Chapter 10
Thin Maintenance Overlays

From… Maintenance Technical Advisory Guide (MTAG)

Managers Overview

From… Maintenance Technical Advisory Guide (MTAG)

Thin Maintenance Overlays

- What are thin maintenance overlays?
- Why use thin maintenance overlays?
- When to use thin maintenance overlays?
- Where to use thin maintenance overlays?

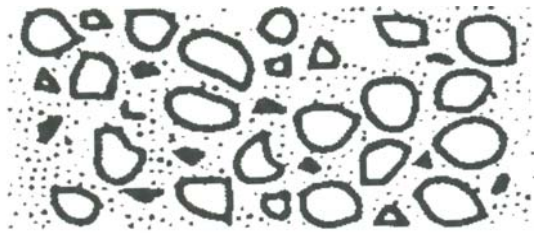
What Are Thin Maintenance Overlays?

- Defined as thin treatment using a hot mix system
- Non-structural layer
- Applied as a maintenance treatment (corrective or preventive)
- Thickness:
  - Caltrans: 1¼ in
  - Nationally: less than 1½ in

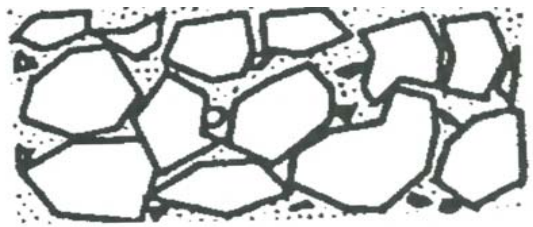
Types of Thin Maintenance Overlays

- Dense-graded: HMA Type A and B
- Open-graded: OGFC, RHMA-O and RHMA-O-HB
- Gap-graded: RHMA-G

a) Dense Graded

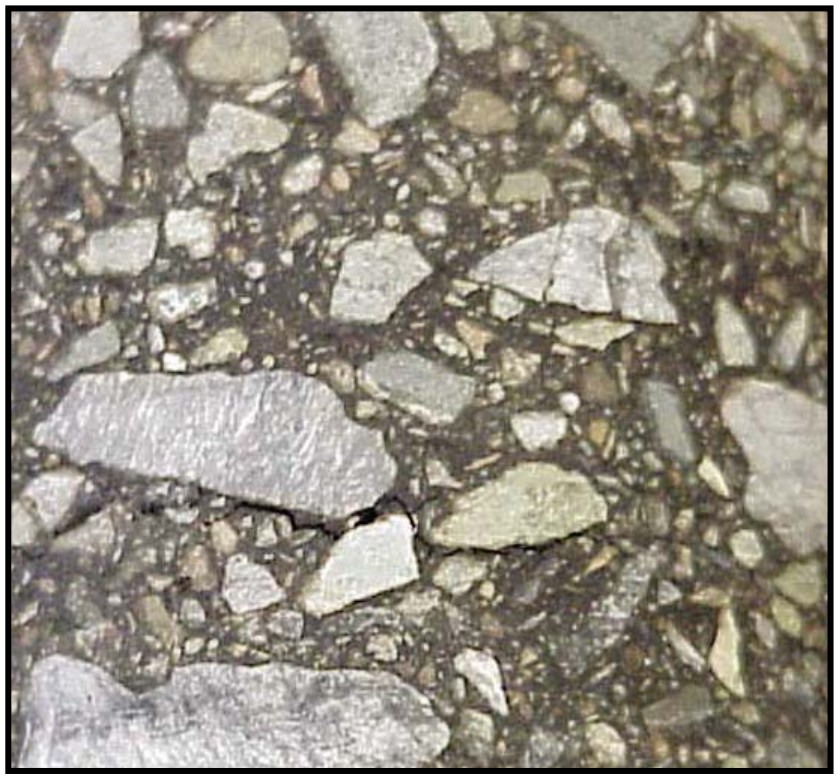


b) Gap Graded



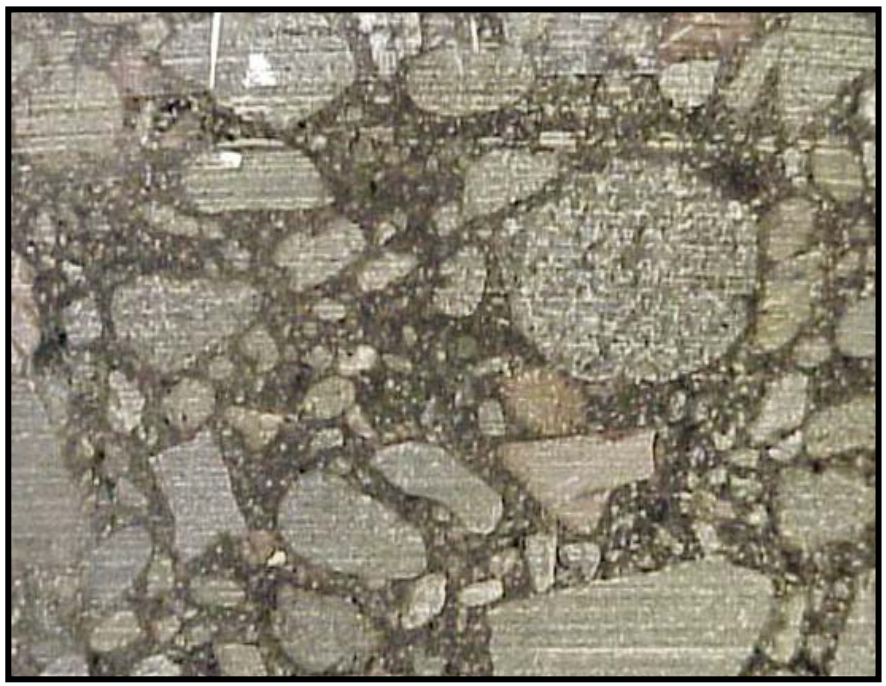
c) Open Graded

Dense Graded Overlays



- Most common type
- Resist abrasion
- Impermeable wearing course
- Improve ride quality
- Over AC or PCC
- Use PG or PM binder
- Service life: 4 – 6 years
- Placed on structurally sound pavements

Open Graded Overlays



- Air void content:15% to 25%
- Important to maintain void structure
- Improves skid resistance
- Significant reduction in splash and spray
- Noise reduction
  (3-5 dBA < DGAC)
- Service life: 4 – 6 years

Gap Graded Overlays

- In Caltrans, gap graded mixes are used with rubberized asphalt binder – RHMA-G
- Gap in grading for asphalt rubber binder
- RHMA usage in Caltrans since the 1980's
- Flexible mix highly resistant to reflective and fatigue cracking

Why Use Thin Overlays?

- Extends Pavement Life
- Improves Ride Quality
- Mitigates Distresses
  - Raveling
  - Oxidation
  - Minor cracking
  - Minor surface irregularities
  - Skid problems
  - Flushing surfaces

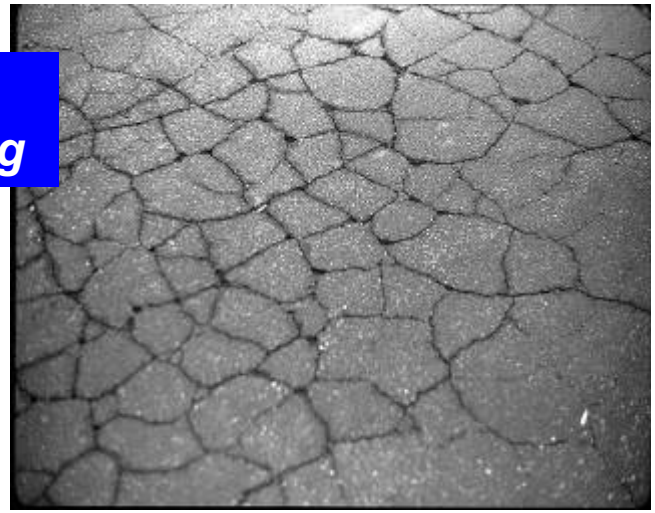
When to Use?

- Structurally sound pavement
- Rut depth < 1/2”
- Minor cracking
- Minor to moderate bleeding
- Raveled surface

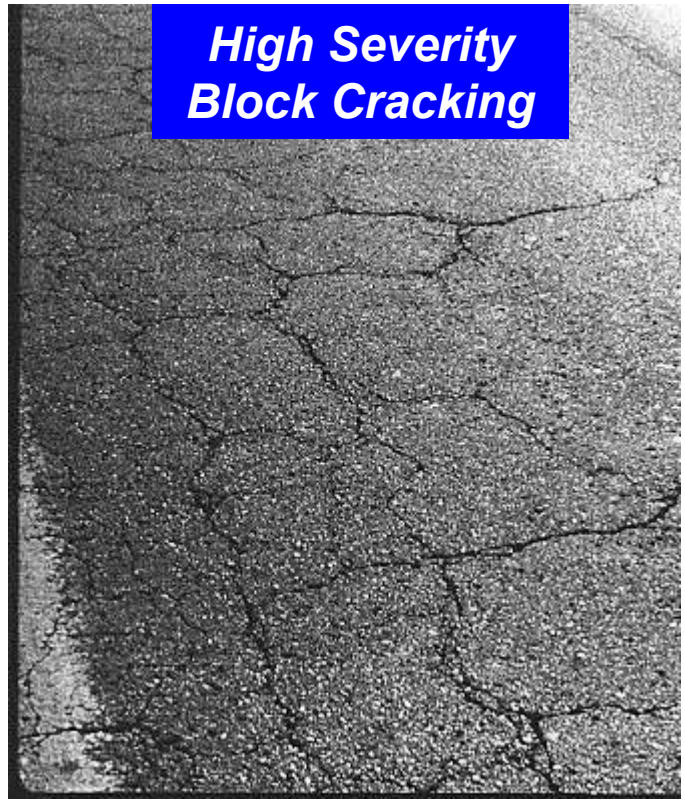
When NOT to use!

Poor Candidates

High Severity Alligator Cracking



High Severity Block Cracking



Rutting >1/2”

High Severity “D” Cracking

Where to Use?

Open- and Gap-Graded Overlays

- In sections with high frequency of wet weather accidents or when recommended to minimize wet weather accident occurrences
- For improving skid resistance
- For noise reduction

Module 10-1

Design, Materials & Specifications

From… Maintenance Technical Advisory Guide (MTAG)

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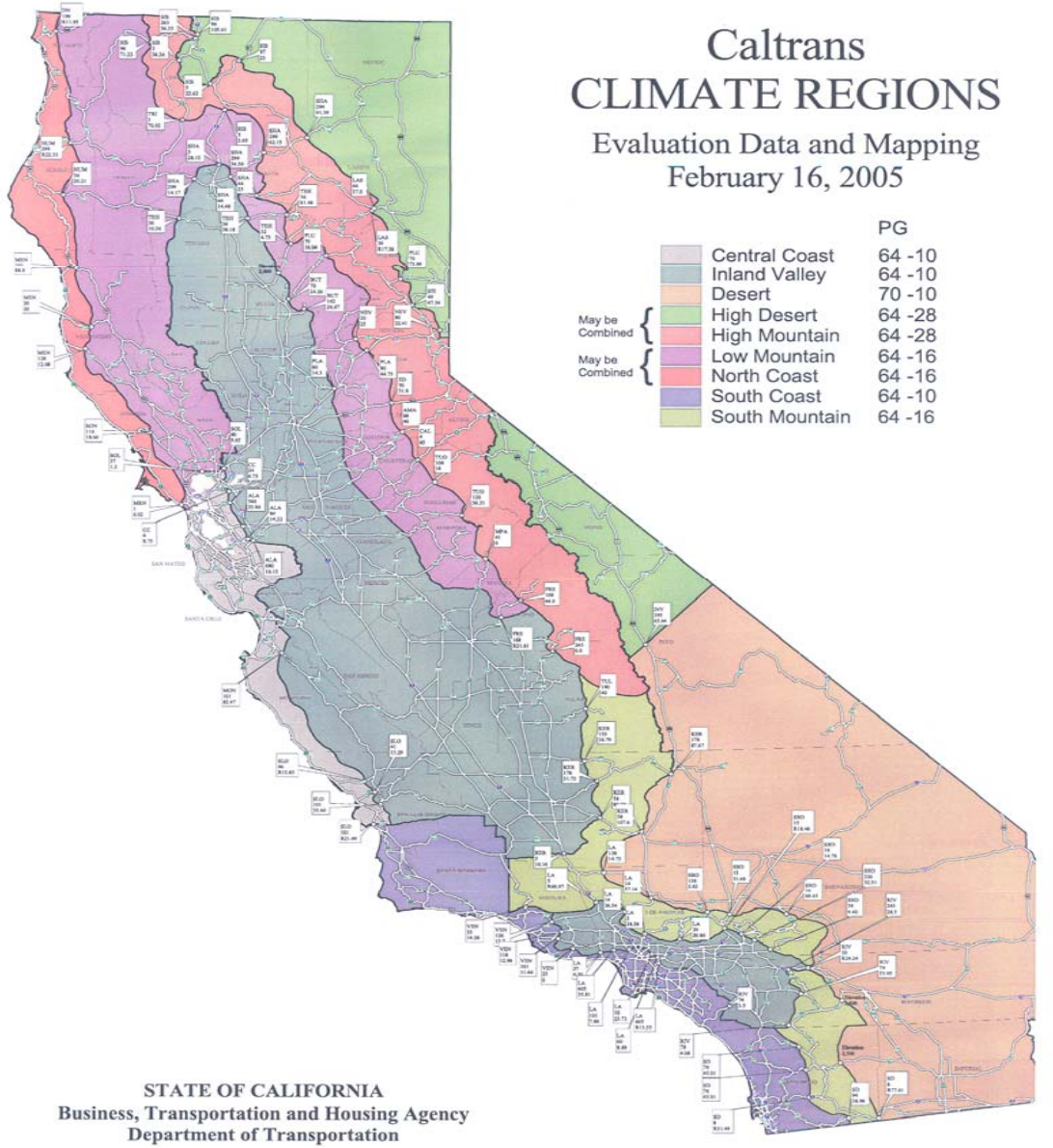
Project Selection

- Distress and Application Considerations
- Variables
  - Traffic loading
  - Existing pavement conditions
  - Environment
- Performance: service life 2-10 years, commonly 4-6 years.
- Costs: depend on materials, location, overlay thickness, etc.

Material Specifications

- Binders
  - PG Grade spec
  - Polymer modified asphalt spec
  - Rubberized Asphalt spec
- Aggregates
  - Gradations
  - Physical Properties
- Mix Design
- Asphalt Emulsion
  - Application
  - Specifications

Asphalt Binders Selection



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Asphalt Binders Selection (cont.)

Binder / Climatic Region	Conventional Hot Mixed Asphalt				RAC
	Dense Graded HMA		Open Graded		
	Typical	Special[1]	Placement Temperature		Base Stock for RAC-O and RAC-G
			>70°F	<70°F	
South Coast Central Coast Inland Valleys	PG 64-10	PG 70-10 PG 64-28 PM	PG 64-10	PG 58-34 PM	PG 64-16
North Coast	PG 64-16	PG 64-28 PM	PG 64-16	PG 58-34 PM	PG 64-16
Low Mountain South Mountain	PG 64-16	PG 64-28 PM	PG 64-16	PG 58-34 PM	PG 64-16
High Mountain High Desert	PG 64-28	PG 58-34 PM[2]	PG 64-28	PG 58-34 PM	PG 58-22
Desert	PG 70-10	PG 64-28 PM	PG 70-10	See Note 3	PG 64-16

Notes:

1. PG 76-22PM may be specified for conventional dense graded hot mixed asphalt for special conditions in all climatic region when specifically requested by the District Materials Engineer.
2. PG 64-28 PM may be specified when specifically requested by the District Materials Engineer.
3. Consult the District Materials Engineer for appropriate binder grade.

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HMA Types A and B Gradations

	HMA Types A and B							
	3/4–inch		1/2–inch		3/8–inch		No. 4	
Sieve Sizes	Target Value Limits	Allowable Tolerance	Target Value Limits	Allowable Tolerance	Target Value Limits	Allowable Tolerance	Target Value Limits	Allowable Tolerance
1"	100	—	—	—	—	—	—	—
3/4"	90-100	TV ±5	100	—	—	—	—	—
1/2"	70-90	TV ±6	95-99	TV ±6	100	—	—	—
3/8"	—	—	75-95	TV ±6	95-100	TV ±6	100	—
No. 4	45-55	TV ±7	55-66	TV ±7	58-72	TV ±7	95-100	TV ±7
No. 8	32-40	TV ±5	38-49	TV ±5	34-48	TV ±6	72-77	TV ±7
No. 30	12-21	TV ±4	15-27	TV ±4	18-32	TV ±5	37-43	TV ±7
No. 200	2-7	TV ±2	2-8	TV ±2	2-9	TV ±2	2-12	TV ±4

OGFC Aggregate Gradations

	1–inch		1/2–inch		3/8–inch	
Sieve Sizes	Target	Tolerance	Target	Tolerance	Target	Tolerance
1 1/2"	100	—	—	—	—	—
1"	99-100	TV ±5	—	—	—	—
3/4"	85-96	TV ±5	100	—	—	—
1/2"	55-71	TV ±6	95-100	TV ±6	100	—
3/8"	—	—	78-89	TV ±6	90-100	TV ±6
No. 4	10-25	TV ±7	28-37	TV ±7	29-36	TV ±7
No. 8	6-16	TV ±5	7-18	TV ±5	7-18	TV ±6
No. 30	—	—	0-10	TV ±4	0-10	TV ±5
No. 200	1-6	TV ±2	0-3	TV ±2	0-3	TV ±2

RHMA-Gap Gradations

Sieve Sizes	3/4-inch		½-inch	
	Target Value Limits	Allowable Tolerance	Target Value Limits	Allowable Tolerance
1"	100	—	—	—
3/4"	95-100	TV ±5	100	—
1/2"	83-87	TV ±6	90-100	TV ±6
3/8"	65-70	TV ±6	83-87	TV ±6
No. 4	28-42	TV ±7	28-42	TV ±7
No. 8	14-22	TV ±5	14-22	TV ±5
No. 200	0- 6	TV ±2	0-6	TV ±2

Aggregate Quality Requirements

Quality Characteristic	Test Method	HMA Type			
		A	B	RHMA-G	OGFC
Percent of crushed particles	CT 205				
Coarse aggregate (% min.)					
One fractured face		90	25	--	90
Two fractured faces		75	--	90	75
Fine aggregate (% min) (Passing No. 4 sieve and retained on No. 8 sieve.)		70	20	70	90
Los Angeles Rattler (% Max.)	CT 211				
Loss at 100 Rev.		12	--	12	12
Loss at 500 Rev.		45	50	40	40
Sand equivalent [a] (min.)	CT 217	47	42	47	--
Fine aggregate angularity (% min.) [b]	AASHTO T 304 Method A	45	45	45	--
Flat and elongated particles (% max. @ 5:1)	ASTM D 4791	10	10	10	10
K_c factor (max.)	CT 303	1.7	1.7	1.7	--
K_f factor (max.)	CT 303	1.7	1.7	1.7	--

Notes:

a Reported value must be the average of 3 tests from a single sample.

b. The Engineer waives this specification if HMA contains less than 10 percent of nonmanufactured sand by weight of total aggregate.

DGAC HMA for Job Mix Formula

Quality Characteristic	Test Method	HMA Type	
		A	B
Air voids content (%)	CT 367[a]	4.0	4.0
Voids in mineral aggregate (% min.)	LP-2		
No. 4 grading		17	17
3/8" grading		15	15
1/2" grading		14	14
3/4" grading		13	13
Voids filled with asphalt (%)	LP-3	65 - 75	65 - 75
Dust proportion	LP-4		
No. 4 and 3/8" gradings		0.9 – 2.0	0.9 – 2.0
1/2" and 3/4" gradings		0.6 – 1.3	0.6 – 1.3
Stabilometer value [c](min.)	CT 366		
No. 4 and 3/8" gradings		30	30
1/2" and 3/4" gradings		37	35

Notes:

a. Calculate the air voids content of each specimen using California Test 309 and Lab Procedure LP-1. Modify California Test 367, Paragraph C5, to use the exact air voids content specified in the selection of OBC.

c. Modify California Test 304, Part 2.B.2.c: "After compaction in the compactor, cool to 140 degrees ± 5 degrees F by allowing the briquettes to cool at room temperature for 0.5-hour, then place the briquettes in the oven at 140 degrees F for a minimum of 2 hours and not more than 3 hours."

RHMA for Job Mix Formula

Quality Characteristic	Test Method	RHMA-G
Air voids content (%)	CT 367[a]	Special Provisions
Voids in mineral aggregate (% min.) No. 4 grading 3/8" grading 1/2" grading 3/4" grading	LP-2	 -- -- 18 – 23[b] 18 – 23[b]
Voids filled with asphalt (%)	LP-3	Note d
Dust proportion No. 4 and 3/8" gradings 1/2" and 3/4" gradings	LP-4	 Note d
Stabilometer value [c](min.) No. 4 and 3/8" gradings 1/2" and 3/4" gradings	CT 366	 -- 23

Notes:

b. Voids in mineral aggregate for RHMA-G must be within this range.

c. Modify California Test 304, Part 2.B.2.c: "After compaction in the compactor, cool to 140 degrees ± 5 degrees F by allowing the briquettes to cool at room temperature for 0.5-hour, then place the briquettes in the oven at 140 degrees F for a minimum of 2 hours and not more than 3 hours."

d. Report this value in the JMF submittal.

Module 10-2

Construction and Inspection

From… Maintenance Technical Advisory Guide (MTAG)

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Understand/Review Specifications

- Review Construction Manual Chapter 4
  - Section 94 emulsion (emulsion membrane)
  - Section 39 Asphalt Concrete (mix and placement)
- Review RE file notes
- Project special provisions

DGAC Construction

- Manufacture
  - Mixed using either a batch or drum plant
  - Adequate drying of aggregate
  - Correct proportioning of aggregate and binder
  - Correct mixing temperatures
  - Full costing of the aggregate
- Storage
  - Not to be stored in silos for >18 hours

DGAC Construction

- Hauling
  - Standard hauling equipment
  - Tarping is advised to prevent any crusting of the mix
  - Release agent should be used on the truck tray (no diesel or other petroleum materials)
  - Prevent mix segregation
- Tack Coat
  - Surface must be clean to ensure a good bond
  - Be applied via a calibrated distributor

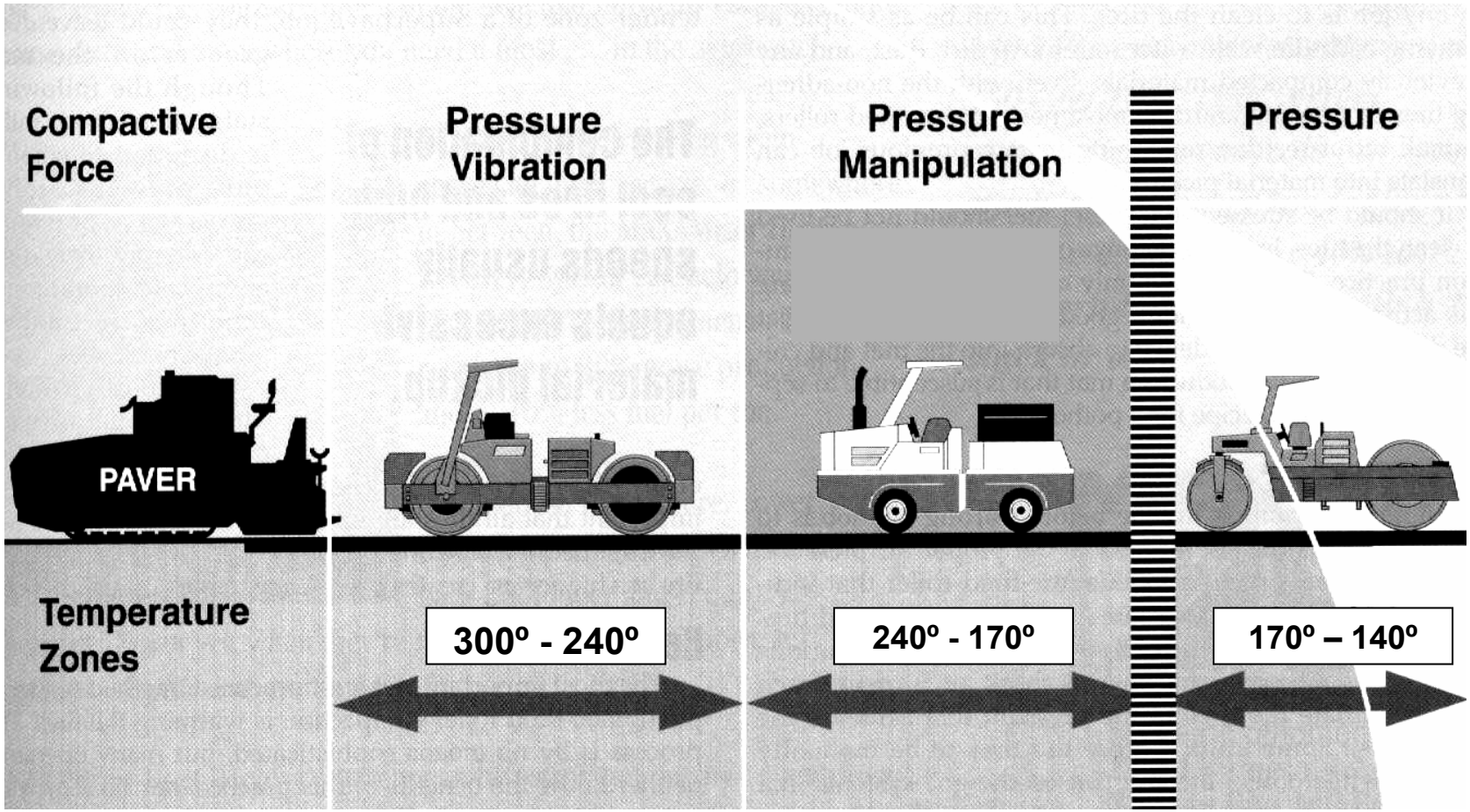
DGAC Construction

- Laydown
  - The length of the windrow must be as short as possible, usually <160 ft
  - Avoid segregation
  - Do not combine cold mix with fresh mix
  - Recommended application temperatures (next slide)
- Rolling
  - Initial breakdown using a vibratory roller, kneading compaction using a pneumatic roller, and finishing using a static roller

Application Temperatures for DGAC

Binder Type	Minimum Air Temperature, °F	Min Surface Temperature, °F	Minimum Breakdown Rolling Temperature, °F	Minimum Finishing Temperature, °F
Conventional (Unmodified)	55	60	250	150
PG-PM	50	55	240	140

Stages of Rolling



DGAC Construction

- Acceptance
  - Usually accepted based on aggregate gradation, binder content, and density of the in-place mixture
  - Acceptance criteria (next slide)
- Post Treatments
  - Usually not required

Acceptance – Method (Caltrans, 2007)

Quality Characteristic	Test Method	HMA Type			
		A	B	RHMA-G	OGFC
Aggregate gradation [a]	CT 202	JMF ± Tolerance	JMF ± Tolerance	JMF ± Tolerance	JMF ± Tolerance
Sand equivalent (min.) [c]	CT 217	47	42	47	--
Asphalt binder content	CT 379 or 382	JMF ± 0.45%	JMF ± 0.45%	JMF ± 0.5%	JMF +0.5 -0.7
HMA moisture content (max.)	CT 370	1.0%	1.0%	1.0%	1.0%
Stabilometer value [c, d, e] (min.)	CT 366				
No. 4 and 3/8" gradings		30	30	--	--
1/2" and 3/4" gradings		37	35	23	--
Percent of crushed particles	CT 205				
Coarse aggregate (% min.)					
One fractured face		90	25	--	90
Two fractured faces		75	--	90	75
Fine aggregate (% min) (Passing No. 4 sieve and retained on No. 8 sieve.)		70	20	70	90
Los Angeles Rattler (% max.)	CT 211				
Loss at 100 rev.		12	--	12	12
Loss at 500 rev.		45	50	40	40

Open-Graded Overlay Construction

- Manufacture
  - Either a batch or drum plant may be used
  - Binder tanks should have agitation especially if asphalt rubber binders are used
  - Carefully control temperatures to avoid drain down or inadequate costing
- Storage
  - In general open-graded mixes should not be stored for >2 hours to prevent drain down

Open-Graded Overlay Construction

- Laydown
  - Surface preparation: Cracks or joints should be sealed. Overlay of an existing OGFC will require removal of existing OGFC before placing a new OGFC
  - Guidelines
  - Tack coating: heavier than DGAC
- Rolling
  - Steel wheeled operated in static mode
  - Limited to two complete coverages
  - Application temperatures

Laydown Guidelines for OGFC

Anticipated Ambient Temperature	Guidelines*
> 70ºF	OGFC may be placed using windrow and pick up machines. The length of the windrow should be usually limited to 164 ft. There should be little or no wind
55ºF – 70ºF	OGFC should be placed by end-dumping into the paving machine, not by windrowing. Keep rollers within 49 ft of paving machine. Tarp trucks for hauls >30 minutes. Mix in hopper to be 194-248ºF.
50ºF – 55ºF	In addition to above rules, PG-PM (polymer modified) asphalt binder should be used. Asphalt rubber binders may also be used. Maximum mixing temperature can be raised to 325 ºF. Mix temperature in hopper to be 275ºF.
< 50ºF	OGFC should not be placed.

**Ensure all Standard Specifications and SSPs (Caltrans, 2007) are followed.*

Application Temperatures for OGFC

Binder Type	Minimum Air Temperature, °F	Min Surface Temperature, °F	Minimum Breakdown Rolling Temperature, °F	Minimum Finishing Temperature, °F
Conventional (Unmodified)	55	60	ASAP (240)	200
PG-PM	50	50	240	180
Asphalt Rubber	55	60	280	250

Open-Graded Overlay Construction

- Acceptance
  - Usually accepted based on aggregate grading, binder content, and visual inspection
- Post Treatments
  - Usually not required if traffic can be kept off
  - Sanding is carried out on rubberized mixes to prevent initial traffic pick up

Gap-Graded Overlay Construction

- Manufacture
  - Either a batch or drum plant may be used
  - Binder tanks require agitation especially if asphalt rubber binders are used
  - Carefully control temperatures to avoid smoke/excess fumes or inadequate aggregate coating
- Storage
  - In general Type-G mixes should not be stored for >2 hours because of workability requirement

Gap-Graded Overlay Construction

- Hauling
  - Standard hauling equipment
  - Tarping is advised to prevent any crusting of the mix
  - Release agent may be used on the truck tray (no diesel or other petroleum materials)
  - Prevent mix segregation
- Tack Coat
  - Surface must be clean to ensure a good bond
  - Too much tack coat may bleed up through the layer

Gap-Graded Overlay Construction

- Laydown
  - The length of the windrow must be as short as possible, usually <160 ft
  - Avoid segregation
  - Do not combine cold mix with fresh mix
  - Recommended application temperatures (next slide)
- Rolling
  - Use static steel wheeled rollers on Type-G mix
  - Pneumatic rubber tired rollers are not allowed
  - The breakdown roller should follow as closely behind the paver as practicable
  - Breakdown rolling should achieve 90-95% of the required compaction

Laydown Temperatures for RHMA-G

Material	Minimum Air Temperature, °F	Minimum Mix Laydown Temperature, °F	Minimum Breakdown Rolling Temperature, °F	Minimum Finishing Temperature, °F
Asphalt Rubber	55 to 65	290	260	203
	≥ 65	280	250	203

These are minimum temperatures. It is recommended that spreading and compacting be performed at temperatures above these minimums, but not to exceed 325ºF (163ºC).

Gap-Graded Overlay Construction

- Acceptance
  - Usually accepted based on aggregate gradation, binder content, and visual inspection
- Post Treatments
  - If traffic can be kept off the mix, no treatment is required.
  - Otherwise apply sand conforming to the Standard Specifications Section 90-3.03 (Caltrans, 2007) after final rolling to avoid pick up by early traffic
  - Sweeping may be required after initial trafficking to remove the sand

Troubleshooting Guide (Example)

Cause	Problem																
	Wavy Surface - Short Waves/ Ripples	Wavy Surface - Long Waves	Tearing of Mat - Full Width	Tearing of Mat - Center Streak	Tearing of Mat - Outside Streaks	Mat Texture - Nonuniform	Screed Marks	Screed Not Responding To Correction	Auger Shadows	Poor Precompaction	Poor Longitudinal Joint	Poor Transverse Joint	Transverse Cracking (Checking)	Mat Shoving Under Roller	Bleeding or Fat Spots in Mat	Roller Marks	Poor Mix Compaction
Fluctuating Head of Material	✔	✔				✔					✔						
Feeder Screws Overloaded	✔	✔				✔			✔								
Finisher Speed Too Fast	✔				✔												
Too Much Lead Crown in Screed					✔												
Too Little Lead Crown in Screed				✔													
Overcorrecting Thickness Control Screws	✔										✔						
Excessive Play in Screed Mechanical Connection	✔	✔					✔	✔				✔					
Screed Riding on Lift Cylinders	✔	✔				✔		✔		✔	✔	✔					
Screed Plates Worn Out or Warped			✔	✔	✔	✔											
Screed Plates Not Tight	✔					✔		✔				✔					
Cold Screed			✔	✔	✔	✔											
Moldboard on Strikeoff Too Low					✔												
Running Hopper Empty Between Loads		✔				✔											
Feeder Gates Set Incorrectly		✔		✔	✔												
Kicker Screws Worn Out or Mounted Incorrectly				✔													
Incorrect Nulling of Screed												✔					
Screed Starting Blocks Too Short												✔					
Screed Extensions Installed Incorrectly					✔	✔											
Vibrators Running Too Slow						✔				✔							

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Common Problems and Related Solutions (an example)

PROBLEM	CAUSES AND SOLUTIONS
Non Uniform Texture-Segregation	CAUSES • The mixture separating in the hopper or in transportation causes segregation • Poor paver set up • Low mix temperature or poor grading or mix design • Prone to occur in thin overlays • Weak base layer. • The dumping of hopper wings when paving with bottom dumps SOLUTIONS • Ensure thickness is at least three times that of largest stone size, mix design is correct, and the paver is properly set up • Ensure mix temperature is correct • Not dump the wings or, alternatively, place insert plates in the hopper eliminating the wing area

Field Considerations (Example Project Inspection Responsibilities)

PROJECT INSPECTION RESPONSIBILTIES	
Rolling of AC	• Has a roller pattern been established? • Have the number of passes required for breakdown rolling been established? • Is the surface temperature of the mat correct at beginning of rolling? • Is the roller being operated at the correct speed? • Does the mat check under the roller? If so, wait a little longer for cooling. • Is the mat uniform looking? • Has density been met? • Does the mix pick up? • Are edge lines and joint overlaps neat and straight? • Is the job stopped if problems persist?

Thank You

Questions?