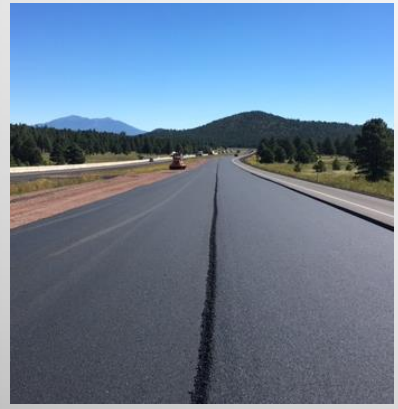
Trackless Tack

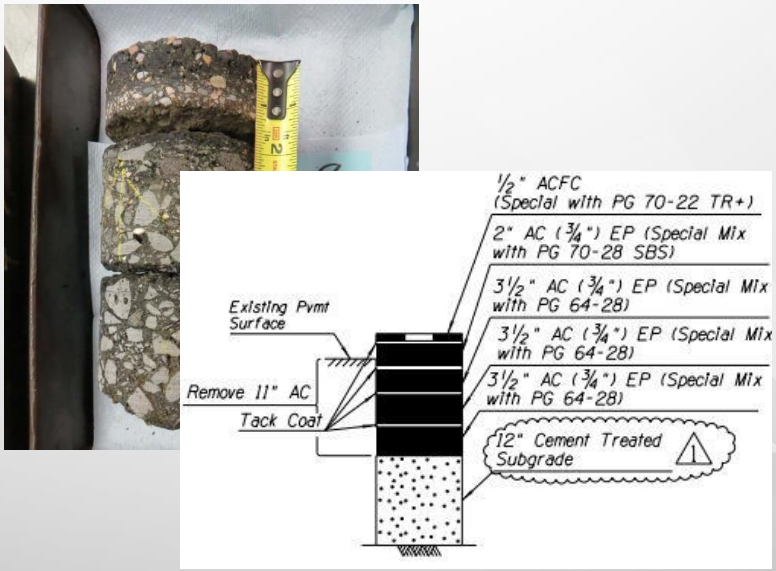
ASU Pavements/Materials Conference 11-16-2022

Prepared by: Nye McCarty, P.E.
Flagstaff Regional Materials Engineer
Arizona Dept. of Transportation

Today we will discuss:



Myths about tack

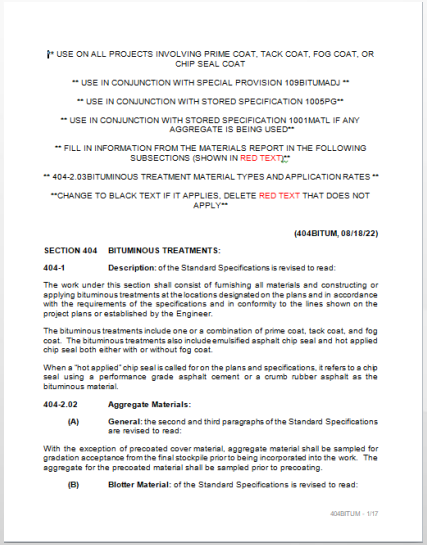


Importance of Tack

Dos and Don'ts

…and we will discuss:

ADOT's Test Section



/* USE ON ALL PROJECTS INVOLVING PRIME COAT, TACK COAT, FOG COAT, OR CHIP SEAL COAT

** USE IN CONJUNCTION WITH SPECIAL PROVISION 109BITUMADJ **

** USE IN CONJUNCTION WITH STORED SPECIFICATION 1005PG**

** USE IN CONJUNCTION WITH STORED SPECIFICATION 1001MATL IF ANY AGGREGATE IS BEING USED**

** FILL IN INFORMATION FROM THE MATERIALS REPORT IN THE FOLLOWING SUBSECTIONS (SHOWN IN RED TEXT)**

** 404-2.03BITUMINOUS TREATMENT MATERIAL TYPES AND APPLICATION RATES **

CHANGE TO BLACK TEXT IF IT APPLIES, DELETE RED TEXT THAT DOES NOT APPLY

(404BITUM, 08/18/22)

SECTION 404 BITUMINOUS TREATMENTS:

404-1 Description: of the Standard Specifications is revised to read:

The work under this section shall consist of furnishing all materials and constructing or applying bituminous treatments at the locations designated on the plans and in accordance with the requirements of the specifications and in conformity to the lines shown on the project plans or established by the Engineer.

The bituminous treatments include one or a combination of prime coat, tack coat, and fog coat. The bituminous treatments also include emulsified asphalt chip seal and hot applied chip seal both either with or without fog coat.

When a "hot applied" chip seal is called for on the plans and specifications, it refers to a chip seal using a performance grade asphalt cement or a crumb rubber asphalt as the bituminous material.

404-2.02 Aggregate Materials:

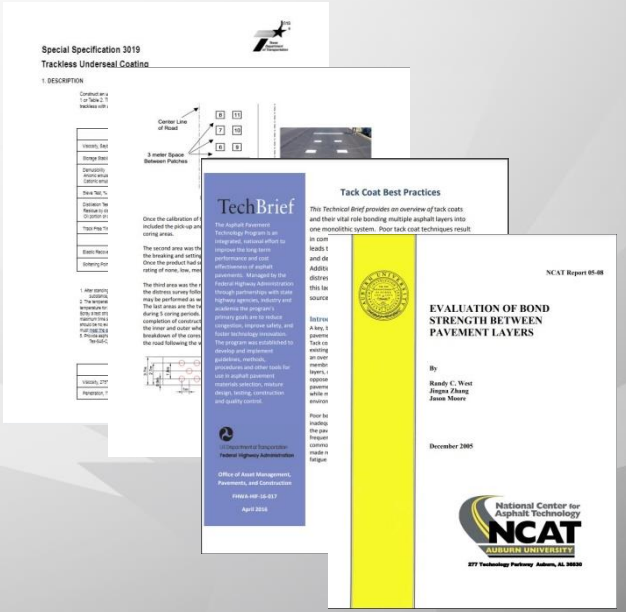
(A) General: the second and third paragraphs of the Standard Specifications are revised to read:

With the exception of precoated cover material, aggregate material shall be sampled for gradation acceptance from the final stockpile prior to being incorporated into the work. The aggregate for the precoated material shall be sampled prior to precoating.

(B) Blotter Material: of the Standard Specifications is revised to read:

404BITUM - 1/17

ADOT Trackless Tack Specification



Special Specification 3019
Trackless Underseal Coating

1. DESCRIPTION

TechBrief

Tack Coat Best Practices

NCAT Report 05-08

EVALUATION OF BOND STRENGTH BETWEEN PAVEMENT LAYERS

Randy C. West
Jingna Zhang
Jason Moore

December 2005

National Center for Asphalt Technology
NCAT
AUBURN UNIVERSITY

Resources

Fact or Fiction?

- It is ok to pave on tack coat that has not yet broken.
- Application rate is not important as long as there is complete and even coverage.
- Don’t need to sweep before applying tack
- Not needed if paving on new pavement surface.
- Ok to put construction traffic on tacked surface.
- Streaks and puddles are ok.
- Old pavement needs more than new pavement.
- All that matters is pavement thickness.

Paving on Unbroken Tack

- **No!**
- **No!**
- **No!**
- **Yes???**

Dense Graded AC
(No!)

Bonded Wearing Course
(Yes)

Tack Application Rate

Table 1. Recommended Tack Coat Application Rates

Surface Type	Residual Rate (gsy)	Approximate Bar Rate Undiluted* (gsy)	Approximate Bar Rate Diluted 1:1* (gsy)
New Asphalt	0.02 – 0.05	0.03 – 0.07	0.06 – 0.14
Existing Asphalt	0.04 – 0.07	0.06 – 0.11	0.12 – 0.22
Milled Surface	0.04 – 0.08	0.06 – 0.12	0.12 – 0.24
Portland Cement Concrete	0.03 – 0.05	0.05 – 0.08	0.10 – 0.16

*Assume emulsion is 33% water and 67% asphalt.

Source: FHWA Tech Brief: https://www.fhwa.dot.gov/pavement/asphalt/pubs/hif16017.pdf

Paving on New Pavement (perhaps even hot lapping)

Tack Coat Necessary?

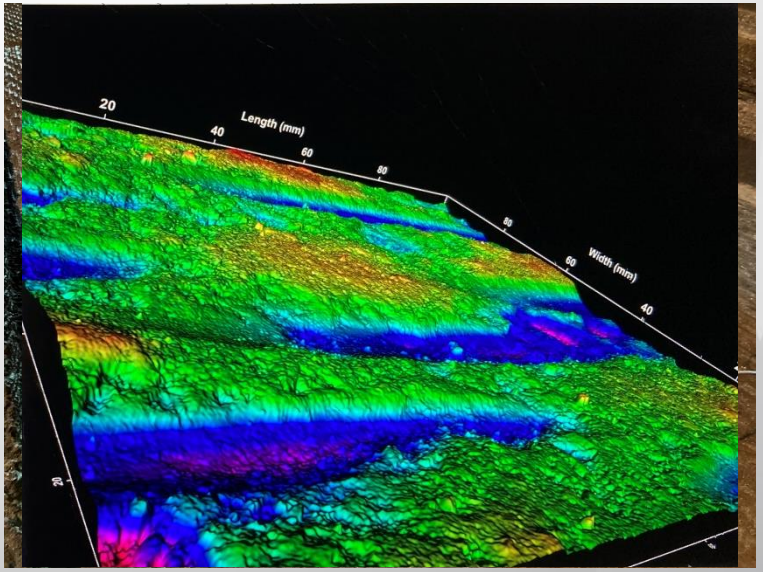
Yes!!!

Pavement Surface Characteristics

- Oxidized/Cracked Surface
- Raveled Surface
- Milled Surface
- Relatively New Surface
- Newly Paved Surface
- Flushed Surface
- Portland Cement Concrete Surface

Pavement Surface Characteristics

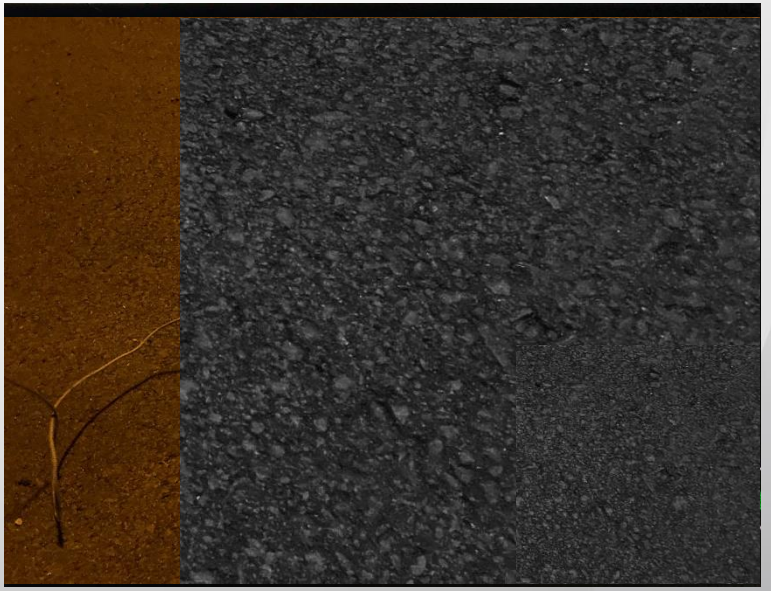
Surface Texture Scanner
(milled AC surface)



Pavement Surface Characteristics

Surface Texture Scanner
(new AC surface)

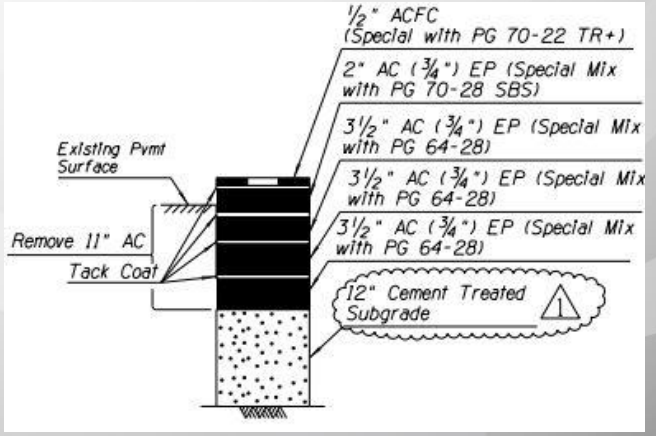
New Pavements Need Tack Coat Too!!



~~Pave~~ Pavement Structure

- Pavement Design Methodologies
  - AASHTO Guide for Design of Pavement Structures (1993)
  - MEPDG/PaveME

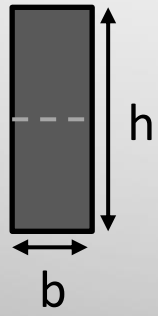
All consider the AC to behave as a “single monolithic pavement layer,” not individual layers.

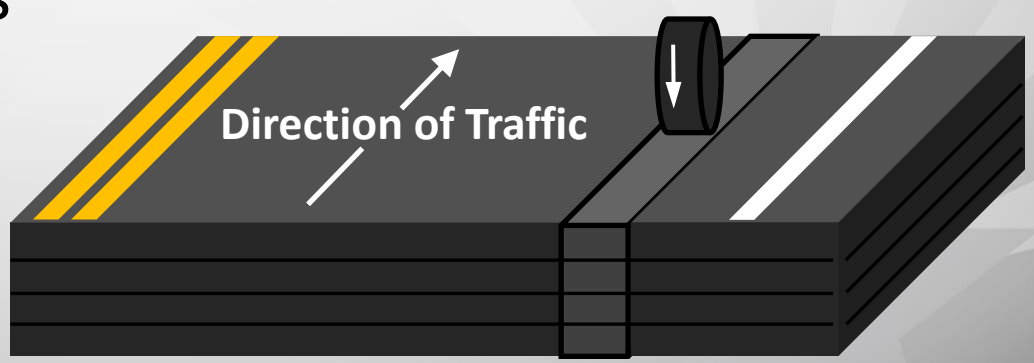


Pavement Structure

- Structural Analysis (kind of)
  - Section Modulus

$$S = \frac{bh^2}{6}$$

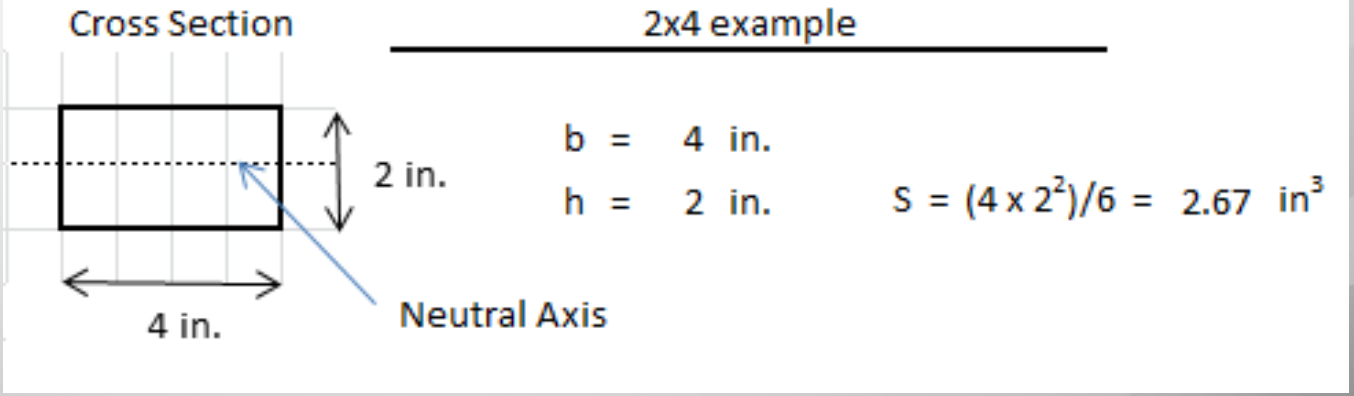




Pavement Structure

- Resistance to Bending

$$S = \frac{bh^2}{6}$$



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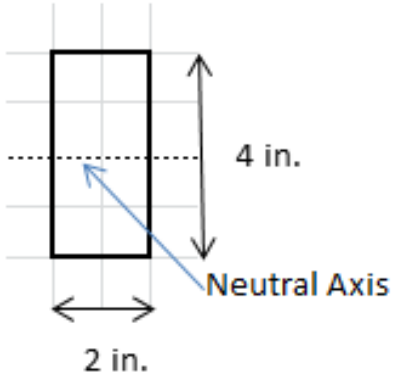


b = 2 in.

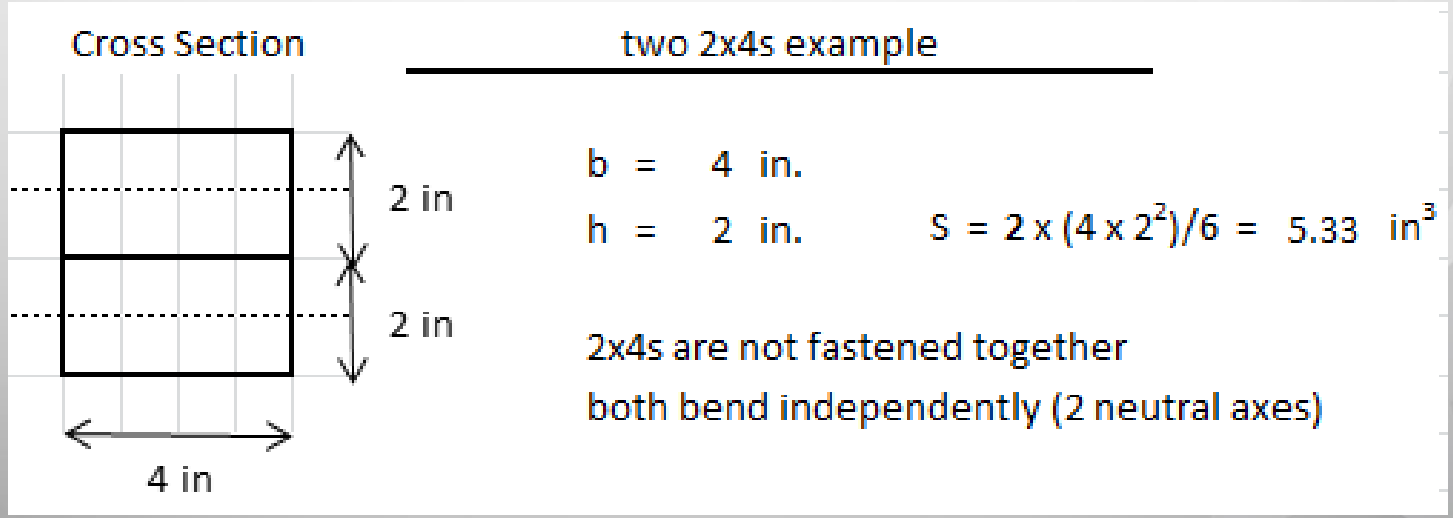
h = 4 in.

$S = (2 \times 4^2)/6 = 5.33 \text{ in}^3$

Increase of 100%

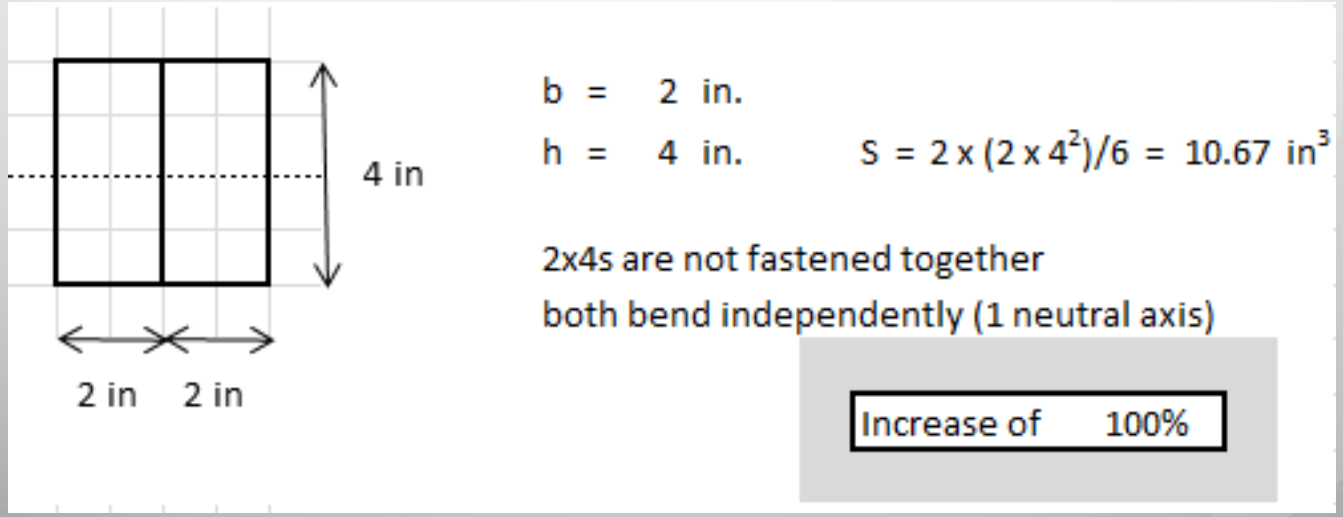
Pavement Structure

- Resistance to Bending



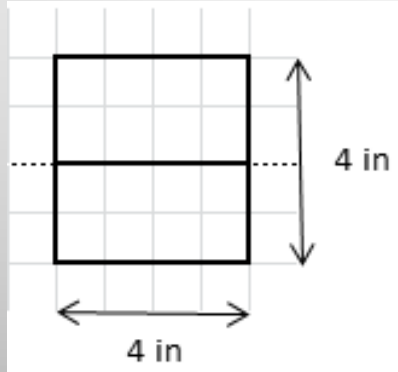
Pavement Structure

- Resistance to Bending



Pavement Structure

- Resistance to Bending



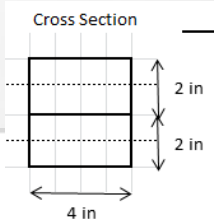
b = 4 in.

h = 4 in. $S = (4 \times 4^2)/6 = 10.67\ in^3$

2x4s are fastened together

bend as a single object (1 neutral axis)

Increase of 100%



two 2x4s example

b = 4 in.

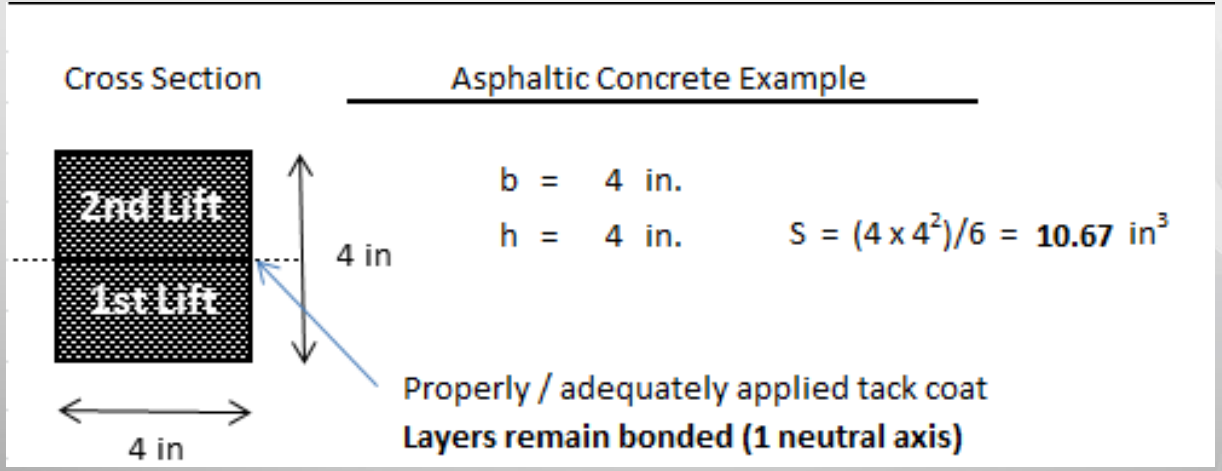
h = 2 in. $S = 2 \times (4 \times 2^2)/6 = 5.33\ in^3$

2x4s are not fastened together

both bend independently (2 neutral axes)

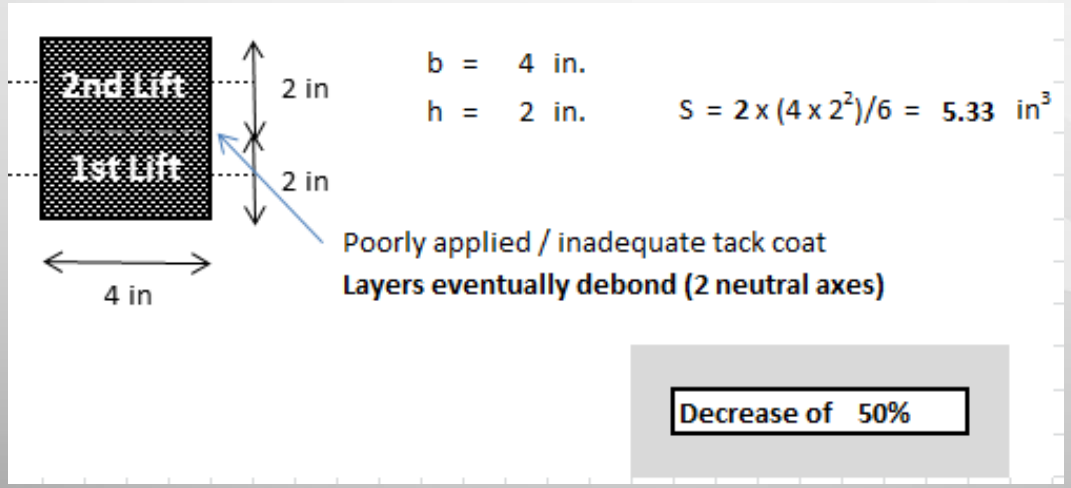
Pavement Structure

- Resistance to Bending



Pavement Structure

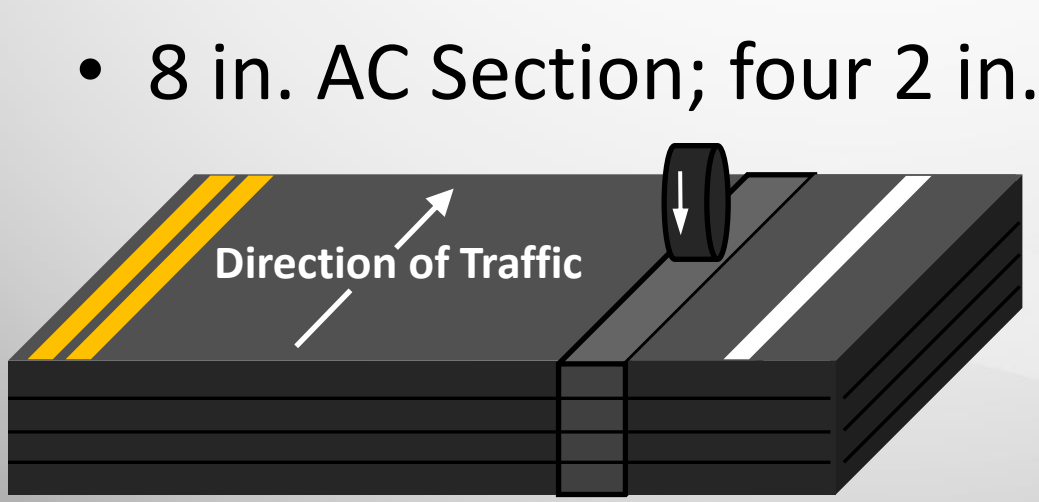
- Resistance to Bending

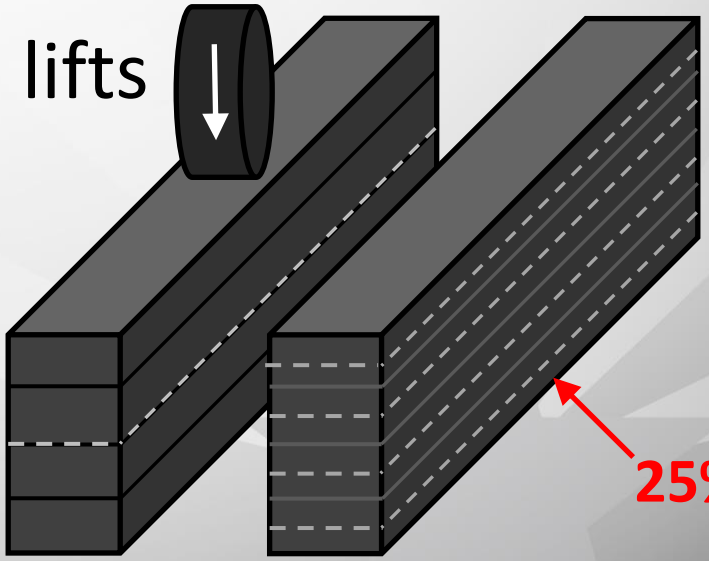


- **Assumptions of the design have been violated**
- **Fatigue life of the pavement has been significantly reduced**

Fatigue Resistance

- 8 in. AC Section; four 2 in. lifts



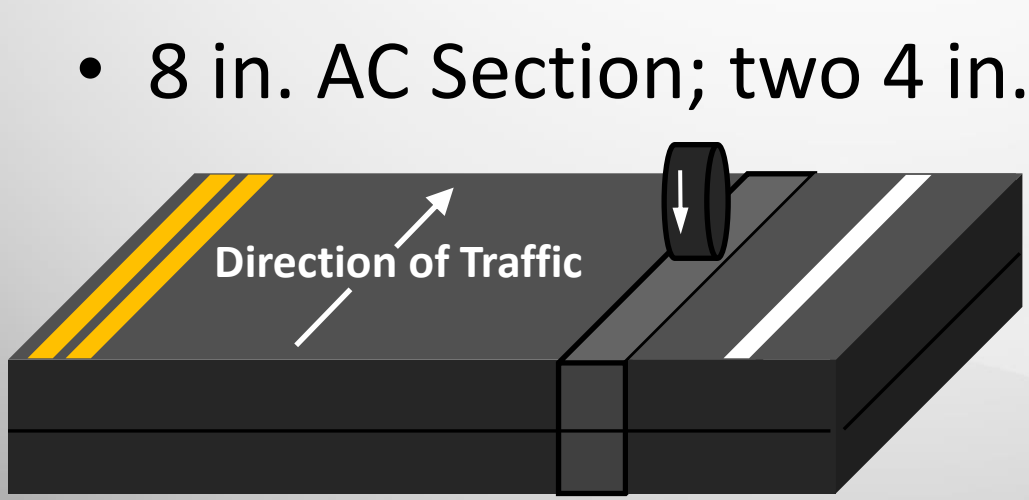


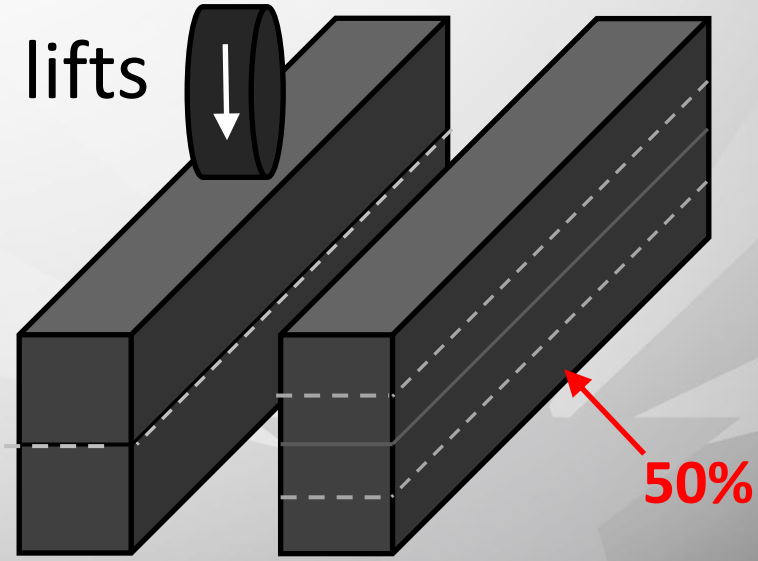
S = 10-2/3 in^3 (per inch

S = 2-2/3 in^3 per inch)

Fatigue Resistance

- 8 in. AC Section; two 4 in. lifts

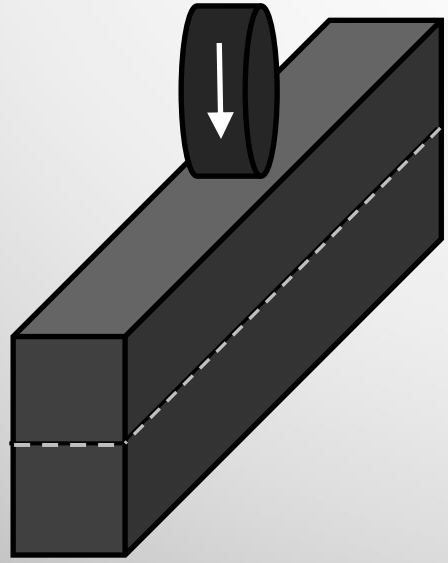




S = 10-2/3 in^3 (per inch)

S = 5-1/3 in^3 (per inch)

Tack Coat



Theoretical

Real World

Tack Coat

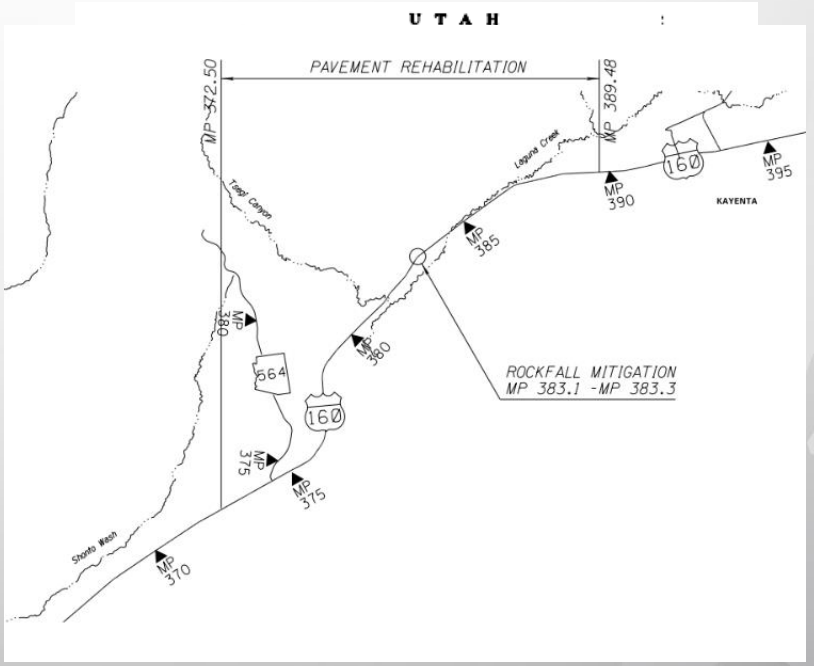
- Minimum Bond Strength
  - 40 psi (LTRC)
    - NCHRP Report 878
  - 100 psi (NCAT)
    - NCAT Report 05-08

Trackless Tack

- ADOT Test Sections:
  - Wickenburg, AZ (US89/SR74)
    - Unsuccessful; significant tracking
  - US 160 Longhouse Valley to Kayenta, AZ
    - Very successful; zero tracking
    - Minimal Break time
    - Achieved very good bond strength

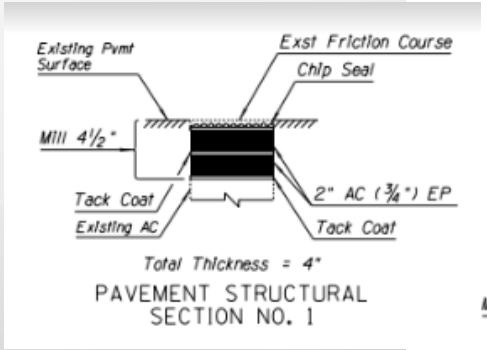
US 160: Long House Valley to Kayenta

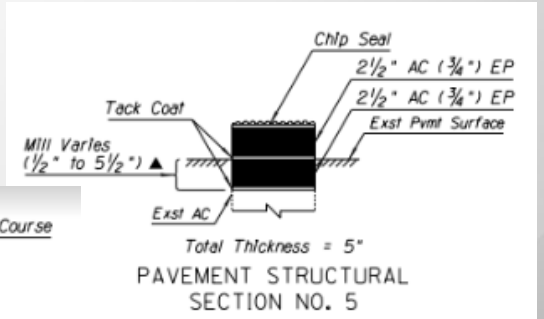
- 17 Miles of single-lane rural highway.
- Approximately 60,000 tons of Asphaltic Concrete
- MP 380-381

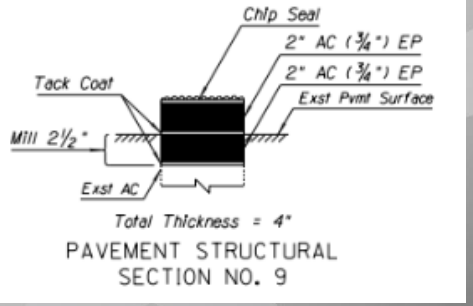


US 160: Long House Valley to Kayenta

- Pavement Preservation
  - Mill and fill
  - Chip Seal
  - 163 Tons of Bituminous Tack Coat







US 160: Longhouse Valley to Kayenta

- Conventional Tack

US 160: Longhouse Valley to Kayenta

mulsions)

Videos

Testing (Bond Strength)

AASHTO TP 114 or Tex-249-F

Testing (Bond Strength)

- AASHTO TP 114 or Tex-249-F
  - Oven dried to constant weight at 100 degrees F (+/- 5 degrees F), not to exceed 24 hrs, or use Core Dry apparatus.
  - Condition at 77 degrees F (+/- 2 degrees F) for a minimum of 2 hrs prior to testing.
  - Constant Displacement of 0.1 inches per minute
  - No Normal Force applied.

Bond Strength Results

Core	(Station)	Direction	Offset (ft)	(gal/sq.yd)	Strength (psi)	Strength (psi)
1A	336+00	EB	7 R of CL	0.08	95.3	133.63
1B					169.5	
1C					136.0	
2A	350+00	EB	5.5 R of CL	0.10	183.9	182.20
2B					Error	
2C					180.5	
3A	370+00	EB	6 R of CL	0.12	239.6	210.78
3B					205.9	
3C					186.9	
4A	324+00	WB	7 L of CL	0.10	236.1	203.56
4B					196.6	
4C					178.0	
5A	320+00	WB	7 L of CL	0.12	268.4	261.50
5B					254.6	

Trackless Tack

- Emulsified Asphalt
  - Harder Base Binder
  - Achieves “non-tacky” state in short period of time
  - Project-specific chemistry
  - Formulated to project conditions
- Variety of products from several suppliers.

Why go Trackless?

Trackless Tack

- Owner / Agency
  - Ensures Adequate Bond between Pavement Layers
  - Improves Pavement Performance
  - Achieve/exceed Pavement Design Life
  - Reduces unsightly tracking.

Trackless Tack

- Contractor
  - Reduces wait time for conventional tack to break
  - Increase daily paving production by 20-25%
  - Extends Paving Season
  - Happy inspectors, project supervisors, and engineers

ADOT Specification (404Bitum)

- 404-2.01 Emulsified Trackless Tack added to table of bituminous materials
- 404-2.03 Bituminous Material Types and Application Rates (404-4.02)
- 404-3.01(E) Seasonal and Weather Limitations
  - Formulated by supplier for project conditions
  - Shall not be applied to surfaces greater than 140 deg. F
  - Use within manufacture recommended conditions unless approved by Engineer
  - Range of conditions need to be provided in product literature
- 404-3.02(A) Equipment (Distributor Truck)
  - Thoroughly cleaned by circulating warm water (consult with supplier)
  - Heating flues covered while slowly heating (circulating) trackless tack

ADOT Specification (404Bitum)

- 404-3.03 Bituminous Material Storage (Trackless Tack)
  - Minimize exposure to air
  - Storage container must be completely emptied/flushed prior to loading
  - Avoid using storage containers used for solvent based materials
  - Store within manufacturer recommended temperature range (50 to 170 deg. F)
  - No contact with anything at/above 212 deg. F
  - Use prior to dropping below 50 deg. F
  - Do not return unused material to storage container.
- 404-3.04 Preparation of the Surface
  - Must remove all debris, dust, coatings (pressure spray if necessary)

ADOT Specification (404Bitum)

- 404-3.05 Application of Bituminous Material
  - Apply at 140 to 170 deg. F
- 404-4.02 Tack Coat
  - Contractor shall choose the product
  - Trackless tack must be formulated for the project
  - Dilution may only be performed by the manufacturer
  - COA for each batch / COC for each delivery
  - Subject to approval by the Engineer

ADOT Specification (404Bitum)

- 404-4.02 Tack Coat (continued)

Test Property	Test Method	Requirement
Viscosity: Saybolt Furol, seconds, @ 77° F	AASHTO T 59	10-150
Settlement: 24hrs, % maximum	AASHTO T 59	1.0
Sieve: Retained on No. 20, % maximum	AASHTO T 59	0.3

ADOT Specification (404Bitum)

- 404-4.02 Tack Coat (continued)

Oil Distillate to 176.7° C (350° F), Volume of Emulsion, % maximum	AASHTO T59	1.0
Solubility in Trichloroethylene, % minimum	ASTM D 2042	97.5
Softening Point, @ 65° C, minimum	AASHTO T 53	65
Dynamic Shear of Original Binder: G*/Sin δ @ 76° C (10 rad/sec), kPa minimum	AASHTO T 315	1.00

ADOT Specification (404Bitum)

- 404-4.02 Tack Coat (continued)

Particle Charge	AASHTO T59	Report Only
Residue from Distillation to 176.7° C (350° F), %	AASHTO T59	Report Only
Shear Bond Strength, psi	Tex-249-F	Report Only

ADOT Specification (404Bitum)

- 404-4.02 Tack Coat (continued)

Type of Bituminous Material	Approximate Tack Coat Application Rates: Gallons / Square Yard		Payment Factor
	Prior to Placing ACFC or AR-ACFC	All Other Tack Coats	
Emulsified Asphalt (Special Type) – See Note (1) Below.	Not Allowed	0.12	0.7
Emulsified Asphalt (Trackless Tack) - See Note (2) Below			1.0
Emulsified Asphalt (Other than Special Type)	0.08	0.08	1.0

ADOT Specification (404Bitum)

- 404-4.02 Tack Coat (Note 2 from Application Rate table)
  - Apply in accordance with manufacturer recommendations based on residual asphalt content
  - Existing Asphaltic Concrete Surfaces: 0.05 gal/sy
  - New Asphaltic Concrete Surfaces: 0.03 gal/sy
  - Milled Surfaces: 0.06 gal/sy
  - Portland Cement Concrete Surfaces: 0.04 gal/sy
  - Application rates are always subject to adjustment as appropriate

  - Refer to supplier's estimated time to achieve a "non-tacky" condition.
  - Test it out before opening to all construction traffic

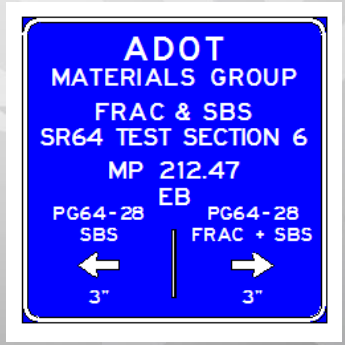
Resources

- NCAT Power Point Slides: Bond Strength of Tack Coat Materials
- NCAT Report 05-08: Evaluation of Bond Strength Between Pavement Layers
- FHWA TechBrief: Tack Coat Best Practices
- FHWA Checklist: Asphalt Emulsion-Based Tack Coat
- NCHRP Synthesis 516: Tack Coat Specifications, Materials, and Construction Practices
- NCHRP Report 878: Validation of the Louisiana Interlayer Shear Strength Test for Tack Coat
- Asphalt Institute: Construction Quality Asphalt Pavements (workshop)

Additional Innovations

- Increased Density – I40, I17, I10, I19
- Polymer Modified Asphalt – I40, SR64 (HiMA; EDC-6 TOPS)
- Trackless Tack – US160

- Longitudinal Joint Compaction – I40, I10
- Fiber Reinforced Asphaltic Concrete – SR89A, SR64



Thank you!

QUESTIONS?

nmccarty@azdot.gov

928 779 7522