



Illinois Department of Transportation

Memorandum

To: ALL BRIDGE DESIGNERS 17.1
From: D. Carl Puzey *D. Carl Puzey*
Subject: Bridge Deck Smoothness Grinding Policy
Date: March 31, 2017

Smoothness grinding of PCC pavement has been used successfully throughout the state and some Districts have extended the merits of this to profile and smoothness grinding of bridge decks also. A recent IDOT/FHWA process review on bridge deck construction recognized the improved ride quality resulting from smoothness grinding of bridge decks and formed a committee to further study it and develop a consistent policy throughout the state.

Bridge decks are currently finished according to Article 503.16 of the Standard Specifications and the Supplemental Specifications. These requirements seek to achieve quality concrete with a smooth riding surface. However, excessive finishing tends to create an overworked and weak laitance surface and also delays curing, all of which can adversely affect the riding surface and the concrete quality.

Therefore, the Department is implementing the attached "Guidelines for Selecting Bridge Deck Smoothness Grinding" to enable the Department to achieve a smoother riding surface on selected bridge decks while keeping in mind economics and time to project completion. It also intends to improve the concrete quality of the bridge deck by separating the deck casting and curing process from the deck surface finishing process. Note that Guide Bridge Special Provision (GBSP) 78 "Bridge Deck Construction" has been revised to permit elimination of several bridge deck finishing requirements for structures where smoothness grinding is specified.

Smoothness and profile grinding is particularly beneficial on high speed, high volume routes where the smoother ride benefits derived by the traveling public offsets the additional cost of this work. Projects utilizing smoothness grinding for bridge decks shall be coordinated during the TS&L phase with the District and the Bureau of Bridges and Structures (BBS). Projects utilizing smoothness grinding for concrete overlays shall be coordinated during repair plan development with the District and the BBS. Exemptions from this policy shall be coordinated through the District and the BBS. An additional document "Design Guidelines for Smoothness Grinding of Bridge Decks" assists the designer in properly preparing bridge plans for structures selected for smoothness grinding.

GBSP 59 "Diamond Grinding and Surface Testing Bridge Sections" provides equipment and construction requirements and defines a bridge section for grinding as the bridge deck plus the approach slabs and the connector pavements. The grinding shall be diminished over the length of the connector pavement to provide a smooth transition to the roadway pavement. The grinding machine geometry, the cutting speed, and the down pressure maintain the profile grade while smoothing the transition between high and low spots. The grinding process may remove up to ¼" of concrete and therefore the bridge deck, approach slabs and connector pavements shall be constructed ¼" thicker on projects selected for smoothness grinding. The contractor is required to satisfy a minimum average smoothness of 25.0 in./mile or less per lane and this is recorded in the BC 2450 form in GBSP 59.

Projects selected for bridge deck smoothness grinding will be longitudinally grooved, in lieu of the typical transverse grooving. Longitudinal grooving provides a quieter ride and it is appropriate to incorporate it with the better ride quality provided by smoothness grinding. Longitudinal grooving also requires fewer passes than transverse grooving which saves time and will be less likely to reduce the improvement of smoothness grinding. GBSP 79 "Bridge Deck Grooving (Longitudinal)" shall be included for this work.

This policy shall be effective for all TS&L's approved after April 1, 2017. Any questions or comments should be directed to Jayme Schiff at 217-782-2125 or Jayme.Schiff@illinois.gov.

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Guidelines for Selecting Bridge Deck Smoothness Grinding

March 29, 2017

Decisions regarding implementation of Bridge Deck Smoothness Grinding shall be made in the Bridge Planning (TS&L) phase of the project. Exemptions shall be coordinated through the District and the Bureau of Bridges and Structures.

Bridge Deck Smoothness Grinding may only be considered for bridges with new concrete decks, slabs, or new concrete overlays.

Required Bridge Deck Smoothness Grinding Applications:

1. Interstate (mainline) bridges satisfying both of the following criteria:
 - a. Bridge length \geq 150'
 - b. ADT > 10,000

Recommended Bridge Deck Smoothness Grinding Applications:

1. All State route bridges satisfying all of the following criteria:
 - a. Bridge length \geq 150'
 - b. ADT > 10,000
 - c. Posted Speed >45 MPH
2. Interstate ramp structures with ADT > 10,000
3. As further defined by District Policy

Grooving Applications:

All bridge decks with smoothness grinding shall be longitudinally grooved.

Applicable Special Provisions

GBSP 59 "Diamond Grinding and Surface Testing Bridge Sections"

GBSP 78 "Bridge Deck Construction"

GBSP 79 "Bridge Deck Grooving (Longitudinal)"

Design Guidelines for Smoothness Grinding of Bridge Decks:

March 29, 2017

Profile Grade:

1. The P.G. shown on the approved TSL is the profile grade after the grinding is complete.
2. This P.G. shall be shown on the final plans along with a note stating:

“The profile grade shows the final elevations after grinding.”

Note on Front Sheet:

1. To clarify the intent of the plans and for information for future users of the plans, add the following note to the bridge GP&E plan sheet:

“Up to ¼ inch may be ground off the bridge deck and the bridge approach slabs.”

Design Computations:

1. For design of the bridge deck, use the Bridge Manual charts for 8 inch deck thickness. Using the charts means that the deck dead load and the deck capacity will both be based on the thinner deck.
2. For composite beams, use the 8 inch deck thickness for capacity calculations.
3. Use the 8 ¼ inch deck thickness for determining the dead load for the design of the beams/girders, the bearings and the substructure.

Pay Items and Quantities:

1. For the smoothness grinding and surface testing work, include the pay item “Diamond Grinding (Bridge Section)”, Sq. Yd. Calculate the quantity as: (Length from the beginning of one connector pavement to end of other connector pavement) x (inside face to inside face of curbs or parapets – 4 ft.).
2. Include the pay item for “Bridge Deck Grooving (Longitudinal)”, Sq. Yds. Calculate the quantity of grooving as: (Length from beginning of one approach slab to end of other approach slab) x (full width of traffic lanes between shoulders).
3. Calculate the quantity of Concrete Superstructure and Concrete Superstructure (Approach Slab) with the ¼ inch thicker slab.
4. Include pay item for “Protective Coat”, Sq. Yd. on bridge and approach slabs.

Top of Deck Elevation Data:

Bridge Deck:

1. Use base sheet E-S1.
2. Use the Profile Grade shown on the approved TSL for the calculation of the "Theoretical Grade Elevations".
3. To calculate the data for the fifth column in the tables, "Theoretical Grade Elevations Adjusted For Dead Load Deflection and Grinding", take the Theoretical Grade Elevations (based on the Profile Grade) and add the deflection that would be caused by an 8 inch deck thickness (and the concrete curb or parapet) and then add an additional $\frac{1}{4}$ inch to all the values.
4. If any joints are used on the bridge, include the location of the CL of these joints in the Top of Slab Elevations data tables.
5. In the "Fillet Heights" detail on the base sheet, the deck thickness to be subtracted when calculating the fillet height is the deck thickness prior to grinding (i.e., $8\frac{1}{4}$ inch for an 8 inch final deck thickness).

Bridge Approach Slab:

1. Use base sheet E-AS1.
2. Use the Profile Grade shown on the approved TSL for the calculation of the "Theoretical Grade Elevations".
3. To calculate the "Theoretical Grade Elevations Adjusted for Grinding", take the Theoretical Grade Elevations (based on the Profile Grade) and then add an additional $\frac{1}{4}$ inch to all the values. (There is no deflection to be considered here since this slab is poured on grade.)

Plan Details:

1. Top of slab elevations given in plan details for construction (e.g., elevations along the top of the hatched block of a stub abutment) should be based on the elevations before grinding. A note should be added to the detail or the sheet: "**Prior to grinding".
2. Dimensions that include the $\frac{1}{4}$ inch that may be ground off later should have an asterisk and the following note should be added to the detail or to the sheet: "**Prior to grinding".
3. The following dimensions should include the $\frac{1}{4}$ inch that may eventually be ground off:
 - a. The bridge deck thickness (add $\frac{1}{4}$ inch to the normal deck thickness).
 - b. The bridge approach slab thickness (add $\frac{1}{4}$ inch to CIP approach thickness and add $\frac{1}{4}$ inch to the concrete wearing surface for precast approaches).
 - c. The clearance between the top of the deck and the top transverse bars in the bridge deck and in the approach slab (change dimension from $2\frac{1}{4}$ inch cl. ($\pm\frac{1}{4}$ inch) to $2\frac{1}{2}$ inch cl. ($\pm\frac{1}{4}$ inch)).
 - d. On a section through the abutment, the dimension given between the top of the approach seat and the top of the slab.

Seat Elevations:

1. On the bridge, determine the bearing seat elevations based on the Profile Grade minus the 8 inch deck thickness.
2. On the bridge approach slab, determine the approach seat elevation by subtracting the 1'-3" approach slab thickness from the P.G.

Top of Beam/Web Elevations Table and Camber Diagram

The Top of Beam/Web Elevations Tables and camber diagrams should be determined based on 8 inch deck thickness and the Profile Grade.

Scuppers

Scupper types should be chosen so they can be installed outside the potential grinding area (i.e., within 2 feet of the inside face of curb or parapet). A DS-33 scupper may be used provided it is recessed $\frac{1}{4}$ " below the top of the slab.

Staging

1. There is no need to grind temporary traffic lanes if they are eventually to be covered by a median or sidewalk.
2. Assume that, similar to grooving, grinding may be delayed until two adjacent lanes have been completed.

Prefomed Joint Strip Seals

Revise the base sheet (EJ-SSJ) as follows:

1. Change the $\frac{1}{4}$ inch dimension between the top of the slab and the top of the locking edge rails to $\frac{1}{2}$ inch.
2. At the bottom corner of the sheet, remove the base sheet notation and date. In the title of the sheet, add the word "Modified" in front of the current title.

Modular Joints and Finger Plate Joints

Detail the joints with $\frac{1}{4}$ inch recess below the top of the slab such that the joint will be flush with the riding surface after grinding.