

# Porous Asphalt Pavement



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# Agenda

- Asphalt history
- Asphalt in NC
- Evolution of asphalt in NC and US
- Basic asphalt review
- Porous Asphalt for parking lots

# Historic Information

- **Around 3,000 B.C.:** The first recorded use of asphalt
- **1595:** Europeans exploring the New World discovered natural deposits of asphalt. Sir Walter Raleigh described a "plain" (or lake) of asphalt on the island of Trinidad, near Venezuela. He used it for re-caulking his ships.
- **1870:** America's first asphalt pavement was laid in Newark, N.J.



# Asphalt in NC

- Over 12 million tons placed annually in NC
- 94% of roads in NC are asphalt
- Produced by NC owned businesses
- Pave while you sleep
- Ride on it in the am
- Long lasting
- Mill and inlay – perpetual pavement

# Asphalt evolution in NC

- Marshall mix – rut problems
- Superpave 1<sup>st</sup> generation – too dry = cracking
- Superpave 2<sup>nd</sup> generation – just right, no rutting or cracking
- Surface, Intermediate and Base mix types
- A,B,C and D mix types
- OGFC mix

# Superpave Asphalt Mix Types

- The pavement structure consists of all courses or layers above the prepared subgrade or foundation.



← Surface Course

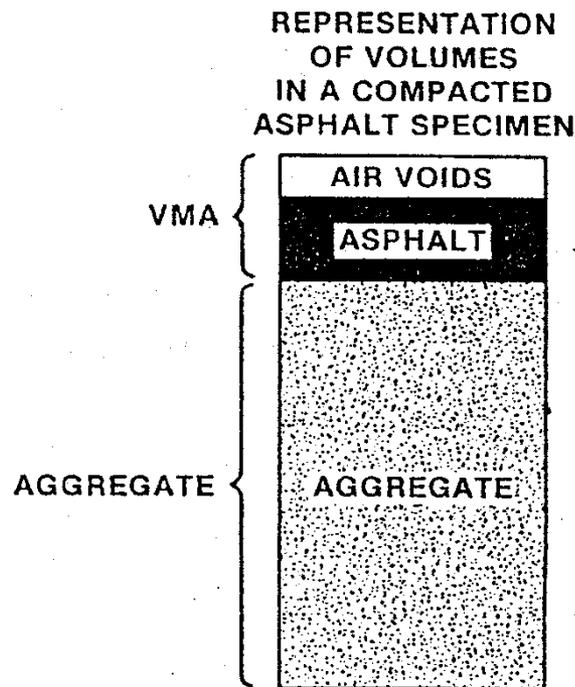
← Intermediate Course

← Base Course

← Prepared Subgrade

# Asphalt mix components

- **Composed of Three Basic Components**



1) Asphalt Binder,

2) Aggregates, and

3) Air Voids



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# Classification and Grading of Paving Asphalts

- 1) Asphalt Binders
  - Performance Graded Asphalts
  - Designated by Grades
    - PG 64 -22
      - Most frequently used in North Carolina
    - The first Number, 64,
      - “High Temperature Grade”
    - Likewise, the second Number – 22
      - “Low Temperature Grade”

# Superpave Performance Graded Binder Grades

- PG 64 -22 is the Grade most often used in N.C.
- Due to Environmental conditions and Traffic Loading a PG 70 -22 may be selected, and
- On Interstates and Major routes with truck traffic much heavier, a PG 76 -22 could be necessary.

		High Temperature, °C				
		52	58	64	70	76
Low Temperature, °C	-16	52-16	58-16	64-16	70-16	76-16
	-22	52-22	58-22	64-22	70-22	76-22
	-28	52-28	58-28	64-28	70-28	76-28
	-34	52-34	58-34	64-34	70-34	76-34
	-40	52-40	58-40	64-40	70-40	76-40

- = Crude Oil
- = High Quality Crude Oil
- = Modifier Required

# Typical Asphalt Binder Contents\*

PG 64-22		PG 70-22		PG 76-22	
S 4.75 A	7.0%	S 9.5 C	6.0%	S 9.5 D	5.5%
SF 9.5 A	6.5%	S 12.5 C	5.5%	S 12.5 D	5.0%
S 9.5 B	6.0%	I 19.0 D	4.7%	OGAFC, Type FC-1 Modified	6.3%
I 19.0 B & C	4.7%				
B 25.0 B & C	4.3%			OGAFC, Type FC-2 Modified	6.0%
OGAFC, Type FC-1	6.3%				
PADC, Type P-57	2.3%				
PADC, Type P-78M	3.0%	* By Weight of Total Mix			

# Binder Temperatures

Superpave Binder Grade

PG 64-22

PG 70-22

PG 76-22

Mixing Temperature @ Plant

300° F

315° F

335° F

Working temperature is increased on stiffer binders

# Typical 'A' or 'B' Mix Route



# Typical 'C' Mix Route



# Typical 'D' Mix Route



# Description of Asphalt Paving Materials / Pavements

## – Aggregates

- Generally Classified into Two Groups
  - 1) Coarse Aggregates, and
  - 2) Fine Aggregates
- Normally Constitute 90 – 96 % by weight of the total mixture

# Sources of Aggregates

- Natural Aggregates

- Pit or Bank-Run Aggregates:

- River Rock, Gravel, Marble, Natural sand
    - contain smooth rounded particles due to the tumbling action of water.
    - Sands and gravels are cleaned to remove undesirable materials such as clay balls and other debris.
    - Hard to get Density on Asphalt with this type of rock

- Processed Aggregates:

- Quarried aggregate or gravel that has been crushed and screened
    - Meets requirement for fractured faces on the stone.
    - More suitable for Asphalt Pavements



# Aggregate Stockpile



# Environmentally Friendly



# RAP, RAS and WMA

- #1 recycled product in US (EPA)
- 100% recyclable
- Most mixes use 15-20% RAP
- Many mixes use 3-5% RAS
- 1.2 million tons WMA placed in NC
- Less energy
- Lower emissions
- GTR

# Recycling of Asphalt Pavements



## Section 8

*Return to Modules Screen*

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# Recycled Aggregate Stockpile



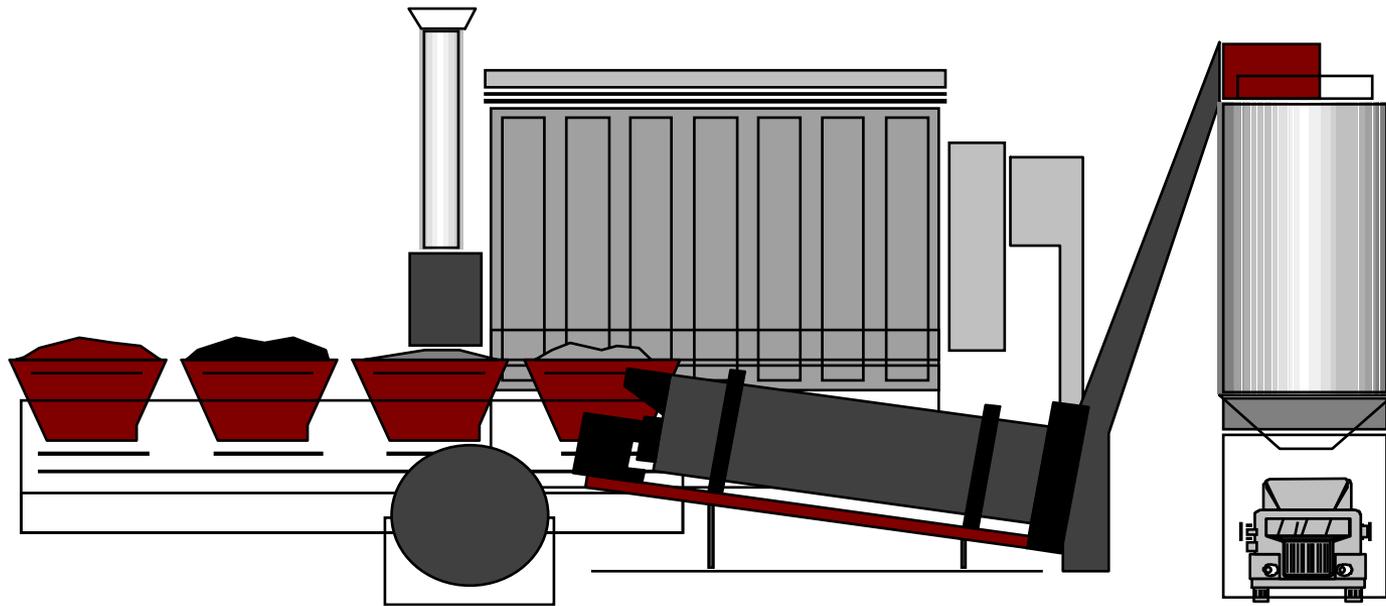
# Tear-off Shingle to Recycle



# Asphalt Additives

- Anti-strip Additive:
  - Must be a heat stable liquid chemical anti-strip additive to be incorporated into asphalt mixes.
  - Prevents the separation of the asphalt from the aggregate particles (stripping).
  - Blended with the asphalt binder prior to introduction of the binder into the aggregate.
  - All mixes including recycled mixes require an anti-strip additive.
    - The technician should always refer to the JMF to determine the type, rate required and the brand specified.

# Plant Equipment & Operations



## Sections 5 & 6

*Return to Modules Screen*

*Press the Space Bar to Advance to the Next Slide.*

# Types of Asphalt Plants

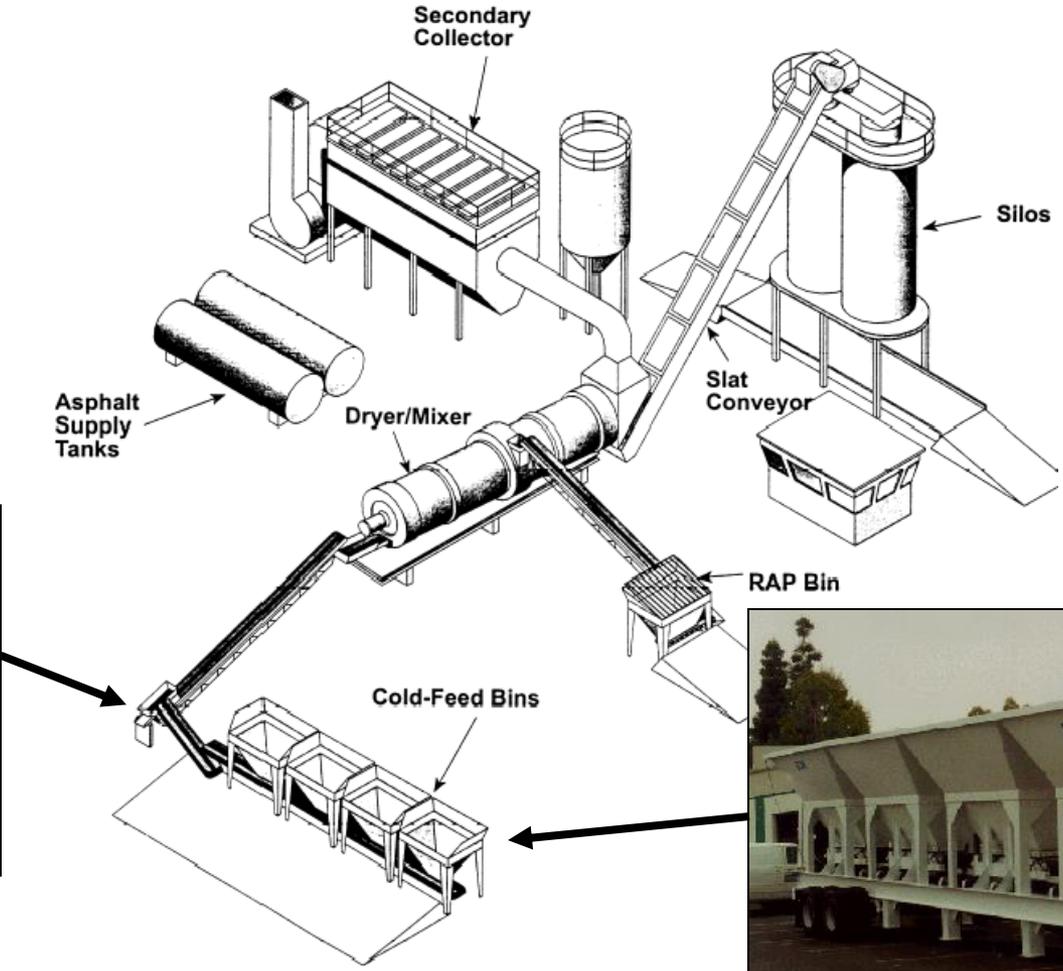
Batch Plant



Drum Plant



# Drum Plants



Vibratory Scalping Screen  
[Required by Specifications]



FIGURE 5-5 Major components of a parallel-flow drum-mix plant.



# Plant from a distance



# Aggregate Bins



# On the way to the drum



# Entering the drum



# Produced and to the silos



# Loading the truck



# On to the Job



# Roadway Placing Operations Equipment Specifications



# Tack Application

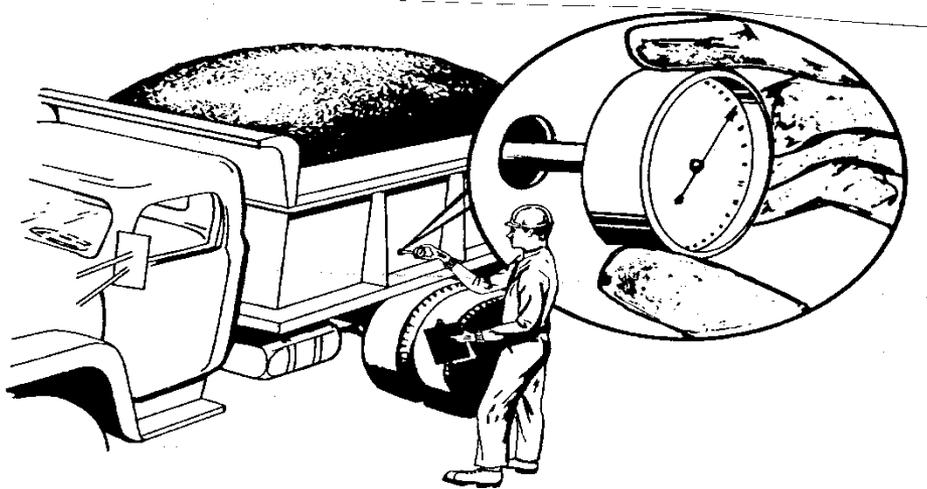


# Trucks arrive at the job



# Temperature of the Mix at the Roadway

- **The truck should be checked for the temperature requirements by measuring the temperature with a thermometer in the 3/8" hole in the side of the truck bed prior to dumping mix into the paver.**
  - **Temperature must be within +15°F and -25°F of the temperature specified on the JMF.**



# Into the paver



# Paver hopper



# Placing asphalt



# Compaction



# Checking density



# Job well done



# OGFC

- Porous mix
- Used to increase friction
- Used to control tire spray
- Polymer liquid
- Long lasting
- Used primarily on high volume routes

OGFC up close



# OGFC on US 264



# Porous Asphalt for Parking Lots and Recreational Facilities

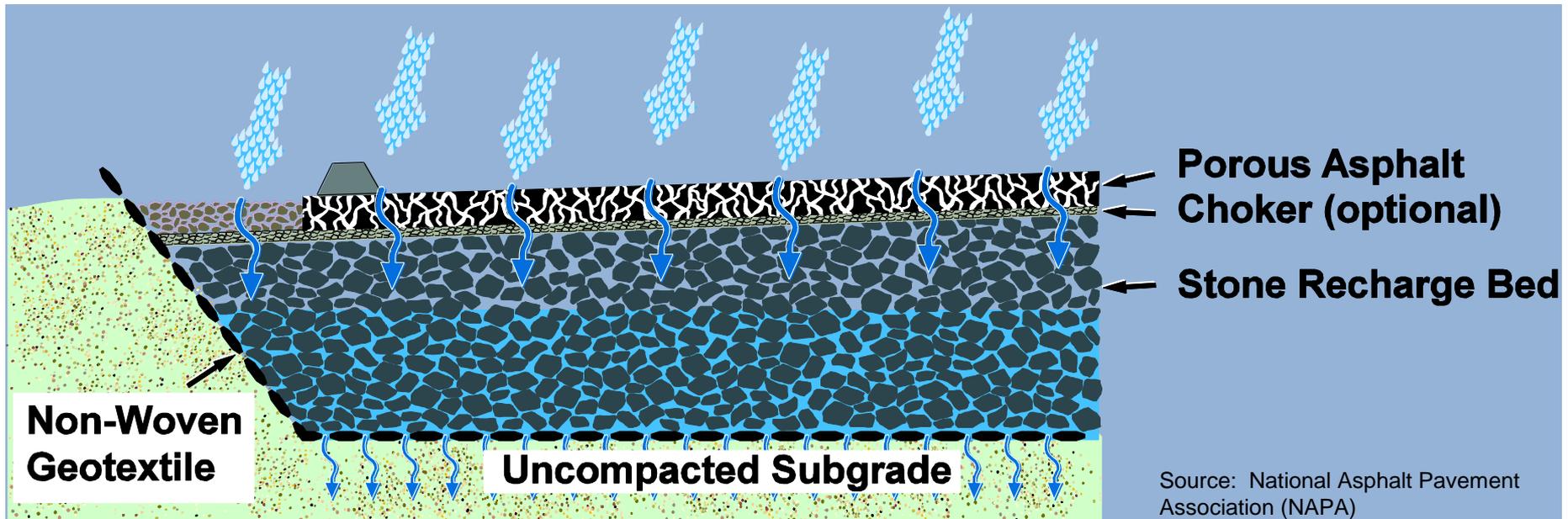
# Parking Lots



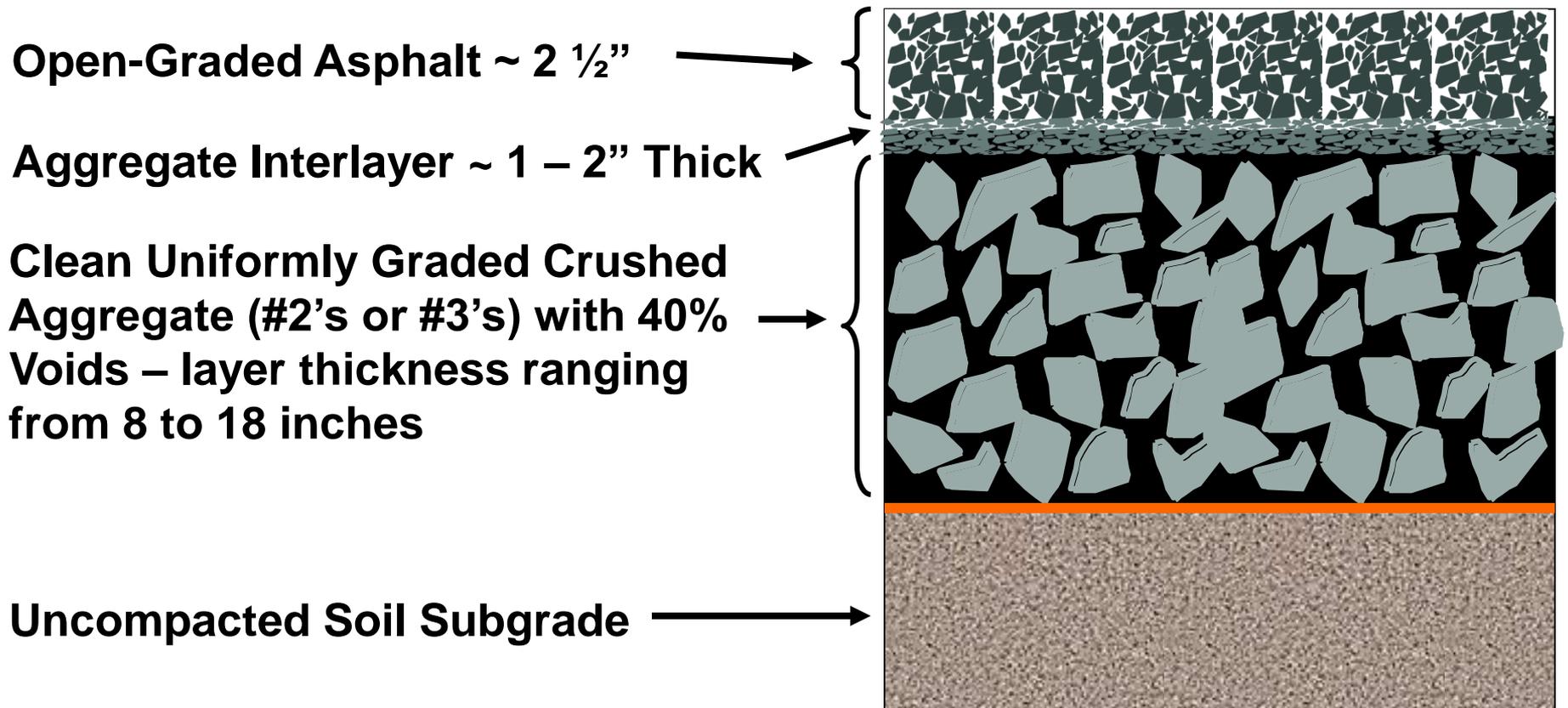
# Recreational Facilities



# Porous Pavements System

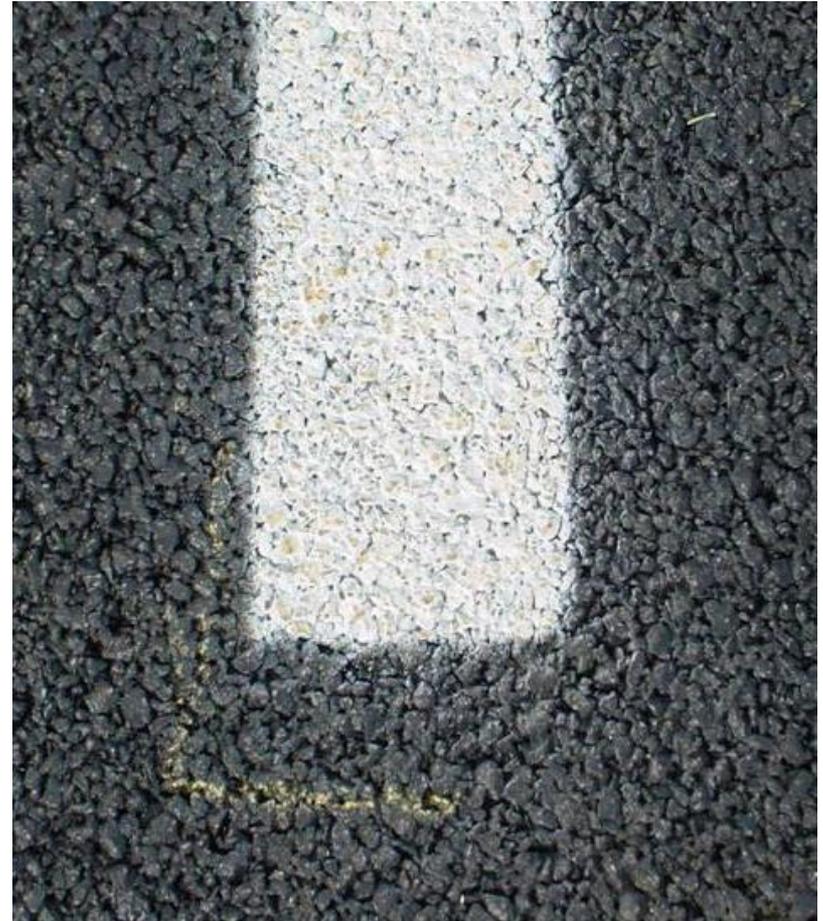


# Cross Sectional Diagram



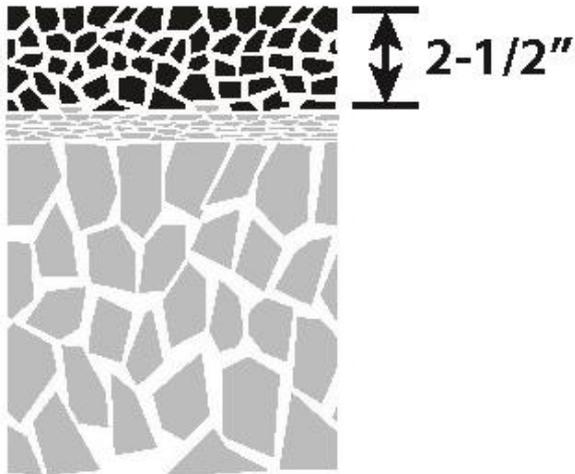
# Asphalt Mixture Design

- Utilize an open graded friction course asphalt mixture
  - 16-18 percent air voids
  - High asphalt content
- Bump the PG Binder grade from 64-22 to a PG 76-22 for durability
  - Produce at lower plant temperatures to prevent draindown

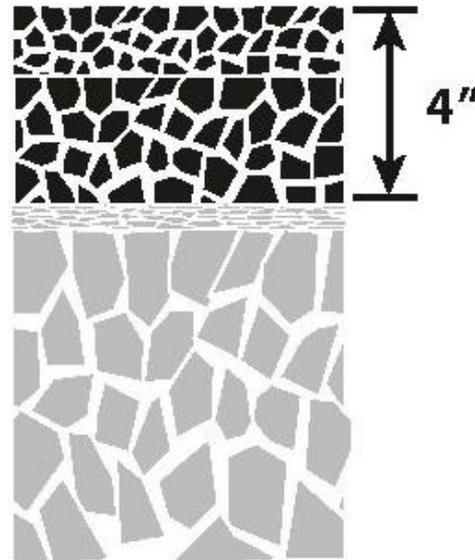


# Minimum Asphalt Thickness

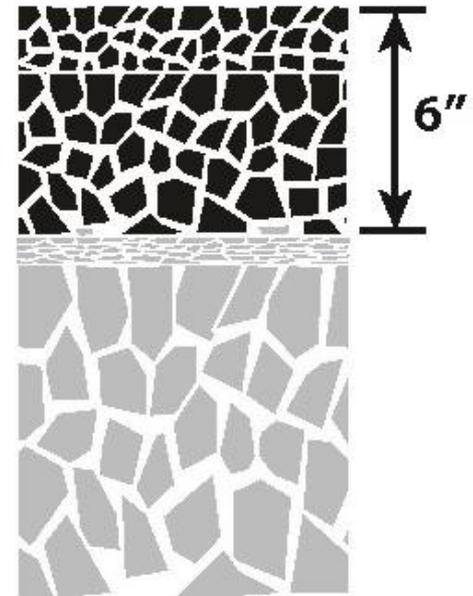
**Parking  
Little or No  
Trucks**



**Residential  
Some Trucks**



**Heavy Truck**



# What about ESALs and CBRs?

- For lightly loaded parking lots – many porous pavements will be overdesigned for the anticipated traffic due to the thick layer of stone utilized to store the storm water
- If truck traffic or heavy loads are expected
  - Design these areas separately
  - Consider thickness and mixture types

# Bed Excavation



# Stone Recharge Bed



# Aggregates

- Crushed
- Washed
- Single-size
- #2 for recharge bed
  - 40% void space
- #57 or #9's for choker course



# Paving on the Stone Bed



# Compaction or “Seating”



# Placing Porous Asphalt

- 60 degree F ambient temperature minimum
- Conventional Paving Equipment
- Rolling to much will reduce infiltration

# Post Construction

- Limit traffic for 24 hours
  - Open graded mixtures are more tender and may require additional cooling time
- Keep sediment controls in place until vegetation is established
- Don't use sand or ash for snow and ice removal
- Don't seal the parking lot!

# Educational Signs



# Ft. Knox



# Porous Pavement Cost Factors

- Additional cost in the excavation (if a cut job)
- Additional cost in thick rock layer
- Porous Asphalt Mixture is more expensive than conventional mixtures due to high asphalt content and PG 76-22
- Low production adds cost
- Annual maintenance
- Don't compare pavement costs alone
- Consider cost and space savings versus retention ponds
- How do you quantify water quality improvements?

Incorrect liquid  
Overcompaction  
Not best project application





# Curb is not optimal



Better Project

# Fayetteville Tech after 5 years



# Works but incorrect liquid



# Main driveway is standard asphalt



# Parking Area Porous



# Still functioning after 17 years



# Swales benefit water flow and compaction



# No curb - preferred



# Fort Bragg



# Fort Bragg



# Fort Bragg



# Fort Bragg



# Fort Bragg



# Unpaved Edges



# No curb - preferred



# Review Major Factors

- Proper Design – system and mix (polymer liquid)
- Proper Planning for Construction – use a CAPA member, NCDOT asphalt certified plant and technicians – coordinate mix and laydown crews
- Proper Construction – site controls & placement
- QC/QA oversight and testing

# Proper Maintenance

- Prevent Clogging – control debris, maintain landscape areas, keep pavement clean
- Snow Removal – Never apply salt or sand, set plow blade higher than pavement
- Repairing Pavement – Never use a seal coat, patch porous areas only with porous asphalt.

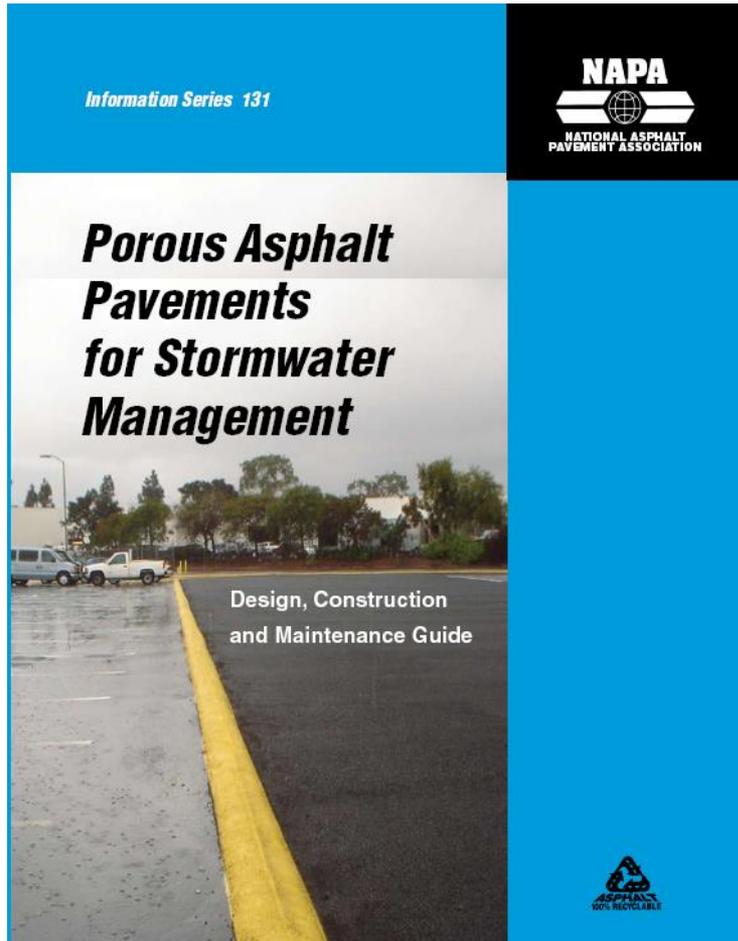
# A Tool for the Toolbox

- Porous Asphalt Pavements offer a good alternative to conventional storm water mitigation
- Properly designed and constructed porous pavements have a history of excellent performance for 20+ years

# It Works Well!



# Additional Resources



## POROUS ASPHALT PAVEMENTS

**Porous asphalt is an environmentally friendly tool for stormwater management.**

In the natural environment, rainfall sinks into soil, filters through it, and eventually finds its way to streams, ponds, lakes, and underground aquifers. The built environment, by way of contrast, seals the surface. Rainwater and snowmelt become runoff which may contribute to flooding. Contaminants are washed from surfaces directly into waterways without undergoing the filtration that nature intended.<sup>1</sup>

Stormwater management tools can mitigate the impact of the built environment on natural hydrology. Unfortunately, however, they also can lead to unsound solutions such as cutting down stands of trees in order to build detention ponds.

Porous asphalt pavements allow for land development plans that are more thoughtful, harmonious with natural processes, and sustainable. They conserve water, reduce runoff, promote infiltration which cleanses stormwater, replenish aquifers, and protect streams.

A typical porous pavement has an open-graded surface over an underlying stone recharge bed. The water drains through the porous asphalt and into the stone bed, then, slowly, infiltrates into the soil. Many contaminants are removed as the stormwater passes through the porous asphalt, stone recharge bed, and soils through filtration and microbial action.

# Additional Resources cont'd

- CAPA Guide Specification
- CAPA Contractors – NCDOT certified plants
- [www.carolinaasphalt.org](http://www.carolinaasphalt.org)
- Ellis Powell 919-838-8004