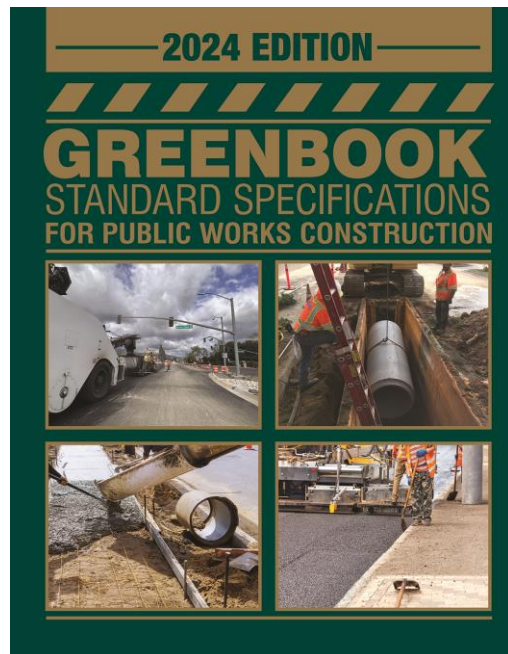


GREENBOOK SEMINAR

October 29, 2024

PART 3

CONSTRUCTION METHODS



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SECTION 300 – EARTHWORK

300-1 CLEARING AND GRUBBING.

- 1) ***“Clearing shall consist of the trimming and removal of trees, and the removal of brush, weeds, stumps, trash, and other debris.”***
(300-1.1)
- 2) ***“Grubbing shall consist of the removal of sod, grass, stumps, roots, and ...”*** (300-1.1)
- 3) ***“Tree trimming and root pruning shall be performed as specified in the Special Provisions.”*** (300-1.2)

- 4) ***“Clearing and grubbing, if measured for payment, will be measured by the acre or lump sum ...” (300-1.3)***
- 5) ***“Removal of trees and stumps, if measured separately, will be measured by “each” ...” (300-1.3)***
- 6) ***“Unless otherwise specified, payment ... will be made at the Contract Unit Price per acre or the lump sum Bid price.” (300-1.4)***

7) "If the Proposal does not include a Bid item for clearing and grubbing, payment will be considered as included in the Contract Unit Price for the Bid item(s) which require clearing and grubbing." (300-1.4)

300-1 Comments:

- 1) Include an item in the Bid for "Clearing and Grubbing" as appropriate.**
- 2) Include an item in the Bid for "Tree Removal" as appropriate. Specify the minimum trunk size to be considered a "tree" in the Special Provisions.
(300-1.1)**

300-2 UNCLASSIFIED EXCAVATION.

300-2.1 General.

- 1) “... *shall consist of all excavation [except structure excavation per 300-3] ... unless separately designated.*”

300-2.2 Unsuitable Material.

300-2.2.1 General.

- 1) Provides for removal and disposal to be paid for as “Unclassified Excavation.”
- 2) Provides for payment per 7-3.7 [Agreed Prices] if a change in the character of the work.

300-2.2.2 Wet Material.

- 1) Provides for high moisture content material to be either processed or removed and replaced, and the basis of payment for such.



300-2.7 Selected Material.

- 1) “... shall be used as shown on the Plans, in the Special Provisions, or as directed by the Engineer.”

300-2.8 Measurement.

- 1) Specifies earthwork operations which will be measured as “Unclassified Excavation.”
- 2) Doesn't specify or provide for “shrink” or “swell” factors.

300-2 Comments:

300-3 STRUCTURE EXCAVATION AND BACKFILL.

300-3.1 General.

- 1) “... removal of material for construction of ... structures, and other excavation shown on the Plans or specified in the Specifications [Special Provisions] as structure excavation.”
- 2) “... furnishing ... placing and compacting backfill material around structures to the lines shown on the Plans.”

300-3.7 Payment.

- 1) ***“Unless otherwise specified, no payment will be made for structure excavation or backfill.”***
- 2) ***Unless otherwise shown on the Plans, the quantity of the structure excavation, where paid for as a separate item or not, shall be that volume in place included within the vertical plane 1 foot ... outside of and parallel with the outermost horizontal dimensions of the structure and the surface of the existing ground, final ground surface, or proposed street subgrade, whichever is lower, and the footing subgrade.”***

3) “Structure backfill will be measured to the finished ground surface, or to the proposed street subgrade, whichever is lower, within the limits specified.”

300-3 Comments:

- 1) Include an item in the Bid for “Structure Excavation” as appropriate.**
- 2) Include an item in the Bid for “Structure Backfill” as appropriate.**
- 3) Include an item in the Bid for “Pervious Backfill” as appropriate.**
- 4) Caltrans Standard Plans, A62A – A62F.**

300-4 UNCLASSIFIED FILL.

300-4.1 General.

- 1) *“... fill generated from unclassified excavation on the Work site.”*
- 2) *“... shall consist of all fill [except structure backfill per 300-3 and imported borrow per 300-5] unless separately specified.”*

300-4.2 Preparation of Placement Areas.

- 1) *“Areas over which unclassified fill is to be placed shall first be cleared and grubbed ...”*
- 2) *“When ... shown to be placed over existing surface improvements which are to remain in place, preparation shall be as specified in the Special Provisions.”*

300-4.3 Other Fill Materials.

- 1) “Unless otherwise specified [300-5], no fill materials may be imported ...”

300-4.4 Benching.

- 1) “*Benching is required when ... placed on a slope of 1 vertical to 5 horizontal or steeper.*”
- 2) “Benching shall be into ... unless otherwise shown on the Plans.”



300-4.5 Placement.

- 1) *“Unless otherwise specified, each layer ... shall not exceed 8 inches ...”*

300-4.7 Compaction.

- 1) *“Unless otherwise specified, each layer ... shall be compacted to a relative compaction of at least 90 percent.”*

300-4.9 Measurement.

- 1) Specifies areas which will be measured as “Unclassified Fill.”
- 2) Doesn’t specify or provide for “shrink” or “swell” factors.

300-4 Comments:

- 1) Doesn't cross reference a material specification. (300-1)**
- 2) Ensure there are no conflicts between the details shown on the Plans and the benching requirements specified in the SSPWC. (300-4.4)**

300-5 Borrow Excavation.

- 1) **Local Borrow:** “... Sources outside the planned or authorized cross section within the right of way and within the limits of the Work ... excavated from sources specified **[Special Provisions]** or designated by the Engineer.” (300-5.1)
- 2) **Imported Borrow:** “... the Contractor shall make arrangements for obtaining imported borrow ...” (300-5.2)

300-5 Comments:

- 1) **“Borrow:”** Context and history of use as a term.
- 2) Doesn't incorporate or cross reference a material specification. (300-5.1)
- 3) Include an item for “Imported Borrow” if fill material must be imported. (300-5.4)
- 4) Doesn't specify or provide for “shrink” or “swell” factors. (300-5.4)
- 5) $VF(IB) = VF(Req.) - VF(UF) - VF(LB)$

300-8 GEOTEXTILES FOR DRAINAGE.

- 1) “... *for trench drains ...*” (300-8.1)
- 2) “*Fabric shall be placed in the trench in accordance with the Plans.*” (300-8.1.1)
- 3) “... *shall be measured for payment by the square yard of fabric placed ...*” (300-8.1.2)



Comments:

- 1) Doesn't cross-reference a material specification in Part 2.
- 2) Measurement by the square yard is not practical.

300-9 GEOTEXTILES FOR EROSION CONTROL.

- 1) “... *bank and shore protection* ...” (300-9.1)
- 2) “... *the Contractor shall construct a subgrade in accordance with the Plans and Specifications.*” (300-9.1.1)
- 3) “*Anchoring of the fabric ... as shown on the Plans.*” (300-9.1.1)
- 4) “... *shall be measured for payment by the square yard of fabric placed ...*” (300-9.1.2)

Comment:

- 1) Doesn't cross-reference a material specification in Part 2.

300-10 GEOTEXTILES FOR SEPARATION.

- 1) “... *for subgrade enhancement ...*” (300-10.1)
- 2) “*Parallel rolls or ends of fabric shall be overlapped 24 inches ... or sewn if required by the Plans or Special Provisions.*” (300-10.1.1)



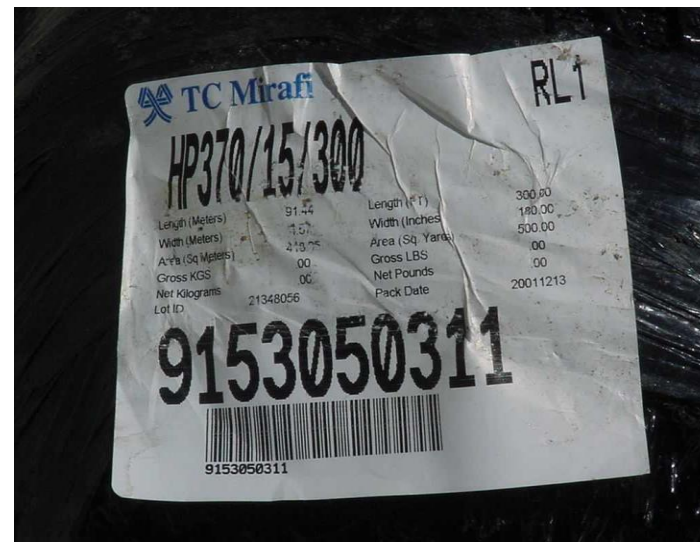
- 3) “When indicated [shown] on the Plans or Special Provisions a 36-inch ... overlap shall be used.” (300-10.1.1)
- 4) “Unless otherwise specified, the minimum thickness [of base material over the fabric] shall be 12 inches (300 mm). “ (300-10.1.1)



5) “... [... shall be measured for payment by the square yard of fabric placed ...] ...” (300-10.1.2)

Comments:

- 1) Doesn't cross reference a material specification in Part 2.
- 2) “Separation” vs. “Stabilization.”
- 3) Ensure the material delivered is the same as the approved Submittal.



300-11 ROCK SLOPE AND EROSION PROTECTION (RIPRAP).

Comments:

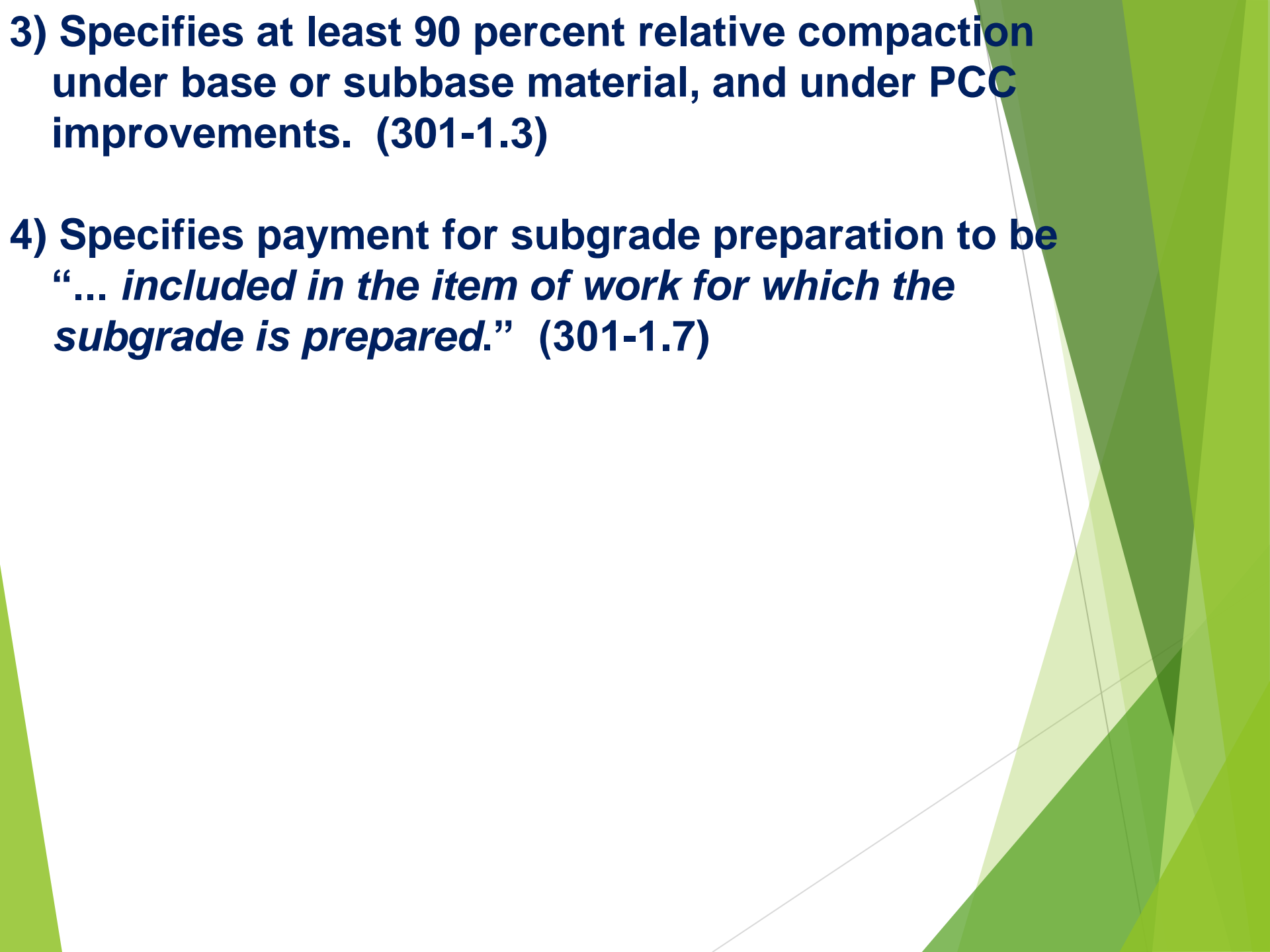
- 1) Revised in the 2021 Edition.
- 2) References 200-1.6. (300-11.1)
- 3) Show on the Plans the class(es) of rock required based on 200-1.6.
- 4) Payment per ton for rock and per and per cubic yard for concrete. (300-11.4)
- 5) Ensure that the details shown on the Plans are consistent with the “method” specified in 300-11.2.



SECTION 301 - SUBGRADE PREPARATION, TREATED MATERIALS, AND PLACEMENT OF BASE MATERIALS.

301-1 SUBGRADE PREPARATION.

- 1) “... *shall govern the preparation of natural, filled, or excavated roadbed material prior to the placement of ...*” (300-1.1)
- 2) Specifies at least 95 percent relative compaction when pavement is to be placed directly on subgrade material (except alleys). (301-1.3)

- 
- 3) Specifies at least 90 percent relative compaction under base or subbase material, and under PCC improvements. (301-1.3)
- 4) Specifies payment for subgrade preparation to be “... *included in the item of work for which the subgrade is prepared.*” (301-1.7)

301-2 UNTREATED BASE.

- 1) References 200-2. (301-2.1)
- 2) Specifies maximum lift thicknesses of 6 inches. (301-2.2)
- 3) Specifies at least 95 percent relative compaction, except under sidewalk and driveways (at least 90 percent). (301-2.3)
- 4) ***“The volumetric quantities ... shall be those compacted in place within the limits of the dimensions shown on the Plans.”*** (301-2.4)




301-3 PORTLAND CEMENT TREATED MATERIALS.

301-3.1 General.

- 1) *“... shall include soil-cement, cement treated base, and cement-stabilized pulverized base.”*

301-3.2 Soil-Cement.

- 1) *“... a mixture of soil, Portland cement, and water ...”*
(301-3.2.1)
- 2) *“The required 7-Day compressive strength shall be as shown on the Plans or as specified in the Special Provisions.”* (301-3.2.1)

- 
- 3) ***“Mixing shall be performed, in place, or off-road ...
as specified in the Special Provisions.” (301-3.2.5.1)***
 - 4) ***“Portland cement will be measured by the ton (tonne).”
(301-3.2.12)***
 - 5) ***“Soil-cement will be measured by the cubic yard ... or by
the square yard ... for each thickness ...”
(301-.2.12)***

301-3.3 Cement Treated Base (CTB).

- 1) *“... shall consist of a mixture of untreated base material, Portland cement, and water ...”* (301-3.3.1)
- 2) *“The required 7-Day compressive strength shall be as shown on the Plans or specified in the Special Provisions.”* (303-3.3.1)
- 3) Other provisions, except compaction, same as soil-cement.

301-3.4 Cement Stabilized Pulverized Base (CSPB).

301-3.4.1 General.

- 1) *“... shall consist of pulverized asphalt concrete pavement, base material, subgrade soil, Portland cement, and water ...”*

301-3.4.3 Mix Design.

- 1) *“Unless otherwise specified in the Special Provisions, the Agency will prepare the mix design.”*

301-3.4.4 Equipment.

301-3.4.4.2 Reclaimer.

- 1) ***“Pulverizing and mixing shall be performed, and cement stabilized pulverized base produced, only by the utilization and operation of a reclaimer ...”***



301-3.4.5 Sequence of Work. *“... as follows:”*

301-3.4.6 Pulverizing. ➡



301-3.4.7 Initial Grading. ➡



301-3.4.8 Spreading. ➡



301-3.4.9 Mixing. ➡



301-3.4.10 Compaction and Final Grading. →



301-3.4.12 Initial Curing.

301-3.4.13 Micro-Cracking. →



301-3.4.14 Final Curing. →



301-3.4.15 Fog Seal
[Prime Coat shown]. →



CSPB Comments:

- 1) Referred to as “Full-Depth Reclamation” (FDR-C) in Caltrans Standard Specifications and ARRA manuals, but ***CSPB has a major difference:***

Existing AC pavement ***may or may not*** remain in-place. May be removed by cold milling for cold central plant recycling or use as RAP in AC.

- 2) Bituminous seal curing method not advisable without road being closed.
- 3) Recommend requiring a prime coat be applied prior to base course paving.

301-4 LEAN CONCRETE BASE.

301-5 LIME-TREATED SOIL.

**301-6 LIME STABLIZED PULVERIZED
BASE (LSPB).**

SECTION 302 - ROADWAY SURFACING.

302-2 CHIP SEAL.

- 1) *“A chip seal shall consist of an application of polymer modified emulsified asphalt [“cold- applied”] or [polymer or tire rubber] modified paving asphalt [“hot-applied”] and screenings to an existing roadway surface.” (302-2.1)*
- 2) *“The type (size of screenings) and grade of emulsified asphalt or modified paving asphalt to be applied, and the type of screenings to be spread, shall be as specified in the Special Provisions or shown on the Plans.” (302-2.1)*

302-2 CHIP SEAL.



302-2 CHIP SEAL.



- 3) Screenings for PMEA chip seals may be produced from RAP aggregate (200-1.2.9, 302-2.2.3.1)
- 4) Screenings for “hot-applied” chip seals are pre-coated with paving asphalt and pre-heated. (200-1.2.2.3, 302-2.6.4.3)
- 5) Measurement and payment per square yard for each type of aggregate and emulsion or modified paving asphalt, or per ton for each type of aggregate and each grade of emulsion or modified paving asphalt. (302-10, 302-11)

302-2 Comments:

- 1) Cape Seal = Chip Seal + Slurry Seal/Microsurfacing
- 2) “Cold Applied:” PMEA, 110 – 140°F

302-3 MICROSURFACING.

- 1) “... a mixture of microsurfacing emulsion (MSE), water, set control agents, and aggregate.” (302-3.1)
- 2) “The combined aggregate gradation (Type) [II or III] shall be as shown on the Plans.” (302-3.1)
- 3) “Continuous-flow mixers (mixers) shall be mixer-spreader trucks or continuous self-loading mixer-spreader machines [shown below].” (302-3.4.1)



- 4) ***“Spreader boxes shall have baffles, reversible motor driven augers, ...” (302-3.6.1)***



- 5) ***“The Contractor shall construct a minimum of 1 test strip for each type of aggregate gradation to be used in the Work for evaluation by the Engineer.” (302-10)***
- 6) ***“Microsurfacing shall be spread at the rates of pounds of dry aggregate per square yard shown in Table 302-3.11 unless otherwise specified or shown on the Plans.” (302-11)***

- 5) *“The basis of measurement shall be the **combined** weight of dry aggregate ... and MSE, in tons (tonnes), for each Type **[size]** of aggregate used in the Work.” (302-3.12)*
- 6) *“Payment ... will be made at the Contract Unit Price per ton (tonne).” (302-3.13)*

302-3 Comments:

- 1) *“Micro-surfacing is a thin surfacing, and can be laid at two to three times the thickness of the largest stone in the grading. The emulsion in the system is always polymer modified and special additives are used to create a chemical break that is largely independent of weather conditions.” Caltrans Maintenance Technical Advisory Guide, <https://www.csuchico.edu/cp2c/library/caltrans-documents.html>*
- 2) **Basis of Measurement and Payment (See Example).**

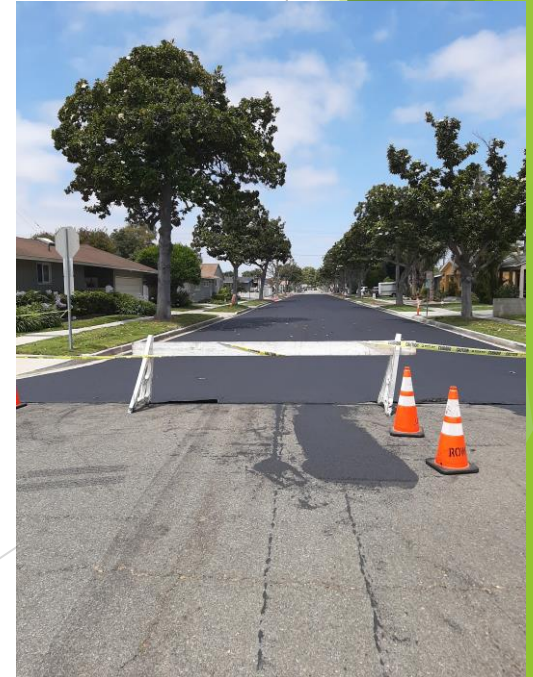
302-4 SLURRY SEAL SURFACING.



- 1) “... mixing, spreading, and application of **[polymer modified]** emulsion-aggregate slurry (EAS) ... polymer modified emulsion-RAP aggregate slurry ... or the spreading and application of rubberized emulsion-aggregate slurry (REAS) ...” (302-4.1)

- 2) ***“The combined aggregate gradation (Type) and slurry seal mixture (EAS, PMERAPAS, or REAS) shall be as specified in the Special Provisions or shown on the Plans.” (302-4.1)***
- 3) ***“EAS shall be a mixture of polymer modified cationic quick-set emulsified Asphalt [CQS-1h], aggregate [Type I, II or III], water, and a set control agent. EAS shall be specified by aggregate gradation, e.g. Type II-EAS.” (302-4.3.1)***
- 4) ***“REAS [material] shall conform to 203-5.” (302-4.4.1)***
- 5) ***“PME-RAP slurry shall be a mixture of polymer modified emulsified asphalt [CQS-1h], reclaimed asphalt pavement aggregate, water, and set control agents. PME-RAP slurry shall be specified by aggregate gradation, e.g. PME-RAP.” (302-4.5.1)***

- 6) ***“Continuous-flow mixers shall be used to mix and spread EAS [and PMERAPAS].” (302-4.6.1)***
- 7) ***“... the Contractor shall, at least 48 hours in advance, notify residents and businesses of the Work and post temporary “No Parking” signs.” (302-4.8)***
- 8) ***“Streets where slurry seal is scheduled to be applied shall be closed from ...” (302-4.8)***



- 9) ***“Slurry seal mixed at the Work site shall be spread by a spreader box attached to a continuous-flow mixer-spreader truck conforming to 302-4.6 or by a continuous mixer-spreader machine conforming to 302-3.4.3. REAS mixed at a central mixing plant shall be spread by a spreader box attached to an agitator truck [see below] conforming to 203-5.4.”***



10) “The Contractor shall prevent slurry seal from being deposited on other than asphalt concrete surfaces ...” (302-4.9.1)





11) “... and shall remove it from surfaces not designated to be sealed.” (302-4.9.1)

- 12) ***“The aggregate application rate shall conform to the requirements **[min. and mix. rates]** shown in Table 302-4.9.2.2 unless otherwise specified or shown on the Plans.” (302-4.9.2.2)***
- 13) ***Note the greater rates when applied over milled surfaces and over chip seals (as part of a cape seal).***



- 14) “... [EAS] surfacing will be measured by the combined weight of each ton (tonne) of [polymer modified] emulsified asphalt and each ton (tonne) of each Type of aggregate used in the Work.” (302-4.11.2)
- 15) “REAS will be measured by each ton (tonne), including aggregate, RPME, additives and water for each Type of aggregate used in the Work.” (302-4.11.3)
- 16) “PME-RAP-aggregate slurry seal surfacing will be measured by the **combined weight** of each ton (tonne) of emulsified asphalt and each ton (tonne) of Type RAP aggregate used in the Work.” (302-4.11.4)

- 17) *“Payment ... will be made at the Contract Unit Price per ton (tonne) for each combination of EAS and aggregate Type used in the Work.” (302-4.12.2)*
- 18) *“Payment ... will be made at the Contract Unit Price per ton (tonne) for each combination of REAS and aggregate Type used in the Work.” (302-4.12.3)*
- 19) *“Payment for PME-RAP slurry seal surfacing will be made at the Contract Unit Price per ton (tonne).” (302-4.12.4)*

302-4 Comments:

- 1) Polymer Modified Cationic Quick-Set Emulsified Asphalt: PMCQS-1h (Table 203-3.4.5 (B))

302-4 Comments:

- 2) ***“The polymer enhances stone retention, especially in the early life of the treatment. The added polymer also reduces thermal susceptibility. Polymers also improve softening point and flexibility, which enhance the treatment’s crack resistance.”*** Caltrans Maintenance Technical Advisory Guide, Volume 1, Chapter 8, page 8-3.
<https://www.csuchico.edu/cp2c/assets/documents/caltrans/fpmtag-chapter-8---slurry-seals.pdf>
- 3) **Set Control Agents.**
- 4) **Calibration.**
- 5) **Wet Track Abrasion Test.**
- 6) **Basis of Measurement and Payment (See Example).**

302-3, 302-4 Comments:

7) Aggregate Size: Type 1 vs. Type 2 vs. Type 3



8) Microsurfacing vs. Slurry Seal

9) Rolling: Required for PME-RAP only. EAS can be rolled, but not required.

302-3, 302-4 Comments:

10) Mixer-spreader trucks vs. continuous self-loading mixer-spreader machines:



11) Spreader Boxes: Slurry (no auger) vs. Micro (auger)



SAMPLE CALCUATION

Combined Weight of Aggregate and Emulsion (“Wet Ton”):

- Slurry Seal (302-4), Type II Aggregate
- $L = 10,560'$
- $W = 40'$
- Micro-Milled Surface
- Minimum Aggregate Application Rate (Table 302-4.9.2.2)
 $= 15 \text{ lbs./yd}^2$
- Weight of Aggregate:
 $10,560' \times 40' \times 1 \text{ yd}^2/9 \text{ ft}^2 \times 15 \text{ lbs./yd}^2 \times 1 \text{ ton}/2000 \text{ lbs.}$
 $= \underline{352 \text{ tons}}$
- Emulsified Asphalt %, by weight of dry aggregate
(Table 302-4.3.2.2): 16
- Weight of Emulsion: $352 \text{ tons} \times 0.16 = \underline{56 \text{ tons}}$
- Bid Quantity (tons): $352 \text{ tons (aggregate)} + 56 \text{ tons (emulsion)} = 408 \text{ tons use } \underline{410 \text{ tons}}$

302-5 ASPHALT CONCRETE PAVEMENT.

302-5.1 General.

- 1) **Completely re-written in the 2024 Edition.**
- 2) **References 203-6.**
- 3) ***“The courses, class and grade of the mixture of each course, thickness, and placement dimensions shall be as shown on the Plans.”***

302-5.2 Materials.

- 1) *“Prime coat material shall be as specified in the Special Provisions.” (301-5.2.2)*
- 2) *“Tack coat material shall be PG 64-10 paving asphalt conforming to 203-1 or SS-1h emulsified asphalt conforming to 203-3.” (301-5.2.3)*
- 3) *“If a specific material is required, the material used shall be that specified in the Special Provisions or shown on the Plans.” (301-5.2.3)*

302-5.3 Submittals.

- 1) *“If specified or requested by the Engineer, the Contractor shall prepare and submit a plan showing the dimensions and sequence of placement for each course.” (301-5.3.3)*

302-5.4 Equipment.

302-5.4.4 Material Transfer Vehicle (MTV).



302-5.4.5 Paving Machines.

- 1) ***“Paving machines shall be equipped with a fully-automatic screed control system ... either a contact (skid) or non-contact (sonic averaging) system.”***



Contact (skid or “ski”) (shown), or Non-Contact (sonic averaging).

302-5.4.5 Paving Machines.



**Full-width, hydraulically extendable,
vibratory screed.**

302-5.4.6 Rollers.

302-5.4.6.2 Number of Rollers.

- 1) ***“The number of rollers in operation during paving shall not be less than the number specified in Table 302-5.4.6.2.”***

Comments:

- 1) Static vs. vibratory vs. pneumatic-tired rollers.

302-5.5 Headers.

- 1) ***“The Contractor shall construct headers where shown on the Plans.”***

- 2) ***“Such headers shall remain in place upon completion of the Work unless otherwise specified.”***

302-5.6 Pre-Paving Meeting.

- 1) ***“If specified or requested by the Engineer, the Contractor shall arrange a pre-paving meeting a minimum of 10 Working Days prior to the scheduled start of placement.”***

302-5.7 Prime Coat.

- 1) ***“If specified or shown on the Plans, a prime coat shall be applied on treated or untreated base material prior to the placement of the base course of asphalt concrete pavement.”***



302-5.8 Tack Coat.

- 1) ***“The minimum rate of application of SS-1h emulsified asphalt shall be that shown in Table 302-5.8 (A), or the application rate necessary to achieve the minimum residual rate shown in Table 302-5.8 (B), whichever is greater.”***
- 2) ***“For PG 64-10 paving asphalt, the application rate shall be a minimum of the residual rate shown in Table 302-5.8 (B).”***
- 3) ***“Table 302-5.8 (B) is applicable to both SS-1h emulsified asphalt and PG 64-10 paving asphalt.”***
- 4) ***“The distributor truck spray bar shall be pressurized during application and discharge tack coat material in a fan shape (spray cone) from each nozzle.”***

302-5.8 Tack Coat. [Comments to follow]

- 5) *“The resultant application shall **uniformly cover** [not streaked] the surface to which it is applied.”*

302-5.9 Placement.

302-5.9.1 General.

- 1) *“Asphalt concrete of the classes shown in Table 302-5.9.1(A) or Table 302-5.9.1(B) shall be placed in courses not exceeding 4 inches (100 mm) in compacted thickness unless otherwise approved.”*
- 2) *“The automatic screed control system shall be in continuous operation during placement of the surface course, and, if specified or requested by the Engineer, the base course.”*

- 3) ***“Asphalt concrete shall be deposited directly into the hopper of the paving machine.”***
- 4) ***“If approved or specified, the Contractor may utilize bottom dump trucks to deposit asphalt concrete into a uniformly sized windrow, ...”***



- 5) ***“Left-turn pockets and curb return and spandrel areas of intersecting streets, if shown on the Plans to be paved, shall be paved before or after the street or highway being paved.”***



302-5.9.2 Joints.

- 1) ***“Longitudinal joints shall be located along, beside, or in the middle of, traffic lane lines.”***

302-5.10 Rolling.

- 1) ***“Except when compacting courses greater than 4 inches (100 mm) in compacted thickness, rolling shall commence along the lower edge of the area to be rolled and continued until the edge is compacted, after which the roller shall be gradually advanced to the crown line, both sides being rolled in like manner.”***



302-5.11 Compaction.

302-5.11.1 General.

- 1) *“Asphalt concrete, after the completion of rolling, shall be compacted to a minimum of 92 percent and a maximum of 97 percent of the theoretical maximum density (TMD) as determined in accordance with AASHTO T 209.”* [Don't confuse this with the 95% of LTMD specified in 2021 and earlier editions. Comments to follow.]

302-5.11.2 Field Density.

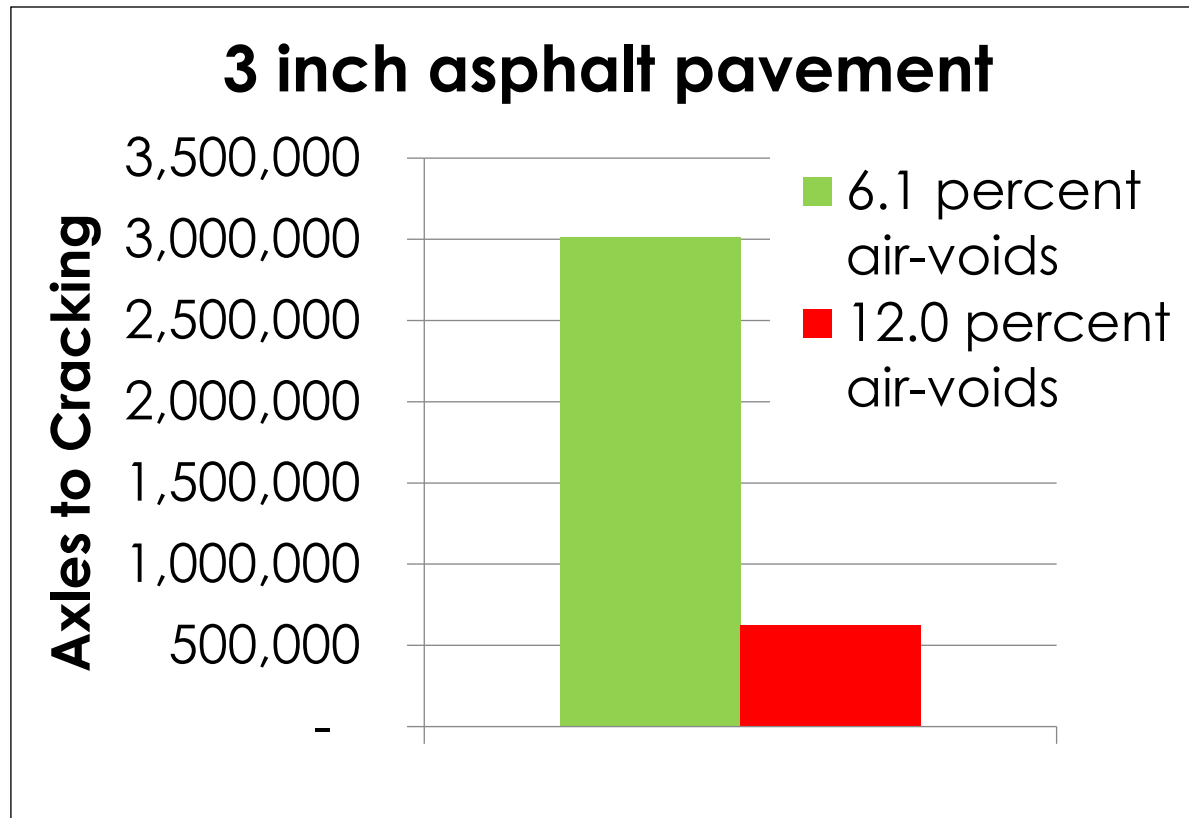
- 1) *“The field density of compacted asphalt concrete will be determined by [the Engineer using] a nuclear asphalt testing device (nuclear gauge) correlated in accordance with California Test 375 ... or by cores ...”*

302-5.11.2 Field Density.

- 2) ***If specified, the Contractor shall construct the test strip required as part of California Test 375 as part of the Work.***
- 3) ***Nuclear asphalt testing devices shall be re-correlated whenever there is a change in course thickness of 1/2 inch (12.5 mm) or greater, underlying material, materials source, or mix design.***

[Comments to follow]

Effect of Asphalt Compaction on Axle Loads to Fatigue Cracking



Simulation
based on
FHWA
Westrack
project
field
results

Effect of Compaction on Fatigue Life



General Rule: 1% increase in constructed air-voids
= **10% reduction** in fatigue life

Compaction/Density/Air Voids: Laboratory Bulk (Test Maximum) Density

- California Tests 304 & 308
- ***Standard Specifications for Public Works Construction***: 302-5.6.2, 2021 and earlier editions
- No direct correlation to air voids
- SSPWC: 95% minimum = 8.8% air voids (for lab air voids of 4%)
- Refer to MS-22, Figure 10.9: 96% = 8% air voids

Compaction/Density/Air Voids: Theoretical Maximum (“Rice”) Density (TMD)

- California Test 309/AASHTO T 209, Method A/ASTM D2041
- **Caltrans Standard Specifications:** 39-2.01A(4)(h)(vi), 39-2.01A(4)(i)(ii), 39-2.01C(15)
- **Standard Specifications for Public Works Construction:** 302-5.11, 2024 Edition.
- % air voids correlates directly to pavement life
- % TMD correlates directly to air voids, e.g. 96% = 4% air voids
- Caltrans Standard Specifications: 91% -97% (should be 92% minimum)

302-5.13 Measurement.

- 1) “Unless otherwise specified, measurement will be made as follows.” (302-5.13.1)
- 2) “Tack coat will be measured by the gallons of residual asphalt in-place.” (302-5.13.4)
- 3) “Asphalt concrete will be measured by the square yard for each thickness shown on the Plans or by the tons of material used in the Work.” (302-5.13.5)

302-5.14 Payment.

- 1) “Unless otherwise specified, payment will be made as follows.” (302-5.14.1)
- 2) “Payment for tack coat will be made at the Contract Unit Price per gallon [of residual asphalt].” (302-5.14.4)
- 3) “Payment will be made at the Contract Unit Price per ton or at the Contract Unit Price per ~~square foot~~ [square yard] for each thickness shown on the Plans.” (302-5.14.5)

302-5.14 Payment.

- 4) *“When payment is to be made on a tonnage basis, the Contractor shall furnish to the Engineer at the time of delivery of the material to the Work site a legible copy of a licensed weighmaster’s certificate ...”*
- 5) *“Payment for the test strip specified in California Test 375, if required to be constructed as part of the Work, will be made as specified in the Special Provisions.”*
[Separate Bid item, in tons.]

Tack Coat Comments:

- 1) Distributor truck: Spray bar must be pressurized and set at a height that results in spray fans overlapping a minimum of 2 (preferably 3) times.
- 2) Application: Uniform and complete. ***Not streaked.***
- 3) Spray Rate (302-5.4): Rate at which material is applied.
- 4) Residual Rate: Rate of asphalt residue remaining after application (PG 64-10) and evaporation (SS-1h).
- 5) Residual Rate (PG 64-10) = Spray Rate



Spray fans overlapping twice shown above. Reference: Asphalt Institute, MS-22, Third Edition, page 115.

Tack Coat Comments:

- 6) SS-1h may be diluted 1:1 or 0.5:1.
- 7) Residual Rate (SS-1h) (undiluted) = Spray Rate x %
(Residue from Distillation) (Table 203-3.4.2, 57 = 0.57)
- 9) Separate Bid item encourages quality.
- 10) For other calculations and more information, see
Caltrans Tack Coat Guidelines:
www.ucprc.ucdavis.edu/ccpic/pdf/Caltrans%20Tack%20Coat%20Guidelines.PDF

TACK COAT SAMPLE CALCUATION

Tack Coat Residual Volume:

- $L = 10,560'$
- $W = 40'$
- Milled Surface
- Minimum Residual Rate (Table 302-5.8(B)) = 0.05 gal./SY
- Tack Coat (Gallons) = $10,560' \times 40' \times 1 \text{ SY/9 SF} \times 0.05 \text{ gal./SY} = 2346.7 > \underline{2350 \text{ gallons}}$

302-7 PAVEMENT FABRIC.

302-7.1 General.

1) References 213-1.

302-7.2 Placement.

302-7.2.1 Pavement Preparation.

- 1) “... as shown on the Plans or specified in the Special Provisions ...”
- 2) “... shall not be placed ... where the ... overlay is less than 1-1/2 inches (38 mm) thick.”

302-7.2.2 Tack Coat.

1) “... shall be *PG 64-10* or *PG 70-10* paving asphalt ...” (302-7.2.2.1.)



302-7.2.3 Laydown.

- 1) *“... shall be placed with no wrinkles that lap.”*
- 2) *“Public traffic shall not be allowed to drive over bare pavement fabric.”*



302-7.3 Measurement.

- 1) *“... will be measured by the square yard ...”*

302-8 SEALCOAT FOR MISCELLAENOUS AREAS.

- 1) *“The materials shall conform to 203-9.”*
- 2) Applicable to parking lots.

302-9 ASPHALT RUBBER HOT MIX (ARHM).

302-9.3 Placement.

- 1) *“... shall conform to 302-5.9.1 except that at the time of delivery to the Work site, the temperature ... shall be between 300°F ... and 330°F ...”*

302-9.4 Rolling.

- 1) *“... shall conform to 302-5.10 except that vibratory rollers using the vibratory mode shall be used for initial breakdown rolling.”*

2) ***“The initial coverage ... shall commence before the ARHM temperature falls below 290°F ...”***



3) “*Pneumatic rollers shall not be used.*”



302-9.7 Rock Dust Blotter.

- 1) “At the option of the Engineer, when traffic conditions warrant, a rock dust blotter may be required to avoid tracking.”



2) *“When the ARHM pavement has cooled to below 150°F ..., the rock dust blotter may not be required.”*



Comment: Notice the excessive application rate and deficient traffic control.

302-9 ASPHALT RUBBER HOT MIX (ARHM).

Comments:

- 1) Several cross-references are missing in the 2024 Edition.

Suggested Special Provisions:

- 1) **302-9.1 General.** *Add the following:*

Submittals shall conform to 302-5.3. Equipment shall conform to 302-5.4.

- 2) **302-9.2 Tack Coat.** *Replace with the following:*

Tack coat shall conform to 302-5.2.3 and 302-5.8.

302-9 ASPHALT RUBBER HOT MIX (ARHM).

Suggested Special Provisions:

3) 302-9.4 Rolling. *Add the following:*

Compaction shall conform to 302-5.11. Smoothness shall conform to 302-5.12.

302-10 ASPHALT RUBBER AND AGGREGATE MEMBRANE (ARAM).

302-10.1 Application.

- 1) *“Asphalt rubber shall be applied by distributor equipment meeting the requirements of the following: ...”*



302-10.2 Screenings.

- 1) ***“... screenings conforming to 203-12.3 shall be placed over all areas receiving asphalt rubber.”***



- 2) ***“Rolling shall be accomplished by 3 self-propelled, pneumatic-tired rollers ... A steel drum roller ... shall complete the final roller coverage.”***
- 3) ***“Sweeping shall be a multi-step operation ... all loose aggregate shall be removed prior to acceptance ...”***



302-10.5 Measurement and Payment.

- 1) *“... will be paid for at the Contract Unit Price per square yard ...”*



Comments:

- 1) ARAM is an asphalt rubber chip seal.**
- 2) Asphalt rubber binder is the same as used in ARHM.**
- 3) Application may be as a driving surface, as part of a cape seal, or as an interlayer (between pavement layers).**

302-11 ASPHALT CONCRETE (AC) CURB.

- 1) “AC curb shall be specified by curb type and curb face height as shown on the Plans or Standard Plans.” (302-11.1)**
- 2) “... measured by the linear foot for each combination of curb type and curb face height.” (302-11.3)**
- 3) “Payment ... per linear foot for each combination of curb type and curb face height.” (302-11.4)**

302-12 TIRE RUBBER MODIFIED ASPHALT CONCRETE (TRMAC) PAVEMENT.

Comments:

- 1) Several missing cross-references in the 2024 Edition.

Suggested Special Provisions:

- 1) **302-12.1 General.** *Add the following:*

Submittals shall conform to 302-5.3. Equipment shall conform to 302-5.4.

302-12 TIRE RUBBER MODIFIED ASPHALT CONCRETE (TRMAC) PAVEMENT.

Suggested Special Provisions:

2) 302-12.2 Tack Coat. *Replace with the following:*

Tack coat shall conform to 302-5.2.3 and 302-5.8.

3) 302-1.4 Rolling. *Add the following:*

Compaction shall conform to 302-5.11. Smoothness shall conform to 302-5.12.

302-14 POLYMER MODIFIED ASPHALT CONCRETE (PMAC) PAVEMENT.

Comments:

- 1) Several missing cross-references in the 2024 Edition.

Suggested Special Provisions:

- 1) **302-14.1 General.** *Add the following:*

Submittals shall conform to 302-5.3. Equipment shall conform to 302-5.4.

- 2) **302-14.2 Tack Coat.** *Replace with the following:*

Tack coat shall conform to 302-5.2.3 and 302-5.8.

302-14 POLYMER MODIFIED ASPHALT CONCRETE (PMAC) PAVEMENT.

Suggested Special Provisions:

3) 302-14.3 Distribution and Spreading. *Replace with the following:*

302-14.3 Placement. Placement shall conform to 302-5.9.1.

4) 302-14.4 Rolling. *Add the following:*

Compaction shall conform to 302-5.11. Smoothness shall conform to 302-5.12.

302-15 INTERLOCKING CONCRETE PAVEMENT SYSTEMS.

(New in the 2024 Edition)

302-16 PERMEABLE INTERLOCKING CONCRETE PAVEMENT SYSTEMS

(New in the 2024 Edition)

SECTION 314 – TRAFFIC STRIPING, CURB AND PAVEMENT MARKINGS, AND PAVEMENT MARKERS



City and County Pavement Improvement Center

References and Links

References

- ***Guidelines for the Stabilization of Subgrade Soils in California, UCPRC-GL-2010-01, (“Stabilization Guidelines”):***
 - www.ucprc.edu/pdf/UCPRC-GL-2010-01.PDF
- ***Guide for Partial and Full-Depth Recycling in California, UCPRC-GL-2020-01, (“Recycling Guide”), Caltrans:***
 - <https://dot.ca.gov//media/dotmedia/programs/maintenance/documents/office-of-asphalt-pavements/469fdrpdr-guidestg6ada.pdf>

References

- ***Flexible Pavement Rehabilitation using Pulverization, Caltrans, January 2013 (“Rehab”):***
 - <https://dot.ca.gov//media/dotmedia/programs/maintenance/documents/office-of-concrete-pavement/pavement-foundations/pulv-guide-jan-2013-update-final-a11y.pdf>
- ***Basic Asphalt Recycling Manual, American Recycling and Reclaiming Association, (“ARRA Manual”):***
 - www.arra.org/store/ListProducts.aspx?catid=595203

References

- ***Construction of Quality Asphalt Pavements, MS-22, Third Edition***, Asphalt Institute, (“MS-22”)
 - www.asphaltinstitute.org
- ***Maintenance Technical Advisory Guide, Volume 1***, (“MTAG”), Caltrans:
 - www.csuchico.edu/cp2c/library/caltrans-documents.shtml
- ***Tack Coat Guidelines***, (“TCG”), Caltrans:
 - www.ucprc.ucdavis.edu/ccpic/pdf/Caltrans%20Tack%20Coat%20Guidelines.PDF

In-Person Outreach Presentations/Discussions

- ❑ Offered at no cost
- ❑ 2-1/2 - 3 hours, virtual or in-person
- ❑ **Current Topics:**
 - Use of PCI
 - AC/HMA Compaction
 - AB 2953 Recycling
 - RAP
 - Warm Mix Asphalt (WMA)

Technical Guidance and Tools

CCPIC website: www.ucprc.ucdavis.edu/ccpic

☐ Tech Briefs

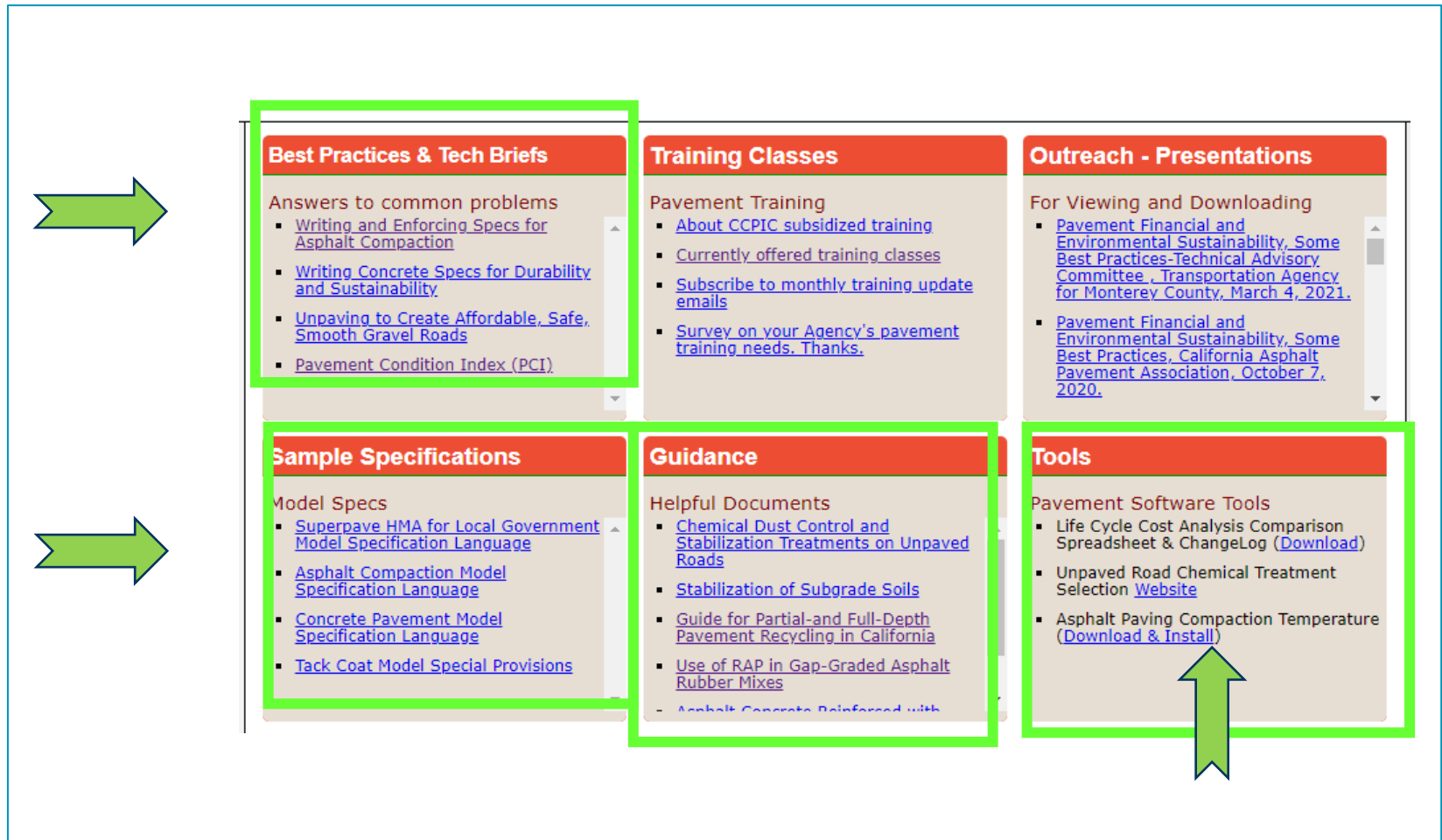
- PCI: There's More (and Less) to the Score
- Writing and Enforcing Specifications for Asphalt Compaction

☐ Specifications/Special Provisions

- Superpave HMA for Local Government (HMA-LG)
 - Modified Caltrans format
 - Greenbook format
- Asphalt Compaction Special Provisions
 - Generic format
- Tack Coat Special Provisions
 - Caltrans format
 - Greenbook format (use with 2021 and earlier editions)

Summary of Technical Resources

CCPIC website: www.ucprc.ucdavis.edu/ccpic



Questions?

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