# Illinois

**State DOT Representative Report Questions**
National Concrete Consortium
San Antonio, Texas
April 2, 2009

**Theme: Ride Quality for Bridges**

**Illinois DOT**
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Please provide your state DOT's perspective regarding the following theme questions. Each NCC state DOT representative will be asked to present their responses to the group during the State Report forum on Thursday morning April 2, 2009.

1. What features of a bridge deck and approach do you consider to have the most impact on ride quality? **The settlement of the approach.**

2. How does your state measure ride quality for bridge decks?
   a. IRI?
   b. Straight edge? **See attached specification Article 503.16(a)(4).**
   c. Other? **See attached special provision Diamond Grinding and Surface Testing Bridge Sections.**
   d. Specifications?

3. What smoothness thresholds does your DOT require for bridge decks? **See attached specification Article 503.16(a)(4). See attached special provision Diamond Grinding and Surface Testing Bridge Sections.**

4. How are transitions near localized features (drainage basins, joints) treated in efforts to ensure acceptable ride quality? **Not applicable.**

5. What corrective actions are required for substandard bridge deck/approach ride quality? **See attached specification Article 503.16(a)(4). See attached special provision Diamond Grinding and Surface Testing Bridge Sections.**

6. Does your state initiate a penalty/incentive structure for bridge ride quality? **See attached special provision Diamond Grinding and Surface Testing Bridge Sections.**

7. Does your state consider ride quality as a scoping item for bridge rehabilitation? **Not applicable.**

8. Does your state require sequencing (casting positive moment regions prior to negative moment regions) of deck pours during placement of bridge deck concrete for continuously designed decks? **Yes.**

9. What method and type of texture does your state apply to your bridge deck surface? **See attached specification Article 503.16(a)(3). See attached special provision Diamond Grinding and Surface Testing Bridge Sections.**

10. How does your state handle transitions/approaches from pavement on to the bridge deck (approach length, profile, joints)? **See attached special provision Diamond Grinding and Surface Testing Bridge Sections.**

11. Does your state maintain a database for bridge ride quality? **No.**

12. How does your state report its network ride quality for pavements and bridges to the Highway Performance Monitoring System (HPMS) database (network report excludes or includes bridges with pavements)? **The report excludes bridges and railroad crossings.**

Illinois DOT

**503.16 Concrete Superstructures.** The concrete in bridge decks, slab bridges or other monolithic superstructures shall be placed in one continuous operation between expansion or construction joints specified. Sidewalks, curbs, and medians shall be placed monolithically with the superstructure unless a construction joint is specified.

When falsework is utilized to support steel or precast concrete beams during erection, the falsework shall be removed prior to pouring the deck. The concrete bridge deck or top riding surface of the superstructure shall be constructed so that the top of the finished surface shall be at the final plan elevation after taking into account any anticipated deflection of the supporting members due to the weight of the deck, median, and parapets.

Fogging equipment shall be in operation unless the evaporation rate is less than 0.1 lb/sq ft/hour (0.5 kg/sq m/hour) and the Engineer gives permission to turn off the equipment. The evaporation rate shall be determined according to the figure in the Portland Cement Association's publication "Design and Control of Concrete Mixtures" (refer to the section on plastic shrinkage cracking). The Contractor shall provide temperature, relative humidity, and wind speed measuring equipment. The fogging equipment shall be adjusted to adequately cover the entire width of the pour.

If there is a delay of more than ten minutes during concrete placement, wet burlap shall be used to protect the concrete until operations resume. Concrete placement operations shall be coordinated to limit the distance between the point of concrete placement and concrete covered with cotton mats for curing. The distance

shall not exceed 35 ft (10.7 m). For pour widths greater than 50 ft (15 m), the distance shall not exceed 25 ft (7.6 m).

(a) Riding Surfaces of Superstructures. Superstructure riding surfaces shall be finished and textured as follows.

(1) Initial Finishing. After the concrete is placed and consolidated, it shall be struck off and finished with a power driven finishing machine.

The finishing machine will not be required for that portion of the surface outside of the outer construction joints shown on the plans when the distance from the construction joint to the parapet flow line is less than 6 ft (2 m). The concrete surface in these areas shall be finished with a hand operated float.

At the Contractor's option, a vibrating screed may be used in lieu of a finishing machine for superstructures with a pour width less than 16 ft (5 m). After the concrete is placed and consolidated, it shall be struck off with a vibrating screed allowing for camber, if required. The vibrating screed shall be of a type approved by the Engineer. A slight excess of concrete shall be kept in front of the cutting edge at all times during the striking off operation. After screeding, the entire surface shall be finished with long handled floats.

Long handled floats having blades not less than 3 ft (1 m) in length and 6 in. (150 mm) in width may be used to smooth and fill occasional porous or open-textured areas in the concrete surface, but shall not be used to float the entire surface. The Contractor shall take immediate corrective action to eliminate the causes of the porous or open-textured areas as they occur.

The Contractor may, at their option, transversely float the entire surface with a hand-operated float having blades not less than 10 ft (3 m) in length and 6 in. (150 mm) in width. If the Contractor chooses to transversely float the entire surface with the 10 ft (3 m) hand float and surface corrections are made, straightedge testing while finishing will not be required.

Water will not be permitted to be applied to the bridge deck surface unless it can be demonstrated to the Engineer that workability cannot be obtained. If water is permitted by the Engineer, it shall be applied in a fine mist by means of a sprayer, at a distance not to exceed 12 in. (300 mm) from the surface. Application by brushes or any other method that concentrates water will not be permitted.

Excess concrete, mortar, or paste produced by the finishing process shall not be discarded into areas of the bridge deck that will be covered by sidewalks, medians, curbs, or parapets or otherwise incorporated into the work but shall be removed and disposed of properly.

(2) Straightedge Testing and Surface Correction. After the finishing has been completed and while the concrete is still plastic, the surface shall





be tested for trueness with a 10 ft (3 m) straightedge. The Contractor shall furnish and use an accurate 10 ft (3 m) straightedge which has a handle not less than 3 ft (1 m) longer than 1/2 the pour width. The straightedge shall be held in contact with the surface and passed gradually from one side of the superstructure to the other. Advance along the surface shall be in successive stages of not more than 1/2 the length of the straightedge. Any depressions found shall be immediately filled with freshly mixed concrete, struck off, consolidated, and refinished. High areas shall be cut down and refinished. The straightedge may be used to finish and seal the bridge deck surface when approved by the Engineer.

(3) Texture. All riding surfaces shall be textured in the plastic state and subsequently saw cut grooved after the concrete has cured.

a. Plastic Texture. The texture shall be formed into the plastic concrete with a burlap or artificial turf carpet drag. The burlap or artificial turf shall be attached to a work bridge riding on rails, or other approved device that will permit control of the time and rate of texturing. The burlap or artificial turf carpet shall have a length equal to the width of the pour or from face-to-face of curbs, as applicable. The burlap or carpet shall be laid on the concrete surface and dragged, parallel to the centerline of the roadway, in the direction that the superstructure is being poured with approximately 2 ft (600 mm) of its width in contact with the concrete surface. The drag shall be operated so as to produce a uniform finish. The burlap shall be double thickness and shall be kept saturated with water while in use. The artificial turf carpet may be weighted, if necessary, for maintaining intimate contact with the concrete surface.

b. Saw Cut Grooving. The grooving operation shall not be started until after the expiration of the required curing or protection period and after correcting excessive variations by grinding or cutting has been completed.

The grooves shall be cut into the hardened concrete, perpendicular to the centerline, using a mechanical saw device equipped with diamond blades that will leave grooves 1/8 in. wide and 3/16 in. ± 1/16 in. deep (3 mm wide and 5 mm ± 1.5 mm deep). The Contractor shall have the option of constructing the grooves at either a random spacing of 5/8 to 1 1/4 in. (15 to 30 mm) centers with an average spacing of 7/8 in. (22 mm) or a uniform spacing of 3/4 in. (20 mm) centers. The grooving shall be stopped 1 ft (300 mm) from the faces of curbs or parapets and 2 in. ± 1 in. (50 mm ± 25 mm) from deck drains and expansion joints. If grooving must be performed as part of stage construction, the grooving may be deferred until at least two adjacent lanes have been poured.

The removal of slurry shall be continuous throughout the grooving operations. The grooving equipment shall be equipped with

vacuum slurry pickup equipment which shall continuously pick up water and sawing dust, and pump the slurry to a collection tank. The slurry shall be disposed of off site according to Article 202.03.

Cleanup shall be continuous throughout the grooving operation. All grooved areas of the deck shall be flushed with water as soon as possible to remove any slurry material not collected by the vacuum pickup. Flushing shall be continued until all surfaces are clean.

(4) Surface Smoothness. All riding surfaces shall be tested for trueness at the expiration of the required curing or protection period. The entire surface shall be tested by means of a 16 ft (5 m) straightedge placed parallel to the grade line and touching the surface. Variations measured from the face of the straightedge to the surface of the superstructure shall not exceed 3/16 in. (5 mm). Variations greater than 3/16 in. (5 mm) shall be removed by grinding or cutting. Bushhammering or any method involving impact shall not be used.

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**DIAMOND GRINDING AND SURFACE TESTING BRIDGE SECTIONS**
Effective: December 6, 2004
Revised: July 9, 2008

Description. This work shall consist of diamond grinding and surface testing bridge sections.

A bridge section shall consist of the bridge deck plus the bridge approach pavement and connector pavement on each side of the bridge.

Equipment. Equipment shall be according to the following.

(a) Diamond Grinder. The diamond grinder shall be a self-propelled planing machine specifically designed for diamond saw grinding. It shall be capable of accurately and automatically establishing the profile grade and shall have a positive means for controlling cross slope. It shall also have an effective means for removing excess material and slurry from the surface and for preventing dust from escaping into the air. The diamond grinder shall not cause strain or damage to the surface.

The grinding head shall be a minimum of 4 ft. (1.2 m) wide and the diamond saw blades shall be gang mounted on the grinding head at a rate of 50 blades / ft. (164 blades/m).

(b) Surface Testing Equipment. Required surface testing and analysis equipment and their jobsite transportation shall be provided by the Contractor.

(1) Profile Testing Device. The Profile Testing Device shall have a decal displayed to indicate it has been tested through the PEV Program administered by the Department.

a. California Profilograph. The California Profilograph shall be either computerized or manual and have a frame 25 ft (8 m) in length supported upon multiple wheels at either end. The profile shall be recorded from the vertical movement of a wheel attached to the frame at mid point.

The California Profilograph shall be calibrated according to the manufacturer's recommendations and California Test 526. All calibration traces and calculations shall be submitted to the Engineer for the project file.

b. Inertial Profiler. The inertial profiler shall be either an independent device or a system that can be attached to another vehicle using one or two non-contact sensors to measure the pavement profile. The inertial profiler shall be capable of performing a simulation of the California Profilograph to provide results in the Profile Index format.

The inertial profiler shall be calibrated according to the manufacturer's recommendations. All calibration traces and calculations shall be submitted to the Engineer for the project file.

(3) Trace Analysis. The Contractor shall reduce/evaluate these traces using a 0.00 in. (0.0 mm) blanking band and determine a Profile Index in in./mile (mm/km) for each bridge section. Traces produced using a computerized profile testing device will be evaluated without further reduction. When using a manual profile testing device, the Contractor shall provide an electronic scanner, a computer, and software to reduce the trace. All analysis equipment (electronic scanner, computerized recorder, etc.) shall be able to accept 0.00 in. (0.0 mm) for the blanking band.

All traces from bridge sections tested with the profile testing device shall be recorded on paper with scales of 300:1 longitudinally and 1:1 vertically. Equipment and software settings of the profile testing device and analysis equipment shall be set to those values approved through the PEV Program."

**CONSTRUCTION REQUIREMENTS**

General. After all components have been properly cured, the bridge section shall be ground over its entire length and over a width that extends to within 2 ft. (600 mm) of the curbs or parapets. The maximum thickness removed shall be 1/4 in. (6 mm); however, when the bridge deck thickness noted on the plans can be maintained, as a minimum, additional removal thickness may be permitted.

The vertical difference between longitudinal passes shall be 1/8 in. (3 mm) maximum. The grinding at the ends of the bridge section shall be diminished uniformly at a rate of 1:240 over the connector pavements.

Grinding shall be continuous through all joints. When sealed joints are specified, grinding shall be completed prior to final installation of the joints seals. During grinding, joint openings shall be temporarily filled with material approved by the Engineer.

Surface Testing. The diamond ground bridge section shall be surface tested in the presence of the Engineer prior to opening to traffic. All objects and debris shall be removed from the surface prior to testing. During surface testing, joint openings may be temporarily filled with material approved by the Engineer.

Profiles shall be taken in the wheel paths of each lane, 3 ft. (1 m) from and parallel to the planned lane lines. A guide shall be used to maintain the required distance.

The profile trace shall be printed on continuous paper with scales of 300:1 horizontally and 1:1 vertically and shall have stationing indicated every 500 ft. (150 m) at a minimum. Both ends of the profile trace shall be labeled with the following information: contract number, beginning and ending stationing, which direction is up on the trace, which direction the profilograph was pushed, and profilograph operator name(s). The top portion of the Profilograph Report of Bridge Smoothness (Attachment 1) shall be completed and the form secured around the trace roll.



Trace Reduction and Bump Locating Procedure. All traces shall be reduced. Traces produced by a mechanical recorder shall be reduced using an electronic scanner and computer software. This software shall calculate the profile index and indicate any bumps in excess of 0.30 in. (8 mm) with a line intersecting the profile on the printout. Computerized recorders shall provide the same information.

The average profile index and locations with deviations exceeding the 0.30 in. (8 mm) limit shall be recorded on the Profilograph Report of Bridge Smoothness as shown in Attachment 1.

All traces and completed reports shall be provided within two working days of completing the testing to the Engineer for the project file. Traces from either a computerized profile testing device or analysis software used with a manual profile testing device shall display the settings used for the data reduction. The Engineer will compare these settings with the approved settings from the PEV Program. If the settings do not match, the results will be rejected and the section shall be retested/reanalyzed with the appropriate settings.

Corrective Actions. Within the bridge section, all deviations in excess of 0.30 in. (8 mm) in a length of 25 ft. (8 m) or less shall be corrected regardless of the profile index value. Correction of deviations shall not result in the deck thickness being less than the minimum.

Any bridge section having an average profile index greater than 35.0 in/mile (555 mm), including bumps, shall be corrected to reduce the profile index to 35.0 in./mile (555 mm/km) or less on each trace.

Where corrective work is performed, the bridge section shall be retested to verify that corrections have produced a profile index of 35.0 in./mile (555 mm/km) or less for each trace.

Corrective actions shall be performed at no additional cost to the department. The Contractor shall furnish the surface profilograph tracing and the completed form to the Engineer within two working days after any corrections are made.

The Engineer may perform profilograph testing on the surface at any time for monitoring and comparison purposes.

Smoothness Assessments. Smoothness assessments will be based on the final average profile index determined for the bridge section after performing any corrective work. Additional payments/deductions will be as indicated in the Smoothness Assessment Schedule.

The Smoothness Assessment Work Sheet (Attachment 2) will be completed by the Engineer for payment.

SMOOTHNESS ASSESSMENT SCHEDULE

| Profile Index in./mile (mm/km) per Bridge Section | Smoothness Assessment per Bridge Section |
|---|---|
| 15.0 (240) or less | +$7,500.00 |
| >15.0 (240) to 18.0 (285) | +$5,000.00 |
| >18.0 (285) to 20.0 (315) | +$2,500.00 |

| | |
|---|---|
| >20.0 (315) to 35.0 (555) | +$0.00 |
| >35.0 (555) to 45.0 (710) | +$0.00 |
| >45.0 (710) | -$5,000.00 |

Method of Measurement. This work will be measured for payment in place and the area computed in square yards (square meters) of diamond grinding performed.

Basis of Payment. This work will be paid for at the contract unit price per square yard (square meter) for DIAMOND GRINDING (BRIDGE SECTION).

## INSTRUCTIONS FOR COMPLETING

## PROFILOGRAPH REPORT OF BRIDGE SMOOTHNESS

This form shall be prepared and submitted, along with the profile trace, to the Engineer.

**The Type of Report is one of the following:**

**Information** – Test conducted for informational purposes only.

**Initial** – Testing of bridge section prior to any corrective action.

**Intermediate** – After some corrective action has been completed.

**Final** – After all corrective action has been completed.

**Other Information:**

**Structure Number** – Numerical identification of the bridge.

**Traffic Direction** – NB, SB, EB, or WB depending on the design traffic flow of the numbered route.

**Lane Designation** – DL (Driving Lane), CL (Center Lane), or PL (Passing Lane).

**Operator** – Printed name of Contractor personnel operating profilograph.

**Engineer** – Printed name of Department representative witnessing data collection.

**Bump locations are listed by station for each track (wheel path).**



## EXAMPLE

### PROFILOGRAPH REPORT FOR BRIDGE SMOOTHNESS

**Type of Report:**

____ Information  √ Initial  ____ Intermediate  ____ Final

**Contract No.** 96739 **Route** IL 255

**Contractor** John Doe Construction Co. **Section No.** _____

**Station** 1795+06.0 **County** Madison

**No. of Lanes** 2 **Structure Number** 060-1234

**Operator** Joe Smith **Traffic Direction** EB

**Engineer** Mike Jones **Date Tested** 09/02/99

| Section No. | Length mile (km) | Track 1 Measured Roughness In. (mm) | Track 1 Profile Index in./mile (mm/km) | Track 2 Measured Roughness In. (mm) | Track 2 Profile Index in./mile (mm/km) | Average Profile Index in./mile (mm/km) |
|---|---|---|---|---|---|---|
| 1 | 0.100 | 2.16 | 21.6 | 1.30 | 13.0 | 17.3 |
| 2 | 0.100 | 2.18 | 21.8 | 2.26 | 22.6 | 22.2 |
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**Bump Locations:** Track 1: 1893+53.5

**Certified by:** _____

**Title:** Chief Profilograph Pusher

**Organization:** John Doe Construction Co.

## ATTACHMENT 1

### PROFILOGRAPH REPORT FOR BRIDGE SMOOTHNESS

**Type of Report:**

**____ Information** **____ Initial** **____ Intermediate** **____ Final**

**Contract No.** _____ **Route** _____

**Contractor** _____ **Section No.** _____

**Station** _____ **County** _____

**No. of Lanes** _____ **Structure Number** _____

**Operator** _____ **Traffic Direction** _____

**Engineer** _____ **Date Tested** _____

| Section No. | Length mile (km) | Track 1 Measured Roughness in. (mm) | Track 1 Profile Index in./mile (mm/km) | Track 2 Measured Roughness in. (mm) | Track 2 Profile Index in./mile (mm/km) | Average Profile Index in./mile (mm/km) |
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**Bump Locations:** _____

**Certified by:** _____

**Title:** _____

**Organization:** _____



## ATTACHMENT 2

### SMOOTHNESS ASSESSMENT WORK SHEET

Contract No. _____ Section _____

Route _____ County _____

| Section Number | Structure Number | Final Profile Index | Smoothness Assessment (+ or -) | Accumulated Assessment (+ or -) | Remarks/Final Profile |
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Computed by: _____ Checked by: _____

Approved by: _____