Instructions for Use: These are changes to Section 704 and Section 1001 for bridge deck performance. For use on projects as listed for each district on the spreadsheet entitled “Improved Bridge Deck Performance Pilot Projects 2016” located at P:\penndot shared\Improved Bridge Deck Performance Committee District Surveys\Improved Bridge Deck Performance Pilots. Also include “PTM 528” located in the ECMS File Cabinet as an attachment to the proposal.

HEADER:

b07041 Section 704 and Section 1001

Provision Body:

SECTION 704—CEMENT CONCRETE

- **Section 704.1(b) Material.** Revise to read as follows:

  (b) **Material.**

  - Cement, Type I/II—Section 701
  - Fine Aggregate, Type A—Section 703.1
  - Coarse Aggregate, Type A, Maximum size AASHTO No. 57, unless approved by the District Materials Engineer/District Materials Manager (Stone, Gravel, or Slag)—Section 703.2
  - Water—Section 720.1
  - Admixtures—Section 711.3
  - Pozzolan—Section 724

- **Table A Cement Concrete Criteria.** Revise to read as follows:
### TABLE A
Cement Concrete Criteria

<table>
<thead>
<tr>
<th>Class of Concrete</th>
<th>Use</th>
<th>Cement Factor(3)(5) (lbs/cu. yd.)</th>
<th>Maximum Water Cement Ratio(6) (lbs/lbs)</th>
<th>Minimum Mix(2,9) Design Compressive Strength (psi)</th>
<th>Proportions Coarse(1) Aggregate Solid Volume (cu. ft./cu. yd.)</th>
<th>28-Day Structural Design Compressive Strength (psi)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Min.</td>
<td>Max.</td>
<td></td>
<td>Days</td>
<td>3</td>
</tr>
<tr>
<td>AAAP</td>
<td>Bridge Deck</td>
<td>560</td>
<td>640</td>
<td>0.45</td>
<td>—</td>
<td>3,000</td>
</tr>
<tr>
<td>HPC</td>
<td>Bridge Deck</td>
<td>560</td>
<td>640</td>
<td>0.45</td>
<td>—</td>
<td>3,000</td>
</tr>
<tr>
<td>AAA(4)</td>
<td>Other</td>
<td>634.5</td>
<td>752</td>
<td>0.43</td>
<td>—</td>
<td>3,600</td>
</tr>
<tr>
<td>AA</td>
<td>Slip Form Paving(7)</td>
<td>587.5</td>
<td>752</td>
<td>0.47</td>
<td>—</td>
<td>3,000</td>
</tr>
<tr>
<td>AA</td>
<td>Paving</td>
<td>587.5</td>
<td>752</td>
<td>0.47</td>
<td>—</td>
<td>3,000</td>
</tr>
<tr>
<td>AA</td>
<td>Accelerated Patching(8)</td>
<td>587.5</td>
<td>800</td>
<td>0.47</td>
<td>—</td>
<td>3,750</td>
</tr>
<tr>
<td>AA</td>
<td>Structures and Misc.</td>
<td>587.5</td>
<td>752</td>
<td>0.47</td>
<td>—</td>
<td>3,000</td>
</tr>
<tr>
<td>A</td>
<td></td>
<td>564</td>
<td>752</td>
<td>0.50</td>
<td>—</td>
<td>2,750</td>
</tr>
<tr>
<td>C</td>
<td></td>
<td>394.8</td>
<td>658</td>
<td>0.66</td>
<td>—</td>
<td>1,500</td>
</tr>
<tr>
<td>HES</td>
<td></td>
<td>752</td>
<td>846</td>
<td>0.40</td>
<td>3,000</td>
<td>3,750</td>
</tr>
</tbody>
</table>

Notes 1 and 3 pertain to structure and miscellaneous concrete only.

1. Proportions shown in the table are shown on the reverse side of Form TR 4221-B and are controlled by class of concrete, fineness modulus of fine aggregate (PTM No. 501) and the solids percent in coarse aggregate (PTM No. 617).
2. Test Procedures: Slump—AASHTO T 119; Compressive Strength—PTM No. 604, or Maturity Meter Method—PTM No. 640. The upper age limit and lower age limit are defined by the values listed for 7-day and 28-day compressive strength.
3. For use in miscellaneous or structural concrete, if the Fineness Modulus (FM) is between 2.3 and 2.5, increase the minimum cement factor for the class of concrete 47 lbs/cu. yd. This requirement may be waived after adequate strength data is available and analyzed according to the mix-design section in ACI 211.
4. AAA concrete is not permitted to be used for new bridge decks.
5. For exception, see Section 704.1(c). Cement factor may be increased to a maximum of 690 with the approval of the DME/DMM.
6. If a portion of the cement is replaced by pozzolan, use a water to cement plus pozzolan ratio by weight. The **minimum water cement ratio for AAAP is 0.40 (lbs./lbs.).**
7. For slip form paving, provide coarse aggregate or a blend of coarse aggregate that has a minimum of 35% passing the 1/2-inch sieve. Base these results on the average of three samples, with no single sample result below 30% passing. Conduct testing at the concrete plant according to the QC Plan. Segregated stockpiles may be reworked and retested if material fails to conform to this requirement.
8. For accelerated cement concrete, submit mix design, as specified, Section 704.1(c), having a minimum target value compressive strength of 1,500 pounds per square inch at 7 hours when tested according to PTM No. 604.
9. AAAP trial mixtures are required to produce a minimum 28-day compressive strength of 4,500 pounds per square inch (500 pounds per square inch overdesign).
• Section 704.1(c) Design Basis. Revise to read as follows:

(c) Design Basis.

1. General. Compute and prepare concrete mix designs according to ACI 211. For AAAP mix designs, determine the aggregate gradation for the mix design according to PTM 528. Base concrete mix designs on the materials to be used in the work.

Make trial mixtures for each class of concrete and mold and cure test specimens. If the requirements of Table A cannot be achieved, furnish other acceptable materials or make necessary changes in the mixing procedure to conform to the specified requirements. Notify the District Materials Engineer/District Materials Manager (DME/DMM) at least 3 days in advance of preparing trial mixtures.

At the start of construction, mix a full-sized batch using the type of mixer and the mixing procedure planned for the project. Use this batch to provide the basis for final adjustment of the accepted design.

2. Cement Factor. For all classes of concrete, use the minimum cement factor (cement or cement and pozzolan combined) specified in Table A, except as follows:

If flyash is used, the Portland cement portion may be reduced by a maximum of 15%. If ground granulated blast furnace slag is used, the Portland cement portion may be reduced by a minimum of 25% to a maximum of 50%. If Mechanically Modified Pozzolan-Cement combinations are used, the Portland cement portion may be reduced by a maximum of 50%.

For AAAP cement concrete, replace Type I/II Portland cement with pozzolan (silica fume or flyash or ground granulated blast furnace slag) weighing as much as or more than the Portland cement replaced. The percentages of pozzolan applicable to AAAP concrete are as shown below. Limit pozzolan to not more than two of the three pozzolans listed below in any one mix design as long as one of the pozzolan supplements meets the minimum percentage of replacement.

Cement factor must include at least one of the following as a replacement for a portion of the cement:

- Ground Granulated Blast Furnace Slag (GGBFS) (Grade 100 or higher) 25% (min)
- Fly Ash (Type C or Type F) (Minimum cement content = 510 lb/cy) 15% (min)
- Silica Fume 5%-10%

3. Air Content. Design cement concrete to have an air content of 6.0% in the plastic state. Design AAAP concrete mixes to have an air content of 7.0% in the plastic state. Obtain the air content through the addition of a solution of an air-entraining admixture as specified in Section 704.1(e)4. Use the quantity of air-entraining admixture necessary to maintain the plastic concrete air content, determined according to AASHTO T 152 (DO NOT APPLY AN AGGREGATE CORRECTION FACTOR) for stone and gravel and AASHTO T 196 for slag coarse aggregate, within a tolerance of ± 1.5% during the work. The plastic concrete air content includes entrapped and entrained air.

If the hardened concrete exhibits deficiencies or the Representative suspects the hardened concrete to have deficiencies, and, if directed, determine the percent of entrained air in the hardened concrete according to PTM No. 623. Voids greater than 0.2 mils and less than 40 mils in their smallest dimension are considered entrapped air. Voids 40 mils or more in diameter are considered entrapped air. The entrained air in the hardened concrete must be between 3.5% and 7.5%, inclusive. For AAAP mixes, the entrained air in the hardened concrete must be between 3.5% and 8.5% inclusive.

4. Mix Design Acceptance. Submit a copy of each completed mix design to the Representative before its use in the work. The Department reserves the right to review any design through plant production before its use in Department work at no additional cost to the Department. The concrete design submitted for review is required to comply with the specified concrete class requirements, supported by slump, air content, and compressive strength test data according to ACI 211.

The Department will accept concrete designs on the basis of the 7-day strength tests (Class High Early Strength (HES) may be accepted on the basis of 3-day strength tests); however, conduct 28-day tests to show the potential of
the design mix. The Department may also accept designs based on the 28-day tests.

Design AAAP cement concrete mixtures to achieve slow strength gain. Adjust component proportions with an objective of attaining a 28 day to 7 day compressive strength ratio during design greater than or equal to 1.33. A PennDOT inspector will witness the compressive strength tests. A waiver by the DME/DMM for Section 704.1 Table A for cement factor and/or water cement ratio may be allowed if mix designs using the limits of the Table cannot achieve the 1.33 ratio. The 1.33 ratio is for mix design purposes only and not to be utilized as an acceptance factor during production. In no case will the Department accept any mixture during design which fails to meet a minimum 28 day to 7 day compressive strength ratio less than 1.20.

Additional criteria for mix design acceptance of AAAP concrete are as follows:

- **Maximum Permeability** - Design the concrete mixture to meet a target maximum permeability of 2000 coulombs after a 56 day curing period in accordance with AASHTO T 277.

- **Shrinkage (Microstrain)** - The 28-day shrinkage based on ASTM C 157 is not to exceed 500 microstrain. Wet cure specimens in the lab for 14 days before beginning the 28-day shrinkage testing (42 total days).

A higher class concrete may be used in place of an indicated lower class concrete if the higher class concrete conforms to all of the requirements of the indicated lower class, and if approved by the Department.

- **Section 704.1(d)4.a QC Sampling and Testing of Plastic Concrete.** Revise to read as follows:

4. **QC Testing.** Perform QC testing according to the reviewed QC Plan and as follows:

4.a **QC Sampling and Testing of Plastic Concrete.** Select an appropriate slump value that will provide a workable mix for the construction element. The Contractor’s technician must have a copy of the Department reviewed QC Plan in their possession during testing and must be aware of the target slump for the structural element being placed. Do not exceed the following slump upper limits:

<table>
<thead>
<tr>
<th>Type of Mix</th>
<th>Slump Upper Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>without water reducing admixtures</td>
<td>5 inches</td>
</tr>
<tr>
<td>with water reducing admixtures</td>
<td>6 1/2 inches</td>
</tr>
<tr>
<td>with high range water reducing admixtures</td>
<td>8 inches</td>
</tr>
<tr>
<td>(superplasticizers)</td>
<td>2 1/2 inches</td>
</tr>
<tr>
<td>mixes specified in Section 704.1(h)</td>
<td></td>
</tr>
<tr>
<td>(except tremie concrete as specified in Section 1001.2(j))</td>
<td></td>
</tr>
<tr>
<td>AAAP</td>
<td>5 inches</td>
</tr>
</tbody>
</table>

Perform plastic concrete slump, air, and temperature tests on the first three consecutive trucks at the beginning of concrete placement operations or after a significant stoppage such as plant or equipment breakdown to determine if material control has been established. Material control is established when all test results of concrete slump, air, and temperature for three consecutive trucks are determined to be within the established action points. Obtain samples of fresh concrete according to PTM No. 601. Perform slump tests according to AASHTO T 119, air content tests according to AASHTO T 152 (DO NOT APPLY AN AGGREGATE CORRECTION FACTOR) or T 196 and temperature tests according to ASTM C 1064. Report test data to the concrete technician promptly in order to facilitate necessary changes. Continue testing consecutive trucks until material control is established. Once material control is established, the frequency of testing may be reduced to a minimum of one test per 50 cubic yards. Select concrete batches for sampling according to the reviewed QC Plan or as directed by the Inspector. Notify the Inspector when sampling and QC testing are to be performed. The Inspector will witness the sampling and QC testing. If a QC test fails to conform to the specified requirements or exceeds the upper or lower action points included in the reviewed QC Plan, increase the testing frequency to every truck until material control has been reestablished.

Maintain the cement concrete consistency within 1 1/2 inches of the selected target slump value (target range). If the upper slump limit is exceeded on any slump test, the Contractor’s technician shall reject the cement concrete. If any slump test result falls outside the target range and has not exceeded the upper limit, immediately perform the air content and temperature tests. If the air content and concrete temperature is within the specified limits, the Contractor may incorporate the material into the work provided a full set of quality control and acceptance cylinders are molded in addition to the cylinders made for the originally selected PTM No. 1 sample location, for compressive strength
testing according to PTM No. 611 and PTM No. 604. If one or more truckloads of cement concrete exceeds the slump target range, make additional quality control and acceptance cylinders from each truck. Use the lowest compressive strength cylinders for acceptance of the lot.

Do not incorporate any concrete into the work that does not conform to the specified requirements.

- **Section 704.1(d)4.b QC Compressive Strength Test Cylinders. Revise to read as follows:**

  4.b QC Compressive Strength Test Cylinders. From the same sample of concrete selected for acceptance testing as specified in Section 704.1(d)5, mold a sufficient number of concrete QC cylinders to be tested for 3-day or 7-day compressive strength, 14-day compressive strength (AAAP), 28-day compressive strength, form removal strength, and loading strengths, as specified.

  If using the maturity method to estimate concrete compressive strength, mold two or more cylindrical specimens for temperature history recording and embed a temperature sensor at the vertical and horizontal center of the cylindrical specimen and activate the maturity meter or data acquisition equipment to record the temperature history for the 3-day, 7-day, 14-day (AAAP), 28-day, and, as required, 56-day compressive strength analysis.

  Field cure cylinders according to PTM No. 611, Section 11.2, for the specified curing period. After concrete curing is discontinued, QC cylinders may be relocated to a pre-approved, acceptable, secure area, to protect them from damage. Provide maintenance and security for the area at no additional cost to the Department. The secure area must be easily accessible for inspection at all times. Continue to provide the same field cure and protection from the elements on all surfaces of the cylinders as that provided for the in-place concrete the cylinders represent until the cylinders are tested for compressive strength. Remove cylinders from molds at the same time formwork is removed.

  Perform QC testing for 3-day or 7-day compressive strength, 14-day compressive strength (AAAP), 28-day compressive strength, and form removal and loading strengths according to PTM No. 611. If using the maturity method to estimate concrete compressive strength, perform QC testing using the procedure to estimate in place strength according to PTM. 640. Do not use the maturity method for determining acceptance strength, typically at 28-days. Notify the Inspector when QC testing is to be performed. The Inspector will witness the QC testing.

  Unless otherwise directed, use QC test results for 3-day or 7-day compressive strength and form removal and loading compressive strength to determine whether to place additional concrete in areas that will be impacted by the lot of concrete represented by the QC cylinders. Acceptable QC compressive strength test results do not relieve the Contractor’s responsibility for providing concrete conforming to the 28-day minimum mix design compressive strength acceptance requirements specified in Section 704.1(d)5.

  For AAAP mixes, in addition to the samples required above, mold two concrete cylinders and cure 2 of them under QC conditions for 56 days. After 56 days test the 2 cylinders for compressive strength and report the compressive strengths.

- **Section 704.1(d)4.b.1 3-Day or 7-Day QC Compressive Strength. Revise to read as follows:**

  4.b.1 3-Day or 7-Day or 14-Day (AAAP) QC Compressive Strength. If the 3-day (HES concrete only) or 7-day QC compressive strength test result is greater than or equal to the minimum mix design compressive strength requirement specified in Table A, the Contractor may discontinue the field cure on the lot of concrete represented by the QC cylinders unless otherwise directed. If the 14-Day (AAAP) QC compressive strength test result is greater than or equal to 3,500 pounds per square inch, the Contractor may discontinue the field cure on the lot of concrete represented by the QC cylinders, unless otherwise directed.

  If the 3-day (HES concrete only) or 7-day QC compressive strength test result is less than the minimum mix design compressive strength requirement specified in Table A, continue the field cure on the lot of concrete represented by the QC cylinders until the specified 28-day minimum mix design compressive strength is obtained, or for a maximum of 28 days. If the 14-day (AAAP) QC compressive strength test result is less than 3,500 pounds per square inch, continue the field cure on the lot of concrete represented by the QC cylinders until the specified 28-day minimum mix design compressive strength is obtained, or for a maximum of 28 days.

- **Section 704.1(d)5 Acceptance Testing. Revise to read as follows:**

  5. Acceptance Testing. Determine the lot size, or portion thereof, for partial lots, for material acceptance according to Table B. Establish new lots daily for each class of concrete. Lots must be specific to a particular structural element, except for incidental concrete items. The Contractor may use a lot combining structural elements if allowed in writing before concrete placement and if the following conditions are met:
• The total volume is 100 cubic yards or less.
• The combined structural elements are constructed using the same mix design concrete.
• The combined structural elements are cured using identical curing methods and conditions.

Cylinders (and cores when necessary) for this lot will represent all of the combined elements.

### TABLE B
Lot Size for Concrete Acceptance

<table>
<thead>
<tr>
<th>Construction Area</th>
<th>Lot Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structural Concrete</td>
<td>100 cu. yd.</td>
</tr>
<tr>
<td>Pavement Concrete</td>
<td>500 cu. yd.</td>
</tr>
<tr>
<td>Pavement Patching Concrete</td>
<td>200 cu. yd.</td>
</tr>
<tr>
<td>Incidental Concrete</td>
<td>100 cu. yd.</td>
</tr>
<tr>
<td>Pavement Concrete RPS</td>
<td>Section 506.3(u)</td>
</tr>
</tbody>
</table>

The Representative will select sample locations for acceptance testing according to PTM No. 1 \((n=1)\). Perform sampling and testing for acceptance in the presence of the Representative. Obtain samples of fresh concrete at the point of placement according to PTM No. 601. Perform concrete temperature tests. Perform air content tests according to AASHTO T 196 or T 152. Reject all concrete not conforming to the specification requirements at the point of placement.

If the results of plastic concrete testing conform to the specification requirements, mold a sufficient number of acceptance cylinders according to PTM No. 611 from the same sample of concrete taken for slump, air content, and temperature determination. Standard cure acceptance cylinders according to PTM No. 611, Section 11.1, for 28 days and 56-days (AAAP only) at an acceptable location. Conduct 28-day and 56-day (AAAP only) compressive strength testing of two acceptance cylinders according to PTM No. 604. If for any reason two testable acceptance cylinders are not available for compressive strength testing, obtain two cores of the representative concrete within 3 working days as directed, and at no additional cost to the Department. Conduct 28-day compressive strength testing of the cores according to PTM No. 604.

The Department will accept the lot of concrete when the 28-day acceptance cylinder compressive strength test result is greater than or equal to the 28-day minimum mix design compressive strength specified in Table A and when the 28-day QC compressive strength requirements specified in Section 704.1(d)4.b have been met.

If the 28-day acceptance cylinder compressive strength test result is less than the 28-day minimum mix design compressive strength specified in Table A, acceptance of the concrete lot will be based on the procedures specified in Section 110.10.

### SECTION 1001—CEMENT CONCRETE STRUCTURES

- **Section 1001.2(a) Cement Concrete.** Revise to read as follows:

  (a) **Cement Concrete.** Section 704. The cement factor may be increased to obtain High Early-Strength concrete, with written consent from the Representative. Do not use Type III High Early-Strength, non-air-entraining cement.

- **Section 1001.3(k)6 Bridge Decks.** Revise to read as follows:

  6. **Bridge Decks.** Follow the procedure as specified below:

    6.a **Pre-Placement Meeting.** At least 2 weeks before concrete deck placement, schedule a deck preplacement meeting to review the specification, method and sequence of placing deck concrete, quality control testing, and method of protective measures, to control the concrete evaporation rate.

    6.b **Ambient Conditions During Placement.** Place concrete at a concrete temperature of between 50F and 80F. Do not proceed with mixing and placement operations if the forecasted ambient temperature is
expected to reach 80°F within the scheduled placement time or if the evaporation rate will exceed 0.06 pounds per square foot per hour. Unless otherwise authorized in writing by the District Executive, do not start the placement operation unless the ambient air temperature is a minimum of 40°F and rising and is predicted to stay above 40°F throughout the placement operation.

Water is not allowed to be added to the mix after initial batching. Adjustment of slump may be allowed through the addition of additional water reducer at the job site if a comprehensive procedure detailed in the QC plan has been submitted and approved by the Assistant Construction Engineer for this purpose.

Provide the necessary equipment and determine the evaporation rate before starting deck placement and every hour during the placement. Do not exceed an evaporation rate of 0.06 pounds per square foot per hour.

6.c Finishing Equipment. Have readily available at the bridge deck placement site, all remediation equipment and procedures as submitted, accepted and demonstrated during the dry run before starting the placement. If the evaporation rate in Section 1001.3(k)6.b is exceeded, stop concrete placement until protective measures are taken to reduce the values to an acceptable level.

Fog cure misting is an acceptable method to mitigate an excessive or unexpected evaporation rate. Use high or low pressure equipment equipped with nozzles that atomize droplets and can keep a large surface damp without causing water deposits.

Apply the fog over the entire placement area behind the finishing operation, not covered by wet burlap when the evaporation rate in Section 1001.3(k)6.b is exceeded. Do not leave concrete exposed for an extended duration. Place concrete no greater than 5 feet ahead of finishing machine to prevent premature drying, unless concrete will be finished within 15 minutes.

Use motorized, mechanical finishing equipment capable of applying vibration to the plastic deck surface through the use of a separate attachment from the machine manufacturer or by other means approved by the Representative. Submit a sketch to the Inspector-in-Charge, describing the equipment and showing complete details of supports for the equipment. Vibrating screeds may be used, with the written permission of the District Executive. Vibrating screeds are to be power-vibrated and moved by means of a positive, power-operated apparatus, but are not to be a substitute for high-frequency vibrators. Hand-finishing methods will be allowed outside mechanically screeded areas and to a placed bulkhead in cases of power equipment failures. Use strike-off finishing machines or screeds large enough to finish the full width of deck between curbs or between longitudinal construction joints, or between both.

When strike-off finishing machines are used, support the wheels above the pavement surface on temporary rails, supported on non-deflecting forms or other horizontal structural devices. Support vibrating screeds on temporary pipe guides or on-grade angles. Use adjustable finishing machine supports or vertical supports for screed guides. Fix supports during finishing, at intervals to limit deflection to not more than 1/8 inch in 10 feet. Use supports that are removable to at least 2 inches below the surface with a minimum disturbance of concrete. Fill voids left upon removal of screed guides and supports with nonstaining, nonshrinking mortar, after the deck concrete has reached its initial set.

6.d Concrete Placement and Finishing.

For rigid frame decks, place the concrete from the center of the span toward each leg or abutment simultaneously. Continuously check falsework or supporting beams so the concrete, as placed, meets the lines and grades indicated. Keep wedges and blocking tight during placement of the concrete.

Use a placing sequence as indicated in the contract drawings or as accepted at the pre-placement meeting.

Unless allowed in writing by the District Executive, do not allow truck mixers, truck agitators, or other heavy motorized equipment on the deck spans in which concrete is being placed.

If it is necessary to stop operations, due to weather or operational conditions, provide bulkheads at the work site, and place them as directed. Remove bulkheads before resuming concrete placement operations.

Obtain acceptance of changes or additions to indicated construction joints, before incorporating into the work.

Adjust the deck openings at expansion joints and at expansion dams at the time concrete is placed to provide the openings indicated at 68°F under full dead load.

Do not allow screed or runway supports to bear on the forms, unless direct undersupport is provided to prevent form damage or deflection. Do not discharge concrete near side laps or at midspan of
the corrugated sheets, to a depth greater than 10 inches above the top of the forms. Do not discharge concrete in a manner that causes excessive concentrated construction loads.

Place concrete, at a minimum rate of 20 linear feet of deck per hour, in a longitudinal direction, except for reinforced concrete slabs and rigid frames.

Vibrate the concrete to prevent honeycombing and voids, especially at construction joints, expansion joints, valleys, and ends of form sheets. Obtain acceptance of placing sequences, procedures, and mixes before placing concrete.

Repair or replace damaged material.

Conduct final finishing operations immediately behind the finishing machines or screeds from work bridges of rigid construction, not in contact with the surface of the concrete, set on rails, and easily moved. Finish with a 10-foot, long-handled straightedge to achieve a smooth surface. Make one pass of the float if the concrete surface remains open after the finishing machine operations. Do not overfinish concrete. Use of steel trowels and fresno floats are prohibited.

6.e Concrete curing and testing. Perform straightedge testing and surface correction as specified in Section 501.3(k)3 while the concrete is workable. After completing the straightedge testing and surface corrections, before the concrete becomes nonplastic, texture the surface as specified in Section 501.3(k)4 unless mechanical grooving is specified in the contract. Immediately after texturing operations are completed, perform intermediate curing as per Section 1001.3(p) 3.c.

Cure the deck as specified in Section 1001.3(p)3.b. Maintain wet burlap application within 15 feet behind the finishing equipment at all times. Minimal marking of the concrete is allowed. Following cure, test the surface again, as specified in Section 501.3(o).

If directed to facilitate inspection, remove at least one section of permanent forms, at a location directed, for each span of every bridge in the project. After the deck concrete has been in place for a minimum period of 2 days, test the concrete by sounding with a hammer, where directed. If hollow sounding areas are found, and if directed, remove the forms for the Representative's inspection after the concrete has attained adequate strength. The forms need not be replaced. Repair the adjacent metal forms and supports in order to present a neat appearance. Remove or repair unsatisfactory concrete. Provide facilities for the safe and convenient conduct of the inspection.

- **Section 1001.3(p) Curing and Protection of Concrete. Revise to read as follows:**

  (p) **Curing and Protection of Concrete.** Begin curing as soon as the concrete has been placed and is sufficiently hardened. Cure concrete as specified in Section 1001.3(p) 3.

  Do not count as a curing day, a day on which the curing temperature drops below 50F at any time during that day, except for flood curing of footings. For bridge decks, during the water cure period do not count as a curing day, a day on which the curing temperature drops below 50F. If at any time during the curing period, the curing temperature falls below 35F, the Department will consider the work unsatisfactory and will reject it.

- **Section 1001.3(p)3.a Liquid Membrane-Forming Curing Compound. Revise to read as follows:**

  3.a **Liquid Membrane-Forming Curing Compound.** For surfaces cured by the membrane method, finish before application of the curing compound. During the finishing period, and until forms are removed, protect the concrete by the water method of curing.

  Apply the compound in two coats, by spraying, to provide a continuous, uniform membrane. For each coat, apply at least 1 gallon of compound per 300 square feet of concrete.

  On formed surfaces, apply the first coat immediately after stripping forms, and after acceptance of the concrete finish. If the surface is dry, soak the concrete with water, and apply the curing compound just as the surface film of water disappears. Apply the second application after the first application has set. During spray-curing operations, keep unsprayed surfaces wet with water.

  Apply compound to unformed surfaces immediately after finishing operations have been completed and after the surface film of water has disappeared.

  Do not apply membrane-curing compound to construction joint surfaces. Protect exposed steel during application of curing compounds. Water cure these areas, as specified in Section 1001.3(p)3.b.
If membrane is damaged or membrane peels from concrete surfaces, repair immediately.

For bridge decks, after 14 curing days, if the 14 day QC compressive strength result is greater than or equal to 3,500 pounds per square inch, the Contractor may discontinue the water cure for the lot of concrete represented by the QC cylinders. If the 14 day QC cylinders are less than 3,500 pounds per square inch, continue water curing until the 28 day minimum mix design strength is obtained, or for a maximum of 28 curing days. At the end of the water curing period, remove the wet burlap. Utilize a white liquid membrane within 30 minutes. Spray two coats of white liquid membrane-forming curing compound to the deck concrete. Apply the curing membrane when no free water remains on the surface of the deck, but while the surface is still saturated. Apply each coat of curing membrane according to the manufacturer’s instructions with a minimum spreading rate per coat of 1 gallon per 300 square feet of deck surface. If the deck surface is dry or becomes dry, thoroughly wet it with water applied as a fog spray by means of approved equipment. Spray the second coat after the first application has set and at right angles to the first application. For approach, slabs apply the liquid membrane curing compound after the 7 day water cure.

Protect the curing membrane against damage for a minimum of 7 days. Re-apply an additional coat of curing compound to any damaged areas. Should the curing membrane be subjected to continuous damage, the Representative may limit work on the deck until the 7 day period is complete. Reduction of the 7 day period will not be allowed under any circumstance. For bridge decks placed between September 1 and March 1, utilize polyethylene sheeting in lieu of the white liquid membrane and after the 7 day period is complete apply Boiled Linseed Oil as specified in section 1019.2(a). For all decks placed outside of the September 1 to March 1 time frame do not apply boiled linseed oil to the deck surface.

- **Section 1001.3(p)3.b Water Curing.** Revise to read as follows:

  **3.b Water Curing.** Use a fog-spray, perforated pipe or hose watering system to keep forms and curing covers saturated during the curing period. For curing and protecting covers on endwalls, inlets, manholes, copings, bridge seats, and similar miscellaneous concrete, keep saturated using an acceptable method. Flood curing of concrete footings will be allowed if the water temperature is 40F or above. Provide curing water for bridge decks and approach slabs that is a minimum of 50F for the entire water curing period.

  Use covers of either burlap-backed, white polyethylene sheeting, or a double thickness of burlap. For bridge decks, use only a double thickness of burlap. Use one type of cover for the duration of curing, unless a change in type is accepted or a combination of covers approved by the Representative. Care shall be taken when placing the burlap to minimize marring of the finished deck surface. Secure covers to prevent their being lifted and displaced. Adequately secure the polyethylene sheeting to prevent displacement due to wind. Provide a minimum of 2 feet overlap at all sheet edges. Replace any torn or damaged areas at the direction of the Representative. If burlap or polyethylene sheeting is temporarily removed for any reason during the curing period, use soaker hoses to keep the entire exposed area continuously wet. Replace saturated burlap and polyethylene sheeting as soon as possible.

  Saturate the covers prior to use and keep in a saturated condition for the curing period. Soak the burlap for a minimum of 48 hours before placement. Re-wet the burlap as needed before placement. Apply two layers of wet burlap within 15 feet of strike-off from the finishing machine. Do not allow the surface to dry after strike-off, or at any time during the cure period. During times of delay expected to exceed 10 minutes, cover all concrete that has been placed, but not finished, with wet burlap. Minimal marking of the concrete from the burlap is allowed. Maintain the wet burlap in a fully wet condition using misting hoses, fogging machines that span the entire burlap covered surface, or other approved devices until the concrete has set sufficiently to support foot traffic. At that time, place soaker hoses on the burlap to maintain continuous saturation of all burlap material to the entire deck surface.

  Cure for a minimum of 7 days; cure bridge decks for a minimum of 14 days; when High Early-Strength concrete is used, cure for a minimum of 3 days. Cure approach slabs for a minimum of 7 days. Cure bridge decks for a minimum of 14 days followed by a 7 day liquid membrane cure. Cure according to the procedures submitted and approved at the deck pre-placement meeting. Cure for at least the minimum time stated above and until minimum compressive strengths are attained, as specified in Section 704.1(d)4.b, as determined from molded cylinder specimens tested according to PTM No. 604.

  As soon as the concrete has hardened sufficiently, place curing covers on the exposed concrete. If the double thickness of burlap method is used, place burlap so each strip overlaps one-half its width.

  As soon as forms or sections of forms are loosened or removed, cover the exposed concrete surfaces with pre-saturated curing covers, then keep saturated for the remainder of the curing period.
3.c Bridge Deck Intermediate Curing. For manually textured decks in the plastic state or as directed by the Representative, apply an intermediate monomolecular film curing agent after the finishing operation. If directed, apply additional applications to prevent surface drying before placement of curing covers.

Apply the monomolecular film in a light-fog application, using a pressure spray tank with an adjustable nozzle. Use a water-to-curing agent ratio and rate of application, both according to the manufacturer's recommendations. Agitate the solution before each application.

Apply the monomolecular film in a continuous film, immediately after the final finishing operation is completed on any area. Do not perform finishing after application of the curing agent.

After application of the monomolecular film, complete curing using water.

- Section 1001.3(q)1. Removal of Falsework and Forms. Revise to read as follows:

  (q) Removal of Falsework and Forms and Application of External Loads to Concrete. Except for flood curing of concrete footings, do not count a day during which the curing temperature falls below 50F in the total elapsed days required for removal of falsework or forms or for the application of external loads on concrete.

  1. Removal of Falsework and Forms. Keep falsework and forms under arches, box culverts, pier caps, slabs, beams, girders, and brackets in place for 5 days after placing the final portion of the section involved, after which they may be removed provided the concrete has attained a minimum compressive strength as specified in Table A. Determine the minimum compressive strength according to PTM No. 604 or determine the minimum compressive strength by the maturity method according to PTM No. 640. Cure test cylinders according to PTM No. 611.

  During normal and cool-weather curing, keep forms for walls, columns, outside faces of pier caps, arches, sides of beams, and other vertical faces not sustaining loads, in place for a minimum of 12 hours after completing placement of concrete. Then, remove forms, provided the concrete has hardened enough to preclude damage resulting from form removal. Barrier forms may be removed in less than 12 hours, provided the concrete has hardened enough to preclude damage from form removal. During cold weather curing, keep forms in place for a minimum of 5 days. Do not remove deck forms before the end of the water curing period (removal of burlap), unless approved by the Representative.

  At construction joints, keep bulkheads in place for a minimum of 12 hours after placing concrete. Then, remove bulkheads provided the concrete has hardened enough to preclude damage resulting from removal of the bulkheads. During cold weather curing, keep bulkheads in place for 48 hours, and keep the concrete moist at all times.
Table A
Minimum Compressive Strength

<table>
<thead>
<tr>
<th>Class</th>
<th>Minimum psi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class AAAP</td>
<td>3,000</td>
</tr>
<tr>
<td>Class AAA</td>
<td>3,300</td>
</tr>
<tr>
<td>Class AA</td>
<td>2,750</td>
</tr>
<tr>
<td>Class A</td>
<td>2,500</td>
</tr>
</tbody>
</table>

- **Section 1001.3(q)2.c Live Loads.** Revise to read as follows:

  **2.c Live Loads.** Do not allow diamond grinding and diamond saw grooving equipment or power-operated concrete buggies to cross a deck until 10 days after the deck concrete in a span has been placed and the deck concrete has attained a minimum compressive strength of 3,400 pounds per square inch.
  Do not place the conveyor-belt systems on a deck until 72 hours after the concrete is placed and their weight is uniformly distributed and operation of the system does not damage the deck.
  Do not allow truck mixers, truck agitators, other heavy equipment, construction traffic, or the traveling public on a structure until authorized by the Representative. This authorization will be given as follows:
  
  - A truck mixer not exceeding 5 miles per hour and a slip form paver for barrier will be allowed on the deck for construction of other concrete appurtenances when the concrete in the deck has attained a minimum compressive strength of 3,250 pounds per square inch and after minimum 7 day wet cure. Do not allow more than one truck on the deck at a time in a span or continuous unit for each truck placement occurrence.
  
  - Bridge deck may be opened to traffic after a period of **21** days after placing the last deck concrete and the deck concrete has attained a minimum compressive strength of 3,500 pounds per square inch and all curing has been completed and removed.
    and;
  
  - Do not open to traffic until texturing of the bridge deck has been applied.
    and;
  
  - After a period of 7 days after placing the last barrier concrete and the barrier concrete has attained a minimum compressive strength of 3,000 pounds per square inch.
  
  Do not construct barrier on new decks until 7 days after placing the deck concrete and the deck concrete has attained a minimum compressive strength of 3,250 pounds per square inch.
  Do not allow trucks or heavy equipment to travel within 12 feet of barrier until 7 days after placing the barrier concrete and the barrier concrete has attained a minimum compressive strength of 3,000 pounds per square inch.
  Control speed of trucks, equipment, and the traveling public until barriers have attained a minimum compressive strength of 3,500 pounds per square inch.

- **Section 1001.3(u) Defective Work.** Revise to read as follows:

  **(u) Defective Work.** **At no expense to the Department,** remove and replace concrete that is bulged, uneven, or that shows honeycombing or marks that cannot be satisfactorily repaired. If directed, remove and replace concrete that has not attained the minimum compressive strength. **Repair or replace concrete that exhibits cracks or surface tears, as directed by the Structure Control Engineer.** Use a high molecular weight methacrylate penetrating crack sealer, a low viscosity epoxy resin, or other suitable material to repair the surface cracks and tears.
Submit for review, a detailed Quality Control and Action Plan that includes, at a minimum, the proposed crack sealing material data sheet from the manufacture and conditions for use, including ambient and substrate temperature and moisture conditions. Do not perform any crack sealing before the Quality Control and Action Plan has been reviewed by the Representative.