



# QUIETER BRIDGE DECKS

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# Quieter Bridge Decks

- **Why**
- **What**
  - What is tire noise?
  - What effects tire noise?
  - What method does CT use to measure tire-pavement noise?
  - What methods are currently used by CT to mitigate tire noise?
  - What textures are typically applied to new bridge decks in California?
  - What are the tire noise measurements for our typical bridge decks?
  - What about friction?
  - What are other State DOT's and Countries doing to solve this problem?
- **How**
  - How can **we** improve tire noise on bridge decks?
    - Short term
    - Long term





# Why is this presentation on the agenda?

- To focus attention on bridge deck tire noise.
- To discuss construction practices that can immediately bring improvement without using any new methods or technology.
- To solicit your ideas and to establish a partnership for long term improvement of the tire noise on bridge decks in California.



# Why?

## Why are quieter pavements necessary?

**Consider this quote,** "I was really looking forward to 2 nights in this Historic Landmark Inn (Pierpoint Inn & Resort), but I was disappointed by the noise level from Hwy. 101. The grounds are nice & so are the people –the bed was comfortable - but I will not stay there again because of the noise level was pretty much everywhere. They did give me \$25 off my stay because I complained...seemed like they had heard it before & had a standard response."

## Public Outcry



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# What is Tire noise?

- Tire noise is the sound emitted from the tire-pavement interaction. 'Where the rubber meets the road.'
  - > 35 mph tire noise is the primary source of traffic noise.



# What effects tire pavement noise?

- The Pavement Texture
- The Tire
- The Vehicle speed
- The Environment



# What pavement texture characteristics improve tire noise?

- Texture
  - Small and Negative
  - High Porosity
  - Low Stiffness



# What method does CT use to measure tire-pavement noise?



On-Board Sound Intensity (OBSI) System

# What methods are currently used by Caltrans to mitigate highway noise?

- Soundwalls/Earth Berms
- Building Insulation/Sound Proofing

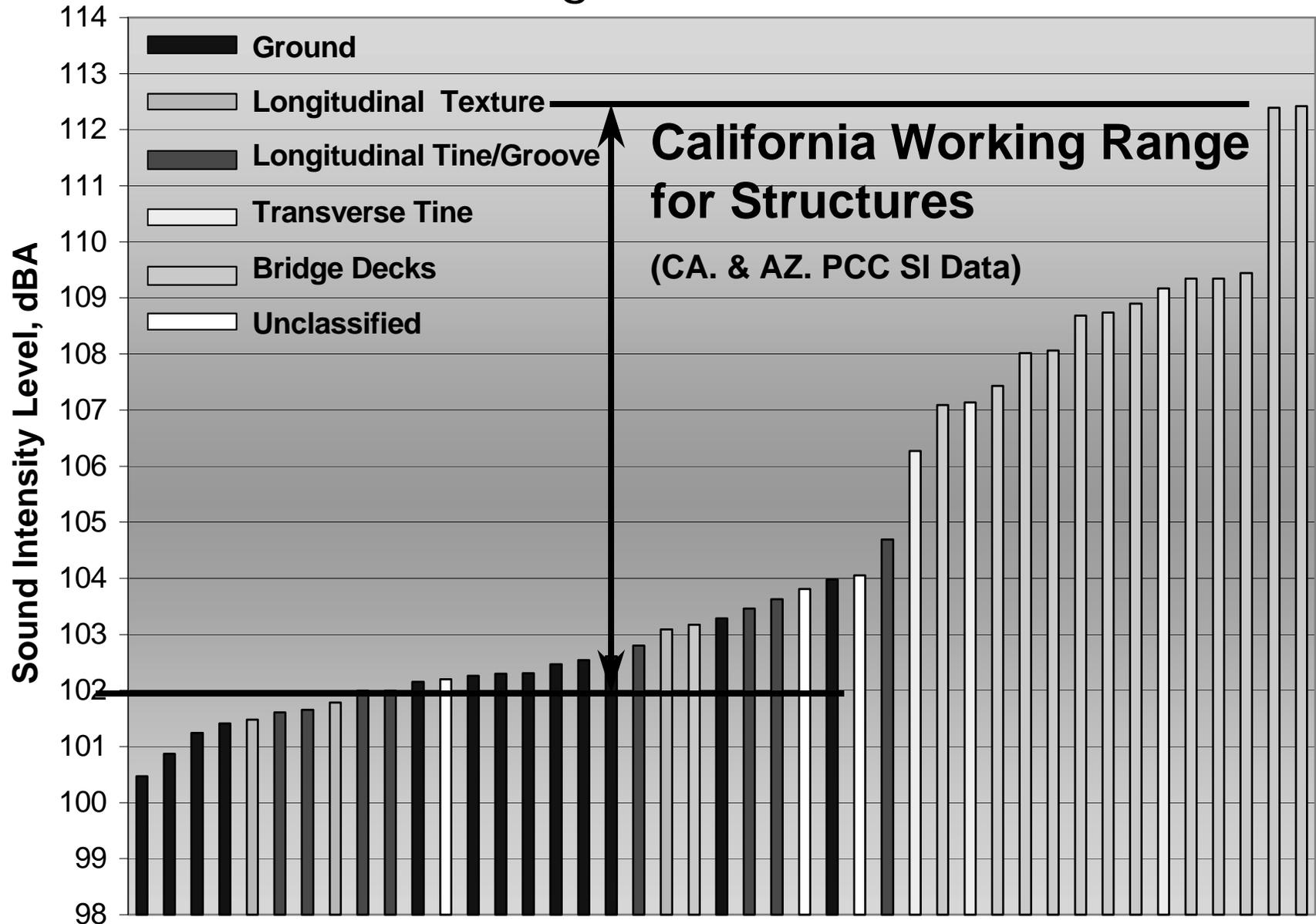


# What textures are typically applied to new bridge decks in California?

- Transverse Astro-Turf
- Transverse Tining
- Transverse Burlap



# What are the tire noise measurements for our typical bridge decks?



# Bridge Deck Texture Comparison

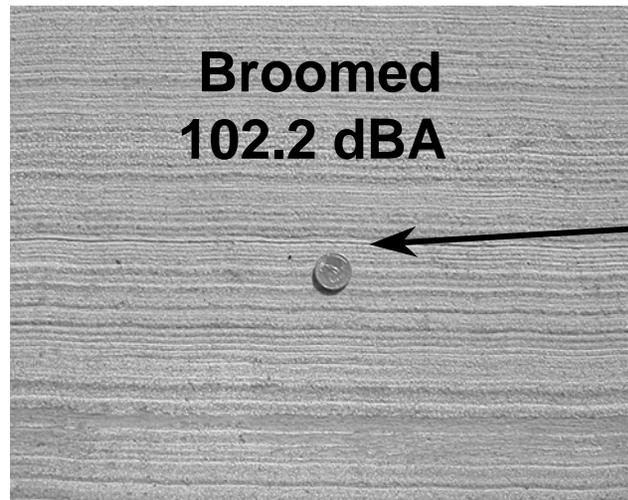
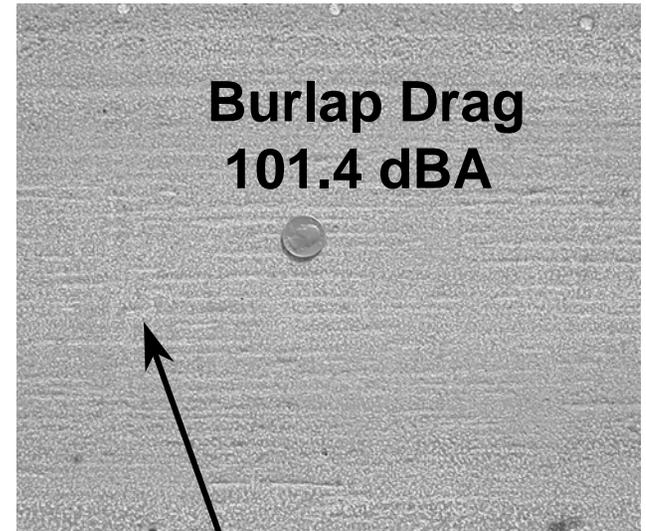
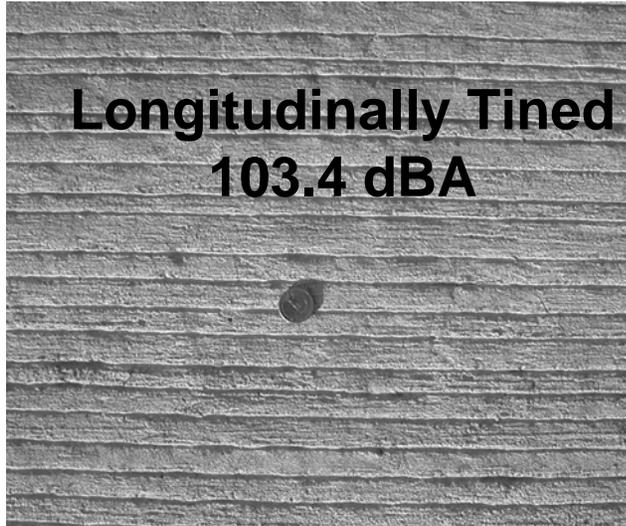


Photographs of the northbound lanes of the Sacramento River Bridge on I-5 near Redding, CA with fully transverse texturing – 112.4 dBA



Photographs of the surface of the railroad overpass structure on the Mojave Bypass with texture applied at an angle to the direction of travel – 103.2 dBA

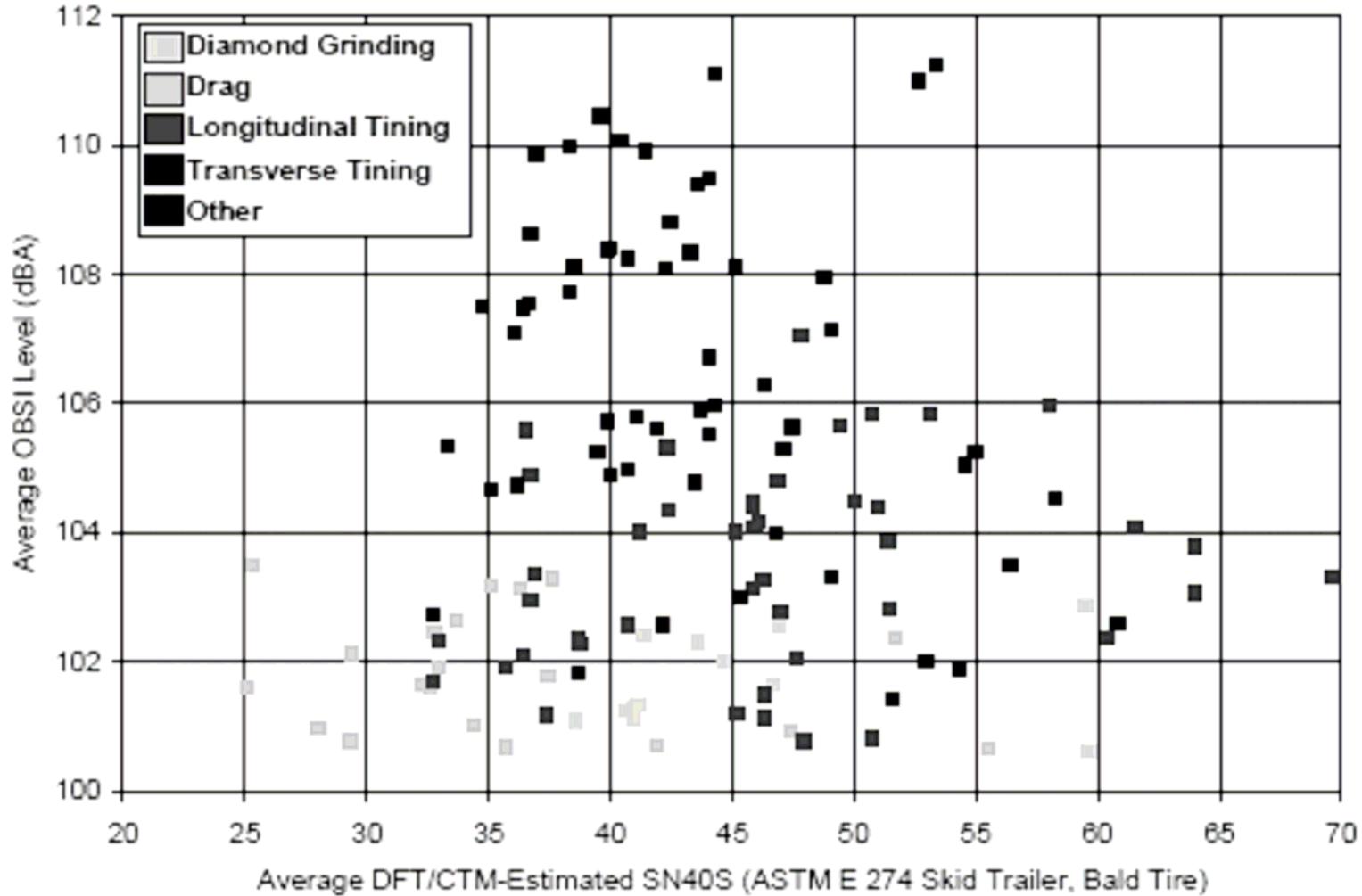
# More Concrete Textures



Quarter  
(typical)

←→  
Direction of Travel

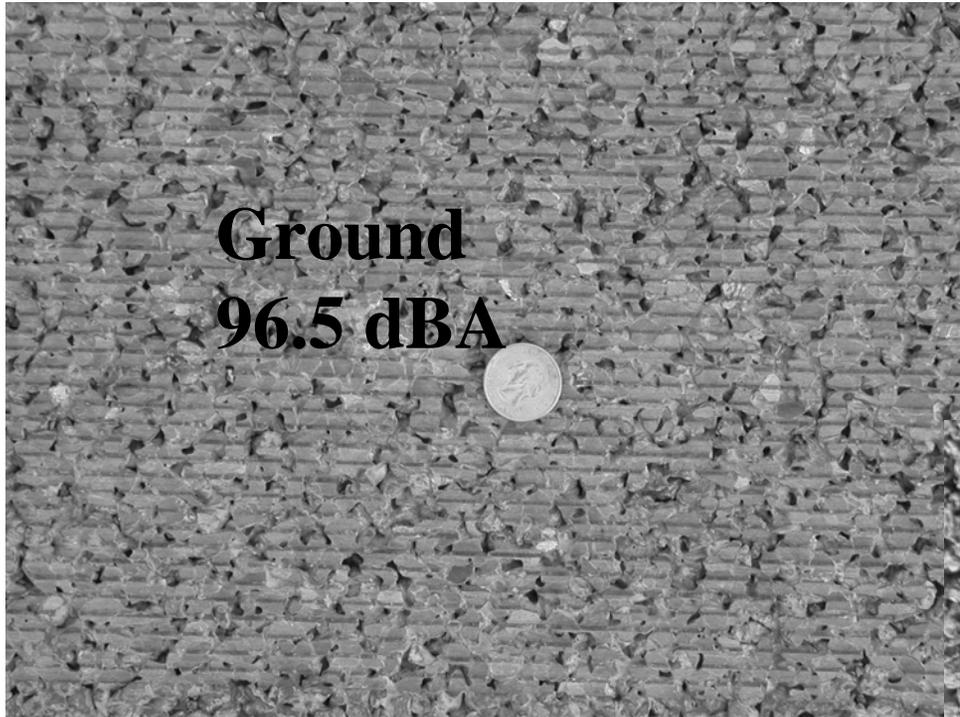
# What about friction?



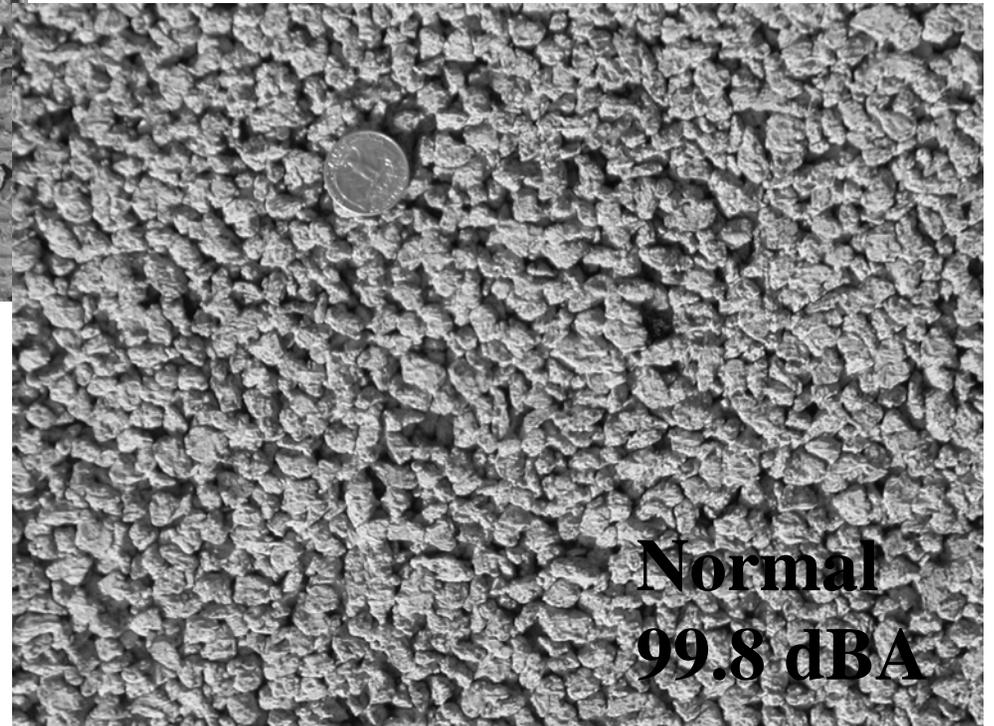
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# What about other States and Countries?



Direction of Travel



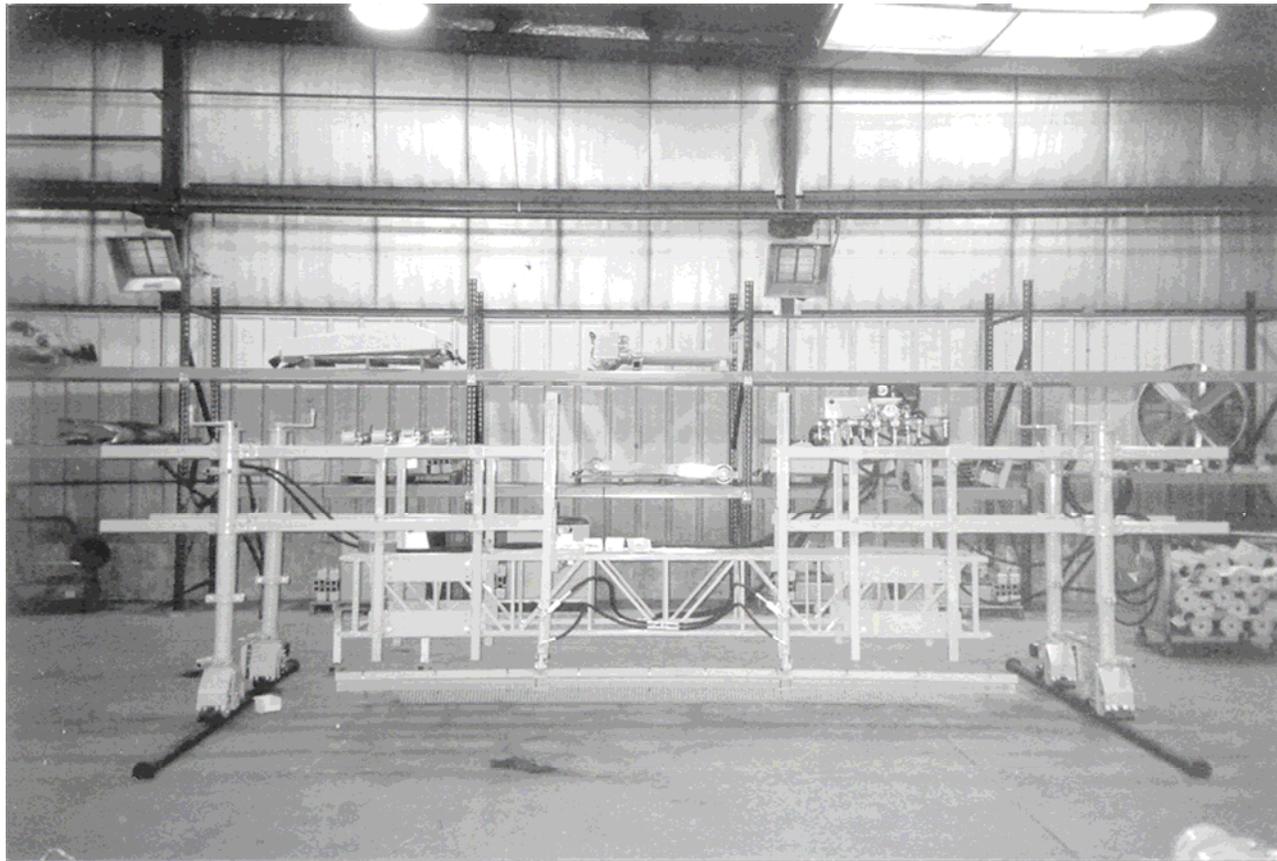
**European Pervious  
Concrete Surfaces**

# How can WE improve tire noise on bridge decks?

- Short Term
  - Diamond Grind Texture
- Long Term
  - Performance Specification
  - \$ Incentive ?
  - Promote Innovation



# Bidwell Longitudinal Tining Device



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**USE WITH 2006 STANDARDS**

**Use when grinding existing bridge decks.**

**Areas to be ground and depressed areas to be excluded from profile measurements shall be shown on the plans.**

**Provide "Materials Information" with PS&E submittal for disposal location of concrete grinding residue.**

**Note: Pavement markers are to be removed before grinding operations and replaced after grinding is completed to allow full lane width grinding.**

**10-1. CONCRETE DECK SURFACE TEXTURING**

This work consists of constructing a texture utilizing diamond grinding and grooving on an existing portland cement concrete bridge deck. This work shall consist of grinding existing portland cement concrete as shown on the plans, as specified in Section 42-2, "Grinding," of the Standard Specifications and these special provisions, and as directed by the Engineer.

**Equipment**

**2**

Grinding equipment for grinding concrete pavements shall use diamond blades mounted on a self-propelled machine designed for grinding and texturing concrete pavements. The equipment shall weigh a minimum 40,000 lbs (grinding head included) and be of a size that will grind a strip at least 4 feet wide in a single pass. Grinding equipment that causes ravels, aggregate fractures, spalls, or disturbance to the transverse or longitudinal joints shall not be permitted. The equipment shall have a positive means of vacuuming the grinding residue from the pavement surface and will leave the pavement surface in a clean condition.

**Construction**

**3\*. List grinding locations on bridge decks.**

Grinding shall be performed at the following locations:

- A. \_\_\_\_\_
- B. \_\_\_\_\_
- C. \_\_\_\_\_

**4**

The contractor shall provide a single lane test grind of 500 ft in length to demonstrate that the equipment and procedures are capable of attaining the desired surface. The contractor will not be allowed to proceed any further until the test grind has been approved in writing by the Engineer.

**5**

Initial grinding shall be performed in the longitudinal direction of the traveled way and shall be done so that the grinding begins and ends at lines perpendicular to the pavement centerline. The existing pavement shall be pre-ground over the entire surface with a conventional diamond

grinding process (e.g. 125 blades and 110 spacers for example). The textured surface will be constructed after the pre-grinding has been completed. The pre-grinding must remove 100% of the existing surface texture on 98% of the pavement surface area. The construction operation shall be scheduled and proceed in a manner that produces a neat, uniform finished surface. A conventional diamond ground feather pass will be required on adjacent shoulders and ramps to maintain a consistent cross slope and ensure pavement surface drainage.

6

Two construction operations are used to construct the textured section. The first operation will create the flush ground surface. The flush grind blades shall be mounted on a 4ft grinding head, stacked with 0.125 blades separated by spacers of no more than 0.025 inches. The flush grind head shall be flat across the blades when mounted on the diamond grinding machine with no bowing of the head. The flush grind blades will be stacked in a manner that leaves no resulting fin between them. The grinding shall eliminate joint or crack faults and provide lateral drainage by maintaining a constant cross slope between grinding extremities in each lane. The cross slope of the pavement shall be as shown on the plans and shall have no depressions or misalignment of slope greater than 0.125 inches in 12 feet when measured with a 12-foot straightedge placed perpendicular to the centerline. Areas of deviation shall be reground. Straightedge requirements will not apply across longitudinal joints or outside the ground area. Grinding shall begin and end at lines normal to the pavement centerline at the project limits. No unground surface area between passes will be permitted. The second operation will provide the longitudinal grooves. The longitudinal grooves shall be 0.125 inches wide and will be 0.125 inches to 0.250 inches deep. The longitudinal grooves will be spaced approximately 0.5 inches center to center. The grooves shall be constructed parallel to the centerline. The contractor shall use a guide to ensure proper alignment of the grooves to centerline.

7

The grinding process shall produce a pavement surface that is true to grade and uniform in appearance with a longitudinal grooved texture. The flush ground surface shall appear smooth and shall contain no ridges that exceed 0.03 inches. The longitudinal grooves shall be constructed parallel to the centerline. At a minimum 98% of the pavement surface shall be textured. Depressed pavement areas due to subsidence, edge slump or other localized causes will be excluded from this requirement when approved by the engineer. The final surface will look like similar to the photo in Appendix A.

8

The ground surface at transverse joints or cracks will be tested with a 12-foot  $\pm 2\frac{1}{2}$  inches long straightedge laid on the pavement parallel with the centerline with its midpoint at the joint or crack. The surface shall not vary by more than 0.01-foot from the lower edge of the straightedge. Cross-slope uniformity and positive drainage shall be maintained across the entire traveled way and shoulder. The cross-slope shall be uniform so that when tested with a 12-foot  $\pm 2\frac{1}{2}$  inches long straightedge placed perpendicular to the centerline, the ground pavement surface shall not vary more than 1/4 inch from the lower edge of the straightedge.

9

The contractor shall remove and dispose of all residue from the pavement surface in a manner and at a location to satisfy environmental regulations. Residue shall be removed per Section 42 of the Standard Specifications and the Special Standard Provision for grinding residue.

**10**

After grinding has been completed, the pavement surface shall be profiled in conformance with the requirements of Section 40-1.10, "Final Finishing," of the Standard Specifications. Two profiles shall be obtained in each lane approximately 3 feet from the lane lines. The average profile index shall be determined by averaging the two profiles in each lane. Additional grinding shall be performed, where necessary, to bring the ground pavement surface within the Profile Index requirements specified in Section 40-1.10, "Final Finishing," of the Standard Specifications.

**11**

An initial profile index of representative portions of the pavement will be available through the project contact person upon written request. This information represents a summary of conditions found to exist at the time the survey was made. This information is provided to give the contractor an idea of the condition of the pavement in regard to smoothness when bidding on this work. The contractor assumes the risk of error if the information is used for any purpose other than the intended purpose.

**12**

Each segment of the finished texture shall have a final International Roughness Index (IRI) of 60 in/mile.

**13**

The profile trace shall be run in both wheel paths and averaged for acceptance. The engineer may test for smoothness and bumps near the centerline and at other spot locations where compliance is questionable. Additional grinding may be required.

**14**

The finished ground surface shall not include any bumps exceeding 0.3 inch in 25 feet. Depressed pavement areas due to subsidence, edge slump or other localized causes will be excluded from testing when approved by the engineer.

**Measurement and Payment****15**

Texturing of pavement will be measured by the square yard. The square yards measured will be the final textured surface area regardless of the number of passes required to achieve acceptable results. Minor areas of untextured pavement within the designated areas to be textured will be included in the measurement. Payment shall be full compensation for all labor, equipment, material and incidentals to complete this work, including hauling and disposal of grinding residue.

**16**

Full compensation for profiling the ground pavement surface with a California profilograph or equivalent and any necessary additional grinding to bring the finished surface within the specified tolerances and for furnishing final profilograms to the Engineer shall be considered as included in the contract price paid per square yard for grind existing concrete pavement and no additional compensation will be allowed therefore.