

CHAPTER 6: CONCRETE FINISHING AND CURING

Bridge decks and approach structures must meet quality standards before opening to public traffic. This chapter details *Standard Specifications (SS)*¹ for surface requirements, as well as finishing and curing methods.

6-1 Specification Review for Concrete Deck Finishing

The Specifications require that bridge decks meet certain qualitative criteria before the bridge deck is opened to public traffic. This section contains concrete finishing specifications for new bridge decks and structure approach slabs.

6-1.1 General Specifications

General criteria for finished bridge decks include: (Pedestrian Overcrossings (POC's) have different requirements.)

1. Decks must meet specified requirements for longitudinal smoothness as measured by, based on bridge profilograph and transverse smoothness, using a 12-foot straightedge.
2. Decks must not have more than 50 linear feet of cracks that are more than 0.02 in. wide at any point within any 500-square ft area.
3. Deck surface texture must have a friction coefficient of not less than 0.35.
4. Decks must meet the “quieter bridge deck” specifications to reduce tire and/or pavement interface traffic noise.
5. Decks must be cured by the curing compound and water method.

Bridge deck and approach structures finishing quality is solely the Contractor's responsibility. The Contractor may propose other construction methods to the Engineer to achieve a deck that meets specification requirements.

6-1.2 Highlights

Following subsections provide details from *2010 Standard Specification* about:

1. Requirements and methods used to test deck and approach surface smoothness and continuity.
2. Specifications for surfacing processes.
3. Abatement methods to reduce traffic noise caused by tire and pavement interface.

6-1.2.A Testing Roadway Surfaces

Requirements for testing roadways are covered in the Standard Specifications.² The

¹ 2010 SS 51-1.01D(4), *Testing Roadway Surfaces* and 2010 SS 51-1.03F(5), *Finishing Roadway Surfaces*.

² 2010 SS 51-1.01D(4), *Testing Roadway Surfaces*.

Engineer tests roadway surfaces for smoothness, coefficient of friction, (except POC's) and crack intensity, as detailed in the following:

1. Surface Smoothness Requirements

The Engineer must test surface smoothness for completed roadway surfaces of structures and approach slabs, and the adjacent 50 feet of approach pavement and surfaces of concrete decks to be covered with another material. The Contractor must allow 10 days for the Engineer to perform smoothness testing. Deck smoothness testing will be performed by the Engineer, using the bridge profilograph per *California Test 547*³ (see Figure 6.1-1.) The test consists of two profiles in each lane, 3 ft from the lane line, plus one test on each shoulder, 3 ft from the curb, or rail face.



Figure 6.1-1. Smoothness Testing, per California Test 547.

The deck surface must comply with the following smoothness requirements:

- a. Profile trace must not have high points over 0.02 ft.
- b. Profile count of five or less in any 100-foot section for portions within the travelway.
- c. Surface must not vary more than 0.02 ft. from the lower edge of a 12-foot long straightedge placed transversely to the direction of traffic.
- d. Any surfaces not meeting the smoothness requirements must be ground down, in accordance with the *Standard Specifications*⁴, until the required smoothness is attained. The minimum cover remaining over the reinforcing bar must not be less than 1-1/2 in.
- e. Deck portions that cannot be corrected by grinding must be replaced as directed by the Engineer.

³ See http://www.dot.ca.gov/hq/esc/ctms/pdf/CT_547Mar2012.pdf for *California Test 547*.

⁴ 2010 SS 42-3, *Grinding*.

Since grinding is common on deck areas at hinges and construction joints, it is recommended that additional concrete be placed in these areas to maintain the minimum reinforcing cover after grinding. See the *Bridge Construction Records and Procedures Manual (BCR&P)*⁵ for policy regarding communications with the Contractor.

2. Coefficient of Friction Requirements

After the deck surfaces and approach slabs have been textured, the deck surface will be tested for the coefficient of friction of the concrete surface under *California Test 342*, as shown in Figure 6.1-2.

Deck surfaces and approach slabs must have a friction coefficient of not less than 0.35. Deck and approach slab portion surfaces not meeting the minimum coefficient of friction must be ground according to SS.⁶



Figure 6.1-2. Coefficient of Friction Testing per *California Test 342*.

3. Crack Intensity Requirements

Deck crack intensity measurements are performed by the Engineer after the deck surface concrete is cured, but before prestressing and before falsework release, with the use of a crack comparator as shown in Figure 6.1-3).

⁵ Bridge Construction Memo (BCM) 112-2.0, *Testing Bridge Deck Surfaces for Compliance with the Straightedge or Profilograph Requirements*.

⁶2010 SS Section 42, *Grove and Grind Concrete*.



Figure 6.1-3. Crack Comparator Makes Checking Crack Width Easier.

Deck surfaces must be measured and comply with the following crack intensity requirements:

- a. Any 500-square foot portion of a new deck surface with a crack intensity measurement of 50 linear feet of cracks, or more and having a width at any point of over 0.02 in., must be treated with methacrylate resin per SS.⁷
- b. The treatment must extend transversely along the entire width of the new deck and longitudinally 5 feet beyond the furthest single crack that exceeds 0.2 in. outside the 500-square foot portion.
- c. The resin treatment must be applied to the deck surface before grinding.⁸

6-1.2.A(1) Finishing Roadway Surfaces⁹

The SS for roadway surface finishing requirements include the following:

1. The completed roadway surfaces must be constructed to the specified grade, cross section, smoothness, surface texture, and surface crack requirements.
2. The Engineer will set deck elevation control points, including all camber allowances for use by the Contractor, to establish grade and cross sections. The points must not be closer than approximately 8 feet longitudinally and 24 feet transversely to the bridge centerline. The Contractor must set to

⁷ 2010 SS 15-5.05, *Bridge Deck Methacrylate Resin Treatment*.

⁸ See BCM 112-5.0 *Methacrylate Deck Crack Treatment* for inspection guidelines and 2010 SS 15-5.05, *Bridge Deck Methacrylate Resin Treatment* for additional methacrylate requirements.

⁹ 2010 SS 51-1.03F(5), *Finishing Roadway Surfaces*.

grade all rails and headers used to support the finishing equipment, and must move all finishing equipment over the entire length of the section to be placed to check steel and bulkhead clearances before concrete placement on any deck section, as shown in Figure 6.1-4.



Figure 6.1-4. Typical Grade Rail Setup.

3. Complete the smoothness testing and any required grinding before applying seal coats.
4. Bridge decks to be covered with membrane seals will be finished to a smooth surface free of mortar ridges and other projections. The coefficient of friction requirements do not apply for these bridges decks.

6-1.2.A(B) Bridge Deck Surface Texture

One of the primary sources of traffic noise is tire-pavement interface. Engineers have researched methods to reduce highway system noise impact beyond building sound barriers. Noise testing equipment is seen in Figure 6.1-5. Research has shown that traffic noise can be minimized at a minimal cost by incorporating quiet pavement strategies in construction practices. These deck surface texture practices will be covered in the Standard Specifications.¹⁰

¹⁰ 2010 SS 51-1.03F(5)(b), *Bridge Deck Surface Texture*.



Figure 6.1-5. Typical Research Setup Quantifying Tire-Pavement Interface Noise Level.

To reduce the tire-pavement noise in noise sensitive areas, all new bridge deck projects advertised for bid after January 1, 2011, include the Standard Special Provision (SSP), *Bridge Deck Surface Texture*. The 2010 *Standard Specification* Section 51-1.03F(5)(b), which has been reserved, will include the *Bridge Deck Surface Texture* requirements in this section.

Standard Specifications provide the following two texturing options depending on whether or not the bridge deck or approach slab is located in a noise sensitive or non-noise sensitive area. These two methods are:

1. Longitudinal tining (see Figure 6.1-6).
2. Longitudinal grinding and grooving (see Figure 6.1-7).

For the longitudinal tining option, the specification requires that initial texturing be performed with burlap drag or a broom device that produces striations parallel to the centerline. Final texturing should be performed with spring steel tines that produce grooves parallel with the centerline.



Figure 6.1-6. Longitudinal Tining Typical Process.

For the longitudinal grinding and grooving option, the specification requires placing .25 in. of sacrificial concrete cover on the bridge deck above the finished grade.



Figure 6.1-7. Close-up of Grooving.

The following sequence must be used to perform grinding and grooving surfaces:



1. Comply with the smoothness and deck crack treatment requirements of the *Standard Specifications*.¹¹
2. Grind the entire surface between the face of concrete barriers to within 18 inches of the barrier toe under *Standard Specifications*¹². Grinding must not reduce the concrete cover on reinforcing steel to less than 1-3/4 in.
3. Groove the ground surfaces longitudinally, parallel to the centerline¹³.

The Contractor may propose to the Engineer other techniques or devices to achieve the requirements of bridge longitudinal texturing. For additional information about longitudinal texturing of new bridges and approach slabs, see the *Bridge Construction Records and Procedures Manual*.¹⁴

6-2 Curing Bridge Decks

Proper curing of concrete deck surfaces is one of the key elements in controlling cracks. The Specifications¹⁵ require bridge decks to be cured by both the curing compound method and the water method.

The following requirements must be met for compound and water curing of bridge decks.

6-2.1 Curing Compound Method

The steps for curing using the Compound Method are as follows:

1. The curing compound must be Curing Compound Number 1.
2. Apply the curing compound at a nominal rate of 150 sq ft/gal. At any point, the application rate must be within ± 50 sq ft/gal of the nominal rate. The average application rate must be within ± 25 sq ft/gal of the nominal rate when tested per *California Test 535*.
3. Apply the curing compound in a manner that prevents runs, sags, thin areas, skips, or holidays.
4. Apply the curing compound using power-operated spraying equipment with an operational pressure gage and a means of controlling the pressure. The Engineer may allow hand-spraying for small and irregular areas that, in the Engineer's opinion, are not reasonably accessible to power-operated spraying.
5. Apply the curing compound to the finished concrete surface immediately before the moisture sheen disappears from the concrete surface, but before drying shrinkage or craze cracks start to appear (see Figure 6.2-1).
6. If the film of curing compound is damaged before the expiration of seven days

¹¹ 2010 SS 51-1.01D(4), *Testing Roadway Surfaces*.

¹² 2010 SS 42-3, *Grinding*.

¹³ 2010 SS 42-2, *Grooving*.

¹⁴ BCM 112-6.0 *Quieter Bridge Deck Construction*.

¹⁵ 2010 SS 51-1.03H, *Curing Concrete Structures* and 2010 SS 90-1.03B, *Curing Concrete*.

after the concrete is placed, immediately apply additional compound.



Figure 6.2-1. Applying Spray Cure from a Moveable Bridge Following the Finishing Machine.

6-2.2 Curing Water Method

1. Concrete must be kept continuously wet by applying water for a curing period of at least seven days after the concrete is placed. A curing medium such as cotton mats, rugs, carpets, or earth or sand blankets, may be used to retain moisture during the curing period.
2. Keep the concrete surface damp by applying water with an atomizing nozzle (fogging) that forms a mist and not a spray until the surface is covered with the curing medium (Figure 6.2-2). Do not apply the water under pressure directly on the concrete or allow the water to flow over or wash the concrete surface.



Figure 6.2-2. Misting Cure Medium.



Other requirements include:

1. Maintain concrete at a temperature of not less than 45°F for 72 hours after the pour, and at not less than 40°F for an additional four days.
2. For each batch of curing compound delivered to the job site, the Contractor must submit curing test samples to Materials Engineering and Testing Services (METS). Samples must be from the shipping containers at the Manufacturer's source of supply. A Certificate of Compliance must be submitted to the Engineer and to METS.

For additional information about curing bridge deck surfaces, see *Bridge Construction Records and Procedures Memo 105-3.0 thru 105-5.0* and Chapter 5 of the *Concrete Technology Manual*.