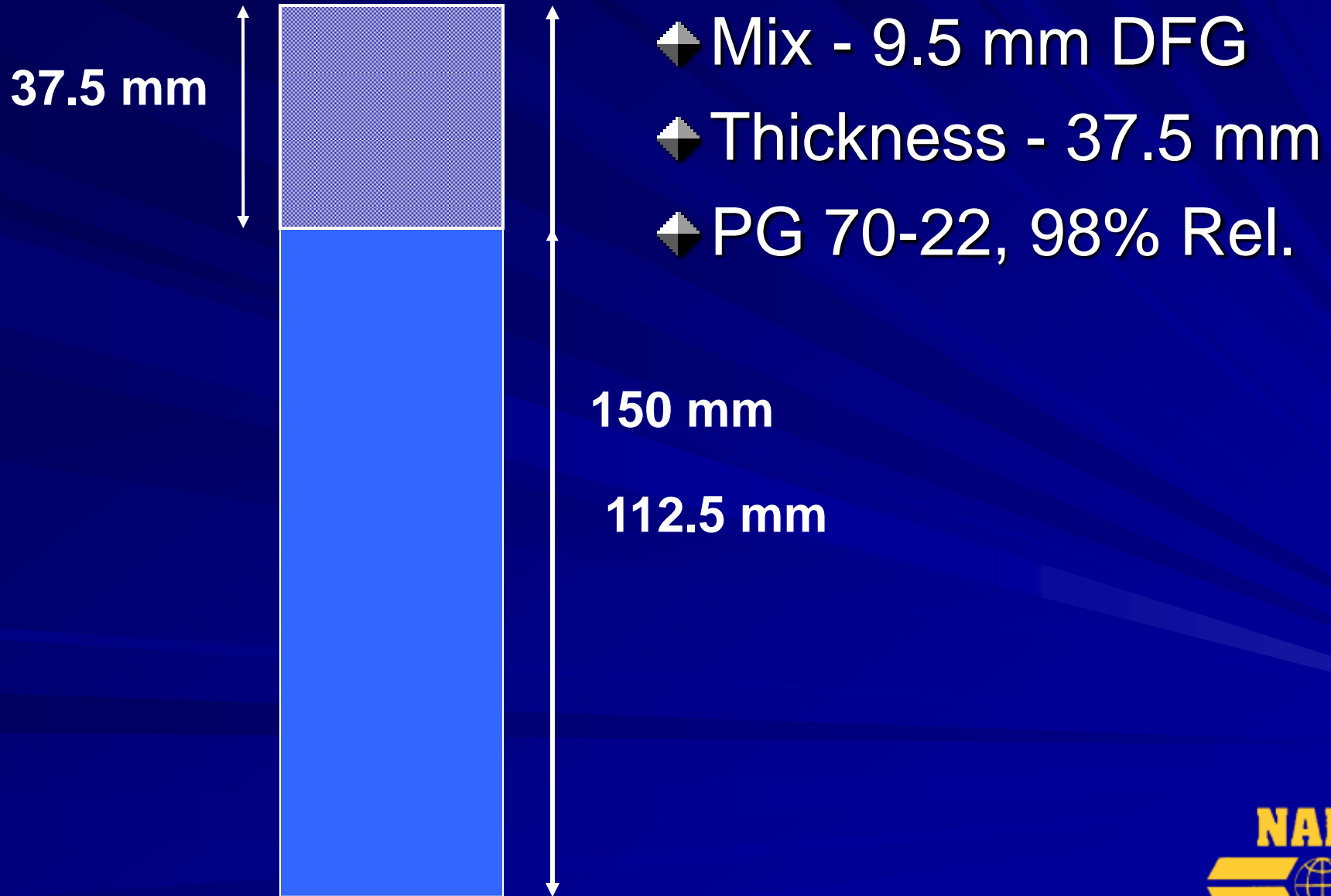
- ◆ 76-22
- ◆ 70-22
- ◆ 64-22 – Workhorse
- ◆ 58-22

# PG vs. Depth

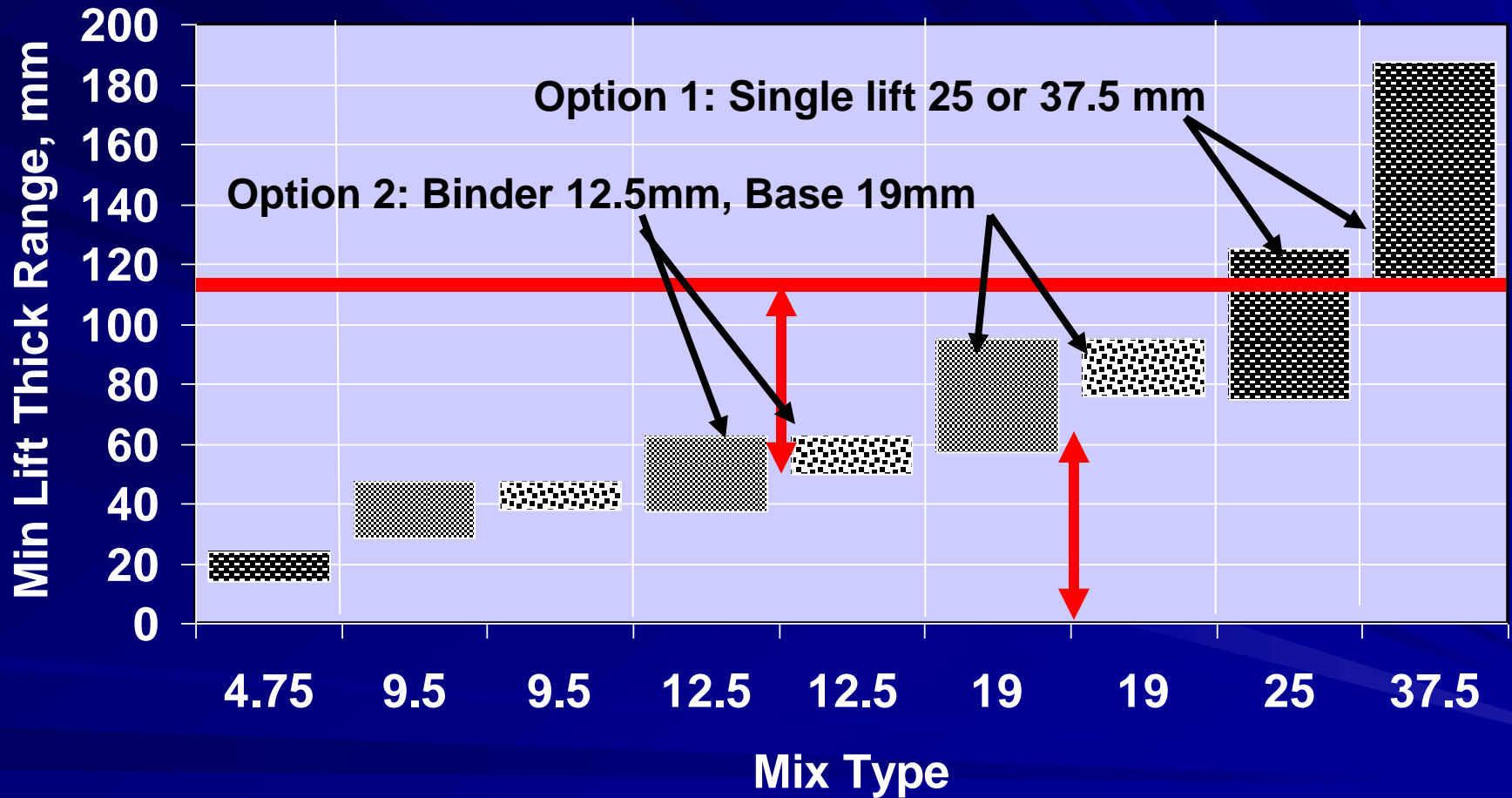
## 3-10 MESAL, Slow



# Step 2: Select surface type & thickness



# Recommended Minimum Lift Thicknesses Dense Graded Mixes



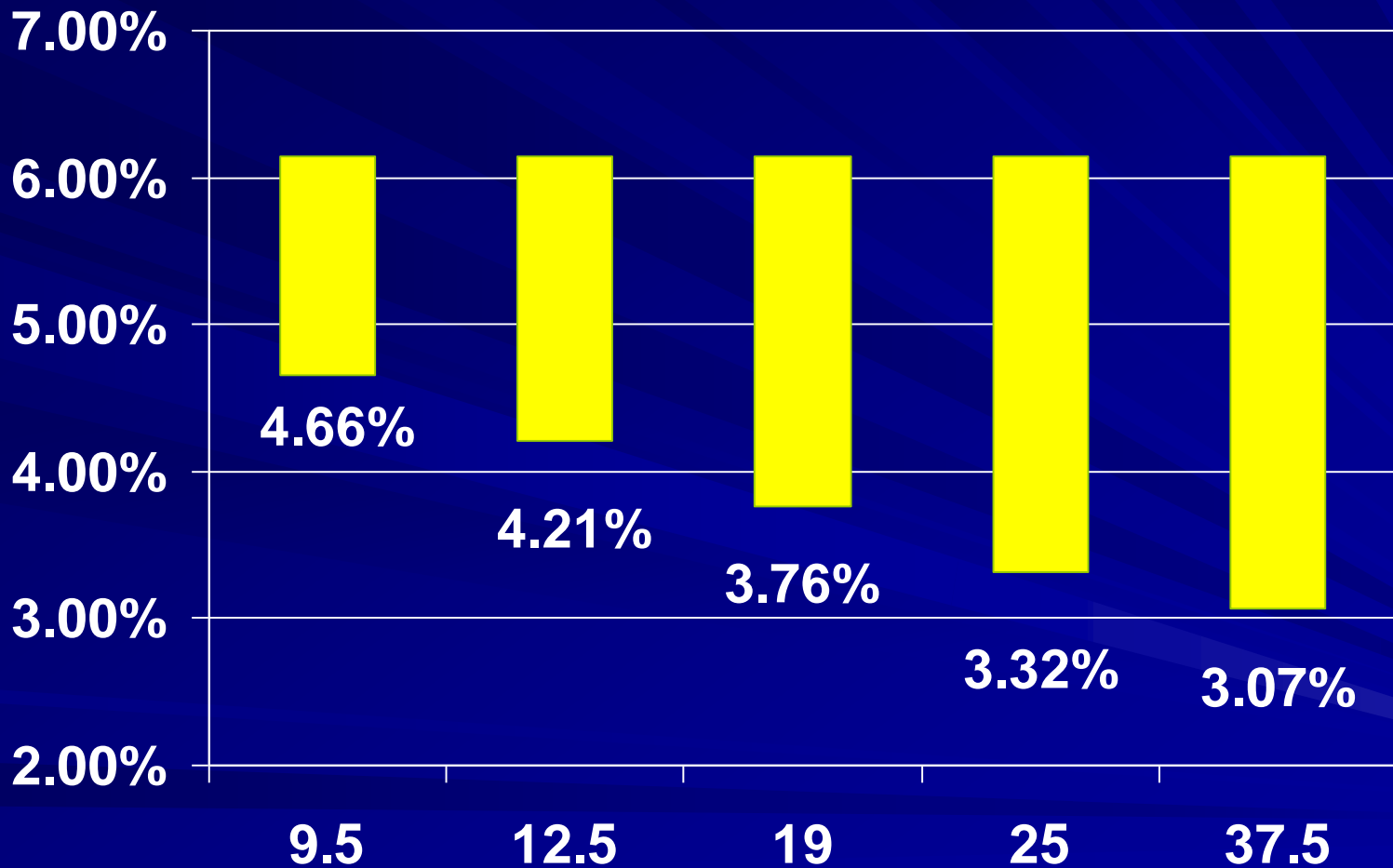
**NAPA**



# Options

- ◆ 1 – Single lift 25 mm or 37.5 mm
  - Advantage - Reduced cost
    - Larger stone mixes use less binder
    - Single paver pass
  - Potential disadvantage
    - Smoothness – more lifts = more opportunities
- ◆ 2 – Binder 12.5 mm, Base 25 mm
  - Advantage – smoothness
  - Disadvantage – Cost
    - Use more binder
    - More paver passes

# Binder Content vs. NMA5





# Mix Binder Costs

◆ 9.5 mm = \$18.64

◆ 12 mm = \$16.84

◆ 19 mm = \$15.04

◆ 25 mm = \$13.28

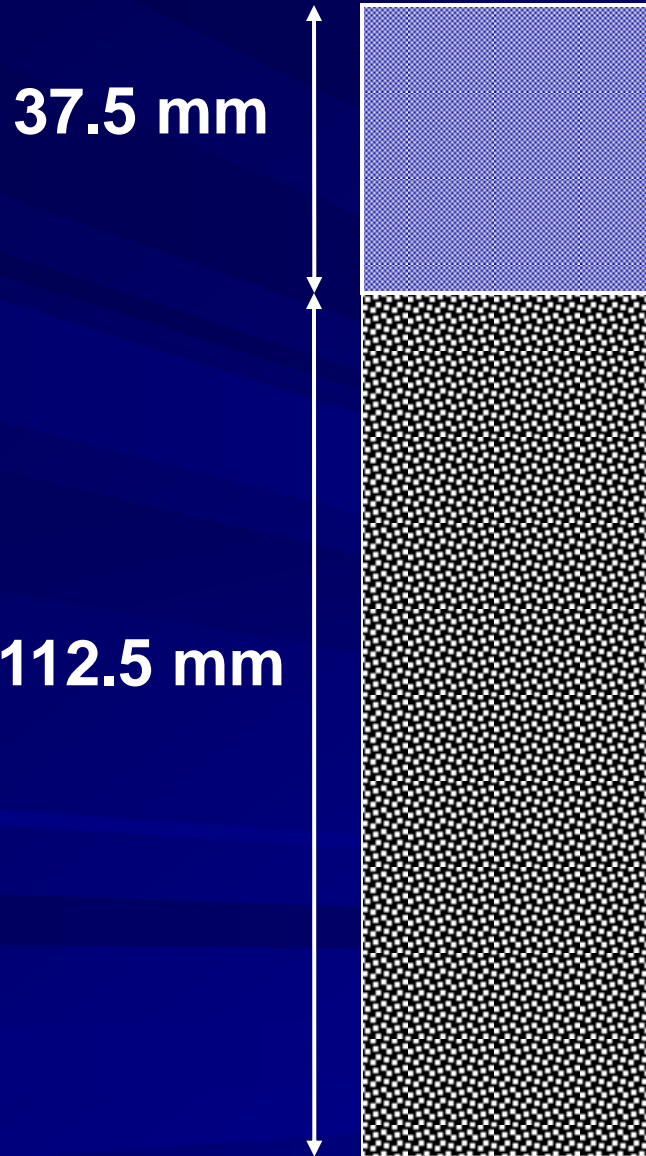
◆ 37.5 mm = \$12.28

Based on 400/ton AC cost.

Actual values not important. Difference in cost more relevant.



# Step 2: Select surface type & thickness



- ◆ Mix - 9.5 mm DFG
- ◆ Thickness - 37.5 mm
- ◆ PG 70-22, 98% Rel.

- ◆ Mix – 37.5 mm DG
- ◆ Thickness – 112.5 mm
- ◆ PG 64-22, >90% Rel.

# Option Comparison

## ◆ Option 1:

- 25 mm, 112.5 mm thick ~ \$22,700
- 37.5 mm, 112.5 mm thick ~ \$21,100

## ◆ Option 2:

- 12.5 mm, 50 mm thick ~\$12,800
- 19 mm, 62.5 mm thick ~\$14,300
- Total ~ \$27,100

## ◆ Difference

- Option 1 25 mm vs Option 2 = \$4,400
- Option 1 37.5 mm vs Option 2 = \$6,000

# Thinner Surface

- ◆ New construction
- ◆ Overlay – structurally sound



**Use when appropriate – Not just because you can**

# Thinner Surfacing

Mix	9.5 mm 1 ½" Thick	12.5 mm 2" Thick
% AC	6.0	5.5
Coverage #/SY	165	220
AC, lb	396	308
Agg. #/SY	155.1	207.5
Material Cost	\$2.76/SY	\$3.46/SY

**Savings \$4,928/lane-mile**

Assumed Cost: AC \$400/ton, Aggregate \$10/ton



# Mix Type Selection

- ◆ Traffic
- ◆ Environment
- ◆ Subsurface Pavement Structure
- ◆ Existing Pavement Condition and Preparation
- ◆ Economics
  - NMAS
  - Binder