

Asphalt Trackbeds For Fastracks

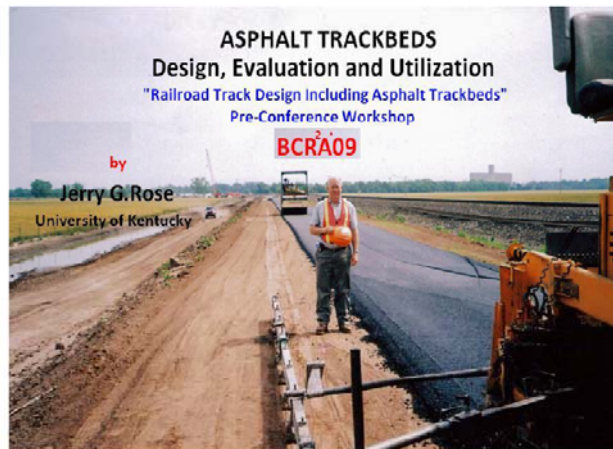
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Special Thanks to Jerry Rose

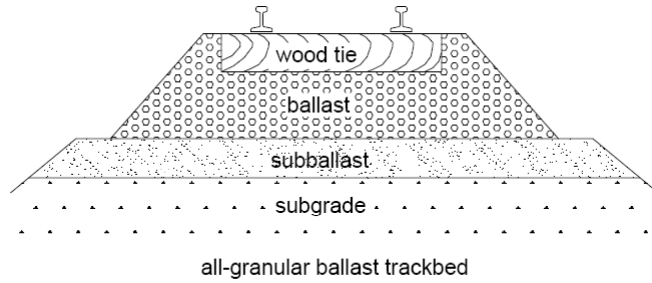
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Traditional Trackbed Construction

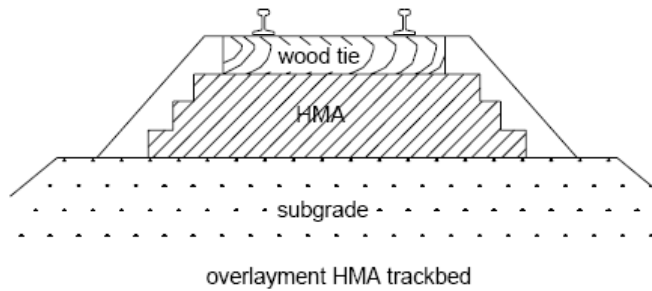
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HMA Overlayment

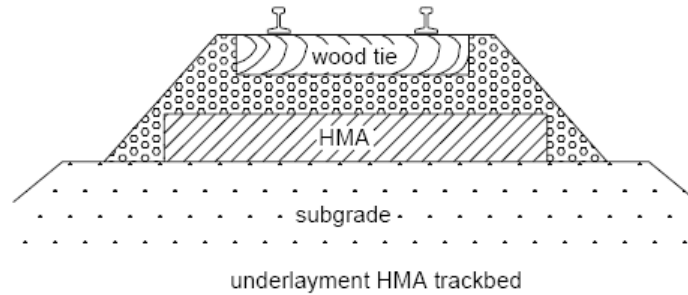
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HMA Underlayment

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First known section built in 1968

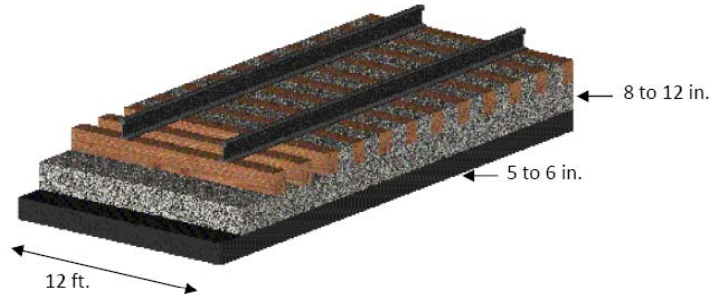
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- Santa Fe Railway Coal Line near Raton, New Mexico
- 2.5", 5" and 7.5" Sections placed
- In a bad area that required regular maintenance
- Performed very well - 30+ years with little or no maintenance
- Samples have been recovered and tested to determine HMA properties due to aging.

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Typical Underlayment Dimensions

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Strengthens Trackbed Support

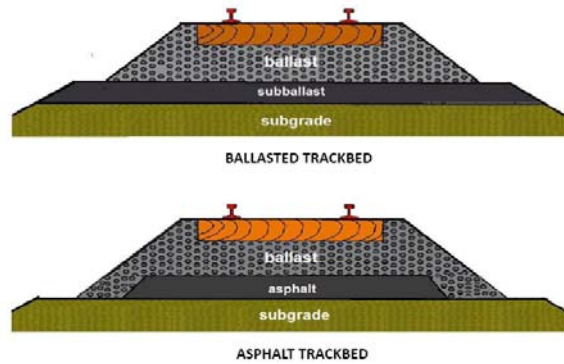
Waterproofs Underlying Roadbed

Confines Ballast and Track

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HMA is typically 12' in width

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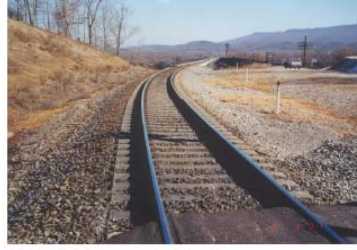


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Multiple applications

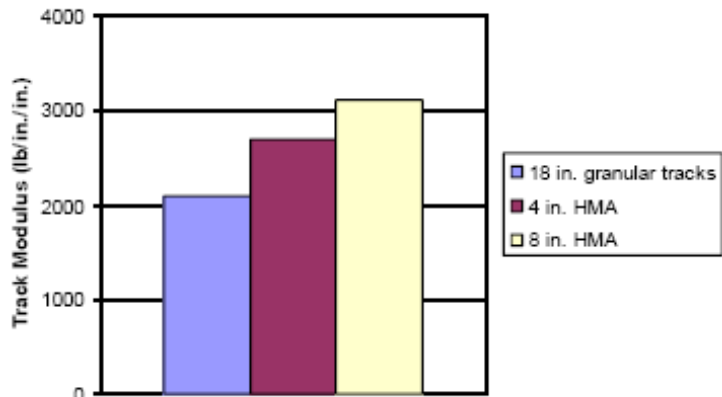
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Increases Trackbed Modulus

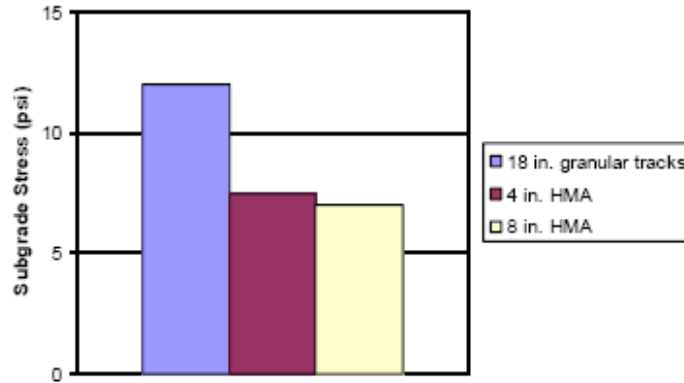
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Reduced Subgrade Stress

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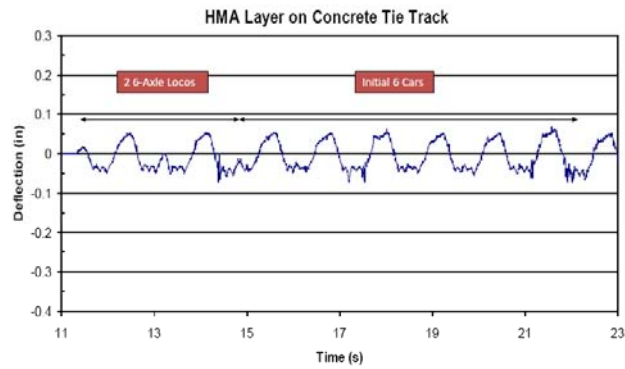


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Resulting in Low Deflections

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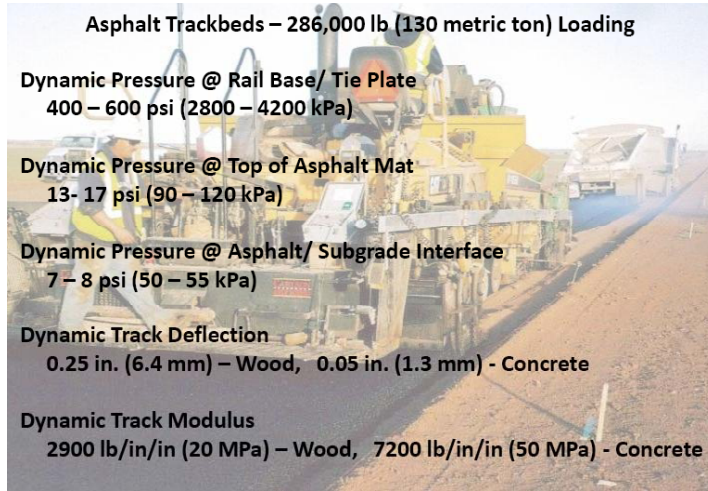
Loaded Coal Train at Brush Creek



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Typical associated stresses

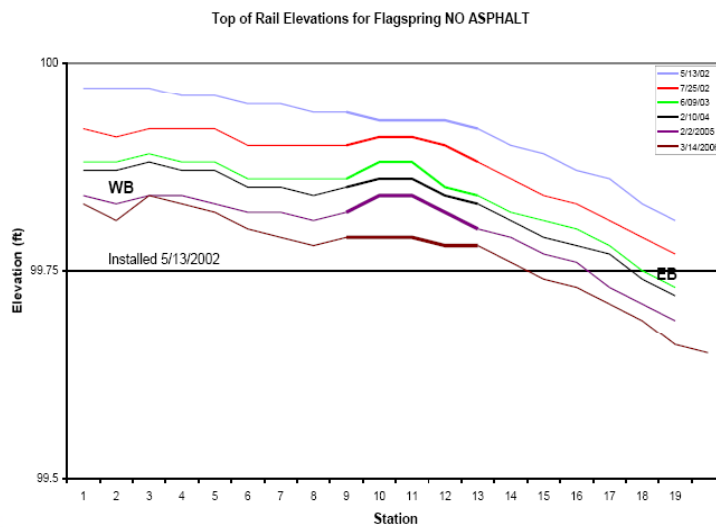
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Reduction in Settlement

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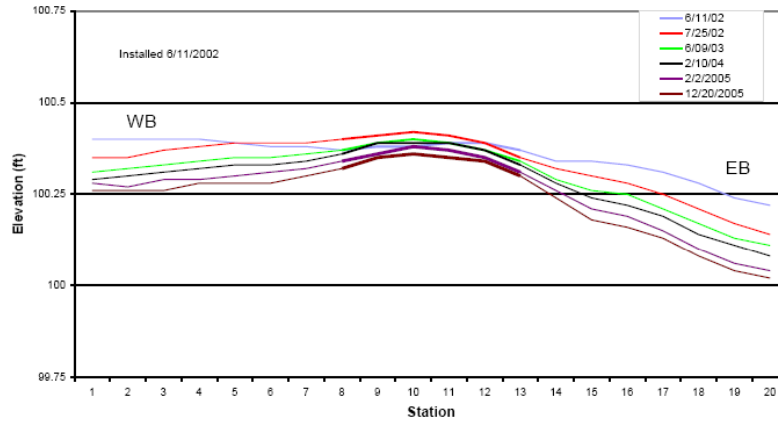


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Reduction in Settlement

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Top of Rail Elevations for South Portsmouth

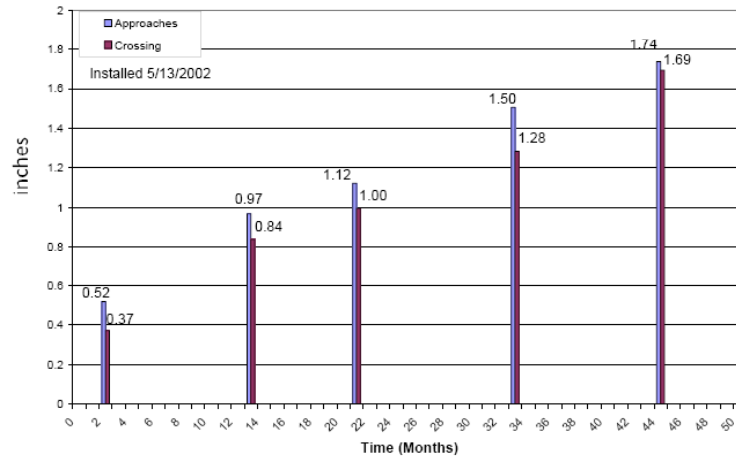


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Reduction in Settlement

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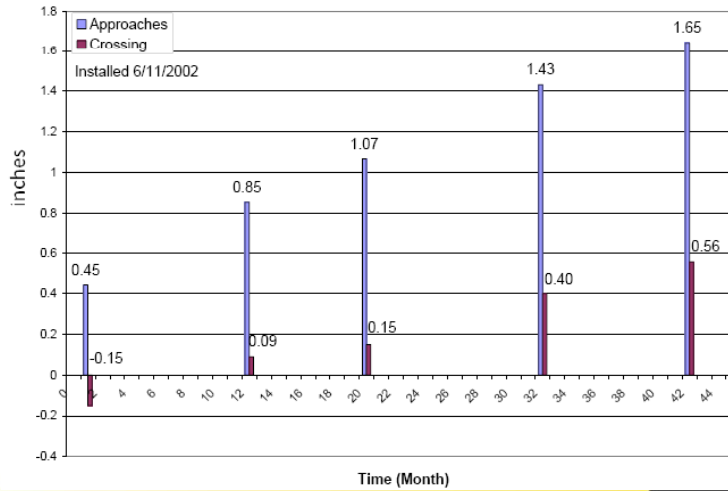
Average Asphalt/Approach Settlement for Flag Spring (no underlayment)



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Reduction in Settlement

Average Asphalt/Approach Settlement for South Portsmouth



Reduced Track Settlement



- Settlement Asphalt Crossings was 41% of non-Asphalt Crossings
- Settlement Asphalt Crossings was 44% of Abutting Approaches
- Settlement of Non-Asphalt Crossings & Approaches – Similar

2005 performance analysis

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- 371 MGT were accumulated on the HMA Track before surfacing was required on 65 feet of track.
- This compares to an average cycle of 15 MGT on 18 inch conventional track.
- The 65 feet of bad track was located in the sag of a horizontal curve.
- At 406 MGT the 65 foot section had to be replaced. The remainder continued without requiring surfacing. Final tonnage not known.

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2005 performance analysis

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We learned that HMA has a Specific Gravity greater than 1



Figure 3. Asphalt Damage and Standing Water

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Improved Constructability

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Improved Subgrade performance

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Subgrade Findings/Discussions

- In-situ Moisture Contents
 - Remain Consistent Over Time
 - Compare Favorably With Optimum
- Assume Unsoaked, Optimum Condition
- Bearing Capacity Remains At or Near Optimum
- Wide Range of Subgrades Evaluated
- Minimum Loading Induced Stress on Subgrade

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Mixture Specifications

Composition of Dense-Graded HMA Mix

Sieve size	Amount finer, mass %	
	Recommended	Actual
1.5 inch	100	100
¾ inch	70 - 98	76
3/8 inch	44 - 76	52
No. 4	30 - 58	41
No. 8	21 - 45	30
No. 16	14 - 35	23
No. 30	8 - 25	17
No. 50	5 - 20	11
No. 200	2 - 6	4.5
Asphalt	3.5 - 6.5	6.4

Mixture Specifications

Marshall Mix Design Criteria for HMA Underlayment

Property	Required Range	Actual Test Results
Compaction	50 blows	50 blows
Stability (lbs)	750 minimum	1730
Flow (inch)	0.15 - 0.25	0.24
Percent air voids	1 - 3%	2%
Voids filled w/asphalt	80 - 90%	86%
In-place density*	92 - 98%	94%**
*Maximum density = 151 ptc		
** Average nuclear density test results		



Use 50 gyrations for SGC compacted mixtures

Will a plastic mix fail?

286,000
lb



13 - 17
psi

62,000
lb



2 - 4
psi

180
lb



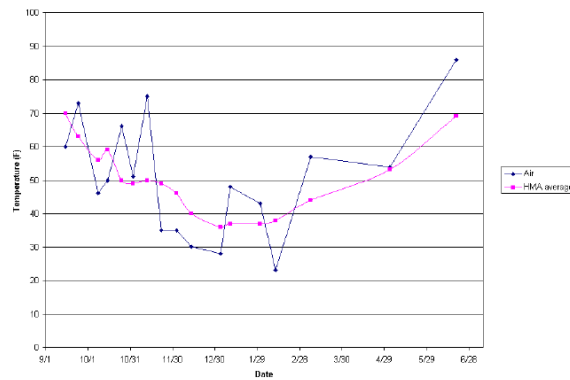
6
psi



100 - 200+
psi

Mixture is isolated from environment

HMA Temperature vs. Air Temperature



International uses of HMA

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Italian High-Speed Passenger Lines

- Rome-Florence: First High Speed Line – 252 km – 1977-1986
- Debated between cement and asphalt
- Asphalt performed better – opted for use on all high-speed passenger lines



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International uses of HMA

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Germany



- German Getrac ballastless track
- Track Panels are directly supported by asphalt
- Two Types: Getrac A1 and Getrac A3



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International uses of HMA

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Dimensions

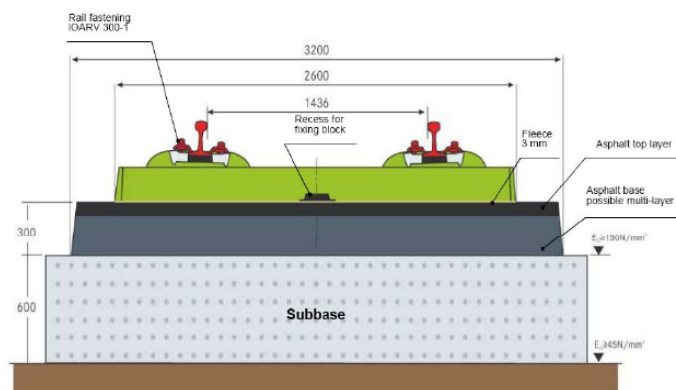
- Getrac A1:
 - 300 cm of asphalt
 - 600 cm of subgrade
 - Concrete Ties
 - Used for open track
- Getrac A3:
 - 260 cm of asphalt
 - 600 cm of subgrade
 - Concrete Ties
 - Used for restricted spaces: tunnels

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International uses of HMA

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Getrac A1 Cross-Section



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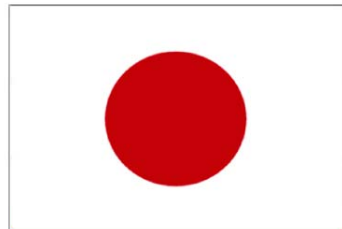


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International uses of HMA

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Japan



- Shinkansen Lines "Bullet Train"
- 1964 – Tokyo to Osaka
- Other lines branched off
- Estimated 396 billion people*km using trains

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International uses of HMA

Ballasted Cross Section

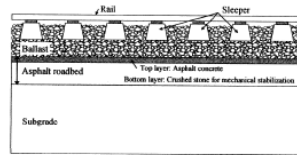


Figure1: Typical cross-section of railway asphalt roadbed.

Asphalt Thickness –
5cm

Well-Graded Crushed
Stone Thickness –
15-60 cm



International uses of HMA

Ballastless Cross Section

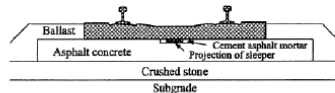


Fig. 1 The first test track of solid bed track on asphalt pavement

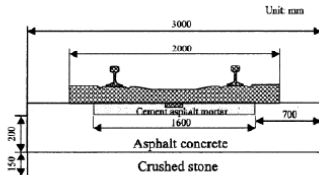


Fig. 7 Cross section of the improved solid bed track on asphalt pavement

- Mainly used for viaducts and tunnels
- Proposed a low noise solid bed track on asphalt pavement



International uses of HMA

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See Jerry's University
of Kentucky Website

<http://www.engr.uky.edu/~jrose>

or
www.asphaltinstitute.org

Thanks!



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