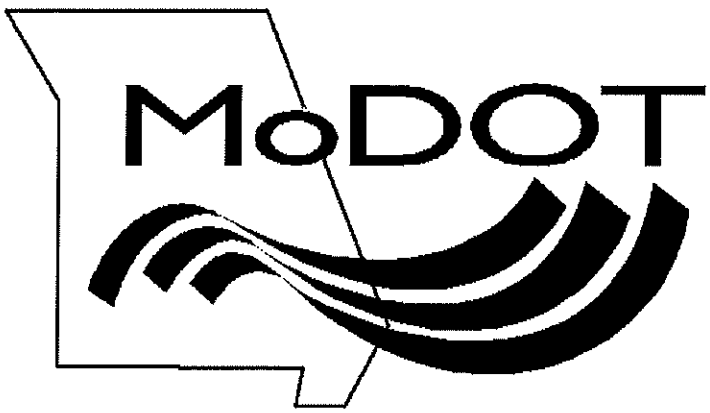
Technician Certification

Low Slump

COURSE CONTENT

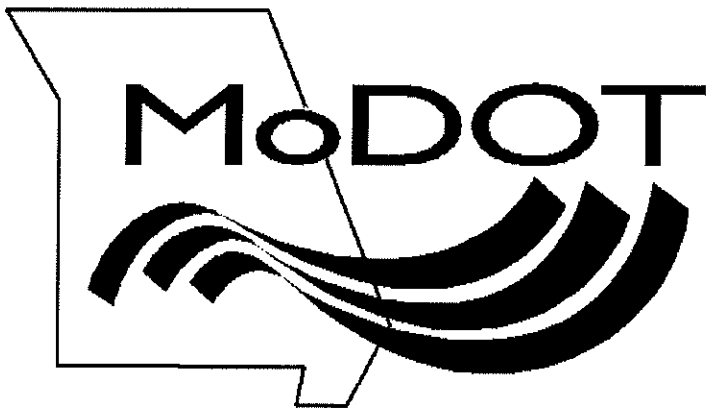
Low Slump Concrete

MoDOT TM 36 Nuclear Density for Concrete Overlays



MoDOT TM 36

Density of Plastic Portland Cement Concrete by Nuclear Gauge



Density of Plastic Portland Cement Concrete by Nuclear Gauge

MoDOT TM 36
AASHTO T 121

Glossary

Plate Glass - glass sufficient in size to cover box with min. 1" over hang on all sides

Steel Box - 27" long x 21" wide x 4" deep (inside min. dimensions), 0.10" min. thick with welded and waterproof joints along with handles for lifting. Boxes built after January 1984 shall be a min. 24" x 24" x 4" of other materials, except wood, as long as dimensions and waterproofing tolerances are met.

Strike off plate - straight steel angle long enough to strike concrete off box; 1/4" thick by 1" by 1" (or larger) angle

Background & Overview

This test method describes a procedure for determining a density correction factor for the nuclear gauge and for determining the in-place density and the percent compaction of plastic portland cement concrete.

MoDOT TM36 4

Precautions

Before operating a nuclear gauge, attendance at a course on gauge operation and safety is required.

Keep gauge between you and the source rod to reduce exposure.

Never touch the source rod with any part of your body!

MoDOT TM36 5

Precautions

At the end of each day's operation, remove the bottom cover plate from the nuclear gauge **PER MANUFACTURER'S INSTRUCTIONS** to assure that no concrete has been carried into the gauge.

MoDOT TM36 6

Precautions

Keep a light coat of oil and graphite on the probe, lead shield, and gauge bottom to prevent concrete from adhering.

Clean the gauge quickly to keep exposure to a minimum.

MoDOT TM36 7

Equipment

- Balance or scales to nearest 0.01 lb.
- Calibrated nuclear gauge
- Steel box & plate glass top
- Square-nose shovel (~ 10" wide)
- Strike-off angle plate
- Calibrated thermometer-1°F increments
- Ruler
- Internal vibrator
- Air pot calibrated for volume (recommended to be 0.25 ft^3 or larger)

MoDOT TM36 8

Procedure for Determining the Volume of the Box

To be determined prior to using box for nuclear correction factor.

Once annually or if box is altered in any way.

Procedure for Determining the Volume of the Box

4.1.1 Weigh the empty water-tight box (W_B) to the nearest 0.01 pound. Weigh the empty box with plate glass in place to the nearest 0.01 pound (W_{BG}). Record both weights.

4.1.2 Fill the box with water, determine the water temperature, then cover with a piece of plate glass to eliminate bubbles and excess water. Weigh the box filled with water and plate glass in place (W_{BGW}) to the nearest 0.01 pound.

MoDOT TM36 10

Procedure for Determining the Volume of the Box

4.1.3 Calculate the volume of the box as shown in paragraph 4.1.13.

4.1.4 Empty the box of water, wipe dry with a cloth.

MoDOT TM36 11

Volume of Box Calculation

4.1.13

$$V_B = \frac{(W_{BGW} - W_{BG})}{W_S}$$

V_B = calibrated volume of box, nearest 0.01 cubic foot.

W_{BGW} = weight of box filled with water and glass plate, nearest 0.01 lb.

W_{BG} = weight of empty box and glass plate, nearest 0.01 lb.

W_S = unit weight of water from following table; interpolate if necessary

MoDOT TM36 12

Unit Weight of Water W_s

Temperature ° F	Pounds Per Cubic Foot
60	62.37
65	62.34
70	62.30
73.4	62.27
75	62.26
80	62.22
85	62.17

MoDOT TM36 13

Sample Temperature Interpolation

What is the Unit Weight of Water (W_S) at 63°F?

W_S = 62.37 pcf at 60°F

W_S = 62.34 pcf at 65°F

W_S change per degree = $\frac{(62.37 - 62.34)}{(60 - 65)} = 0.006$

W_S at 63°F = 62. 37 - (0.006 x 3) = 62.35 pcf

MoDOT TM36 14

Sample Box Volume Calculation

W_S = 60° F water yields 62.37 pcf from chart

W_B = 80.48 lb. empty box

W_{BG} = 105.48 lb. empty box and glass

W_{BGW} = 187.18 lb. box, glass, and water

$$V_B = \frac{(W_{BGW} - W_{BG})}{W_S}$$

$$V_B = \frac{(187.18 - 105.48)}{62.37} = \frac{81.70}{62.37} = 1.3099 \approx 1.31$$

MoDOT TM36 15

Procedure for Determining the Nuclear Correction Factor

To be determined at the start of operations, after any change in materials, mix proportions, mixing procedures, placing procedures, as otherwise specified, or as deemed necessary by the engineer.

Also at least once each day during concrete production.

Procedure for Nuclear Correction Factor

4.1.5 Place the box on a flat, solid and level surface, preferably concrete. Obtain a representative sample of concrete from the mixer discharge.

MoDOT TM36 17

Procedure for Nuclear Correction Factor

4.1.7 Fill the box in 2 equal layers and consolidate by spading from end to end and then side to side, with a square point shovel. When spading the top layer, penetrate into but not through the bottom layer.

MoDOT TM36 18

Procedure for Nuclear Correction Factor

4.1.8 After spading is complete, close the spading by raising one end of the box approximately 3 inches and dropping it. Repeat this until the voids are closed, approximately 4 to 6 times for each end. An internal vibrator may be used in lieu of raising and dropping the box. Since this test is primarily used for low slump concrete, the vibrator is the preferred method.

MoDOT TM36 19

Procedure for Nuclear Correction Factor

Repeat process for both layers.

MoDOT TM36 20

Procedure for Nuclear Correction Factor

4.1.9 Strike off the consolidated concrete with a screeding motion of the strike-off angle. Repeat if necessary to obtain a smooth, voidless surface.

MoDOT TM36 21

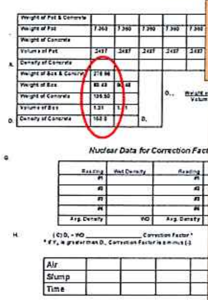
Procedure for Nuclear Correction Factor

4.1.10 Weigh the box full of concrete, to the nearest 0.01 lb. (W_{BC}).

MoDOT TM36 22

MOBILE MIXER VERIFICATION SHEET **Determination of Concrete Density**

Date:
Project:
Route:



$$D_I = \frac{(276.98 - 80.48)}{1.31} = \frac{196.50}{1.31} = 150.0\ pcf$$

$$D_I = \frac{(W_{BC} - W_B)}{V_B}$$

D_I = Density (unit weight) of concrete in the box to the nearest 0.1 pcf.

W_{BC} = Gross weight of box full of concrete

W_B = Weight of box, nearest 0.01 lb.

V_B = Calibrated volume of box, nearest 0.01 CF

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Procedure for Nuclear Correction Factor

Obtain the standard density count per gauge manufacturer's instructions.

Use the "*Marshall*" setting when testing concrete density. This disables the moisture operation of the gauge.

Precaution: Verify the gauge has a thin film of oil on probe and gauge bottom.

MoDOT TM36 24

Procedure for Nuclear Correction Factor

4.1.11 Place the gauge on the concrete approximately the same distance from all sides of the box (center). Pull the gauge slightly toward the scalar end.

MoDOT TM36 25

Procedure for Nuclear Correction Factor

Obtain an average density value (WD_{avg}) to the same depth as the field tests by taking 4 one minute counts by the procedure in paragraphs 4.2.2 to 4.2.8 in this test procedure. Do not move the gauge during this procedure.

MoDOT TM36 26

Procedure for Nuclear Correction Factor

4.1.12 Carefully remove the gauge and using a 24" min. length swab, clean concrete from the source rod and bottom of the gauge.

Note: A garden sprayer with water has been used effectively to aid in cleaning gauge.

MoDOT TM36 27

Procedure for Nuclear Correction Factor

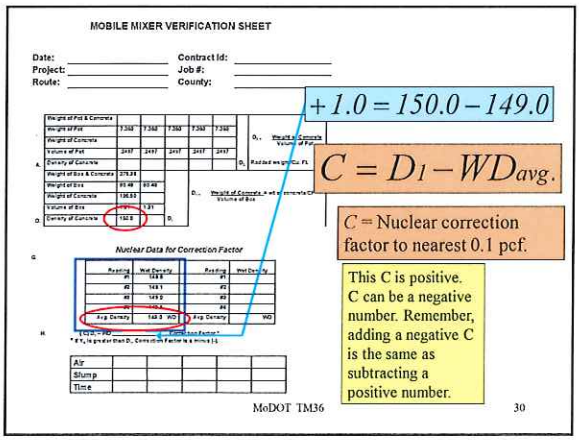
MoDOT TM36 28

Procedure for Nuclear Correction Factor

Perform cleaning process quickly but thoroughly. Any concrete mortar that gets to the interior of the gauge will harden and freeze the source rod to the safe position.

SEE PRECAUTIONS and Section 4.2.7 of this test method.

MoDOT TM36 29



MoDOT TM36 30

Procedure for Determining Standard Density

To be performed at least every two hours of concrete production or any time significant fluctuations occur within the range of air content or slump.

Procedure for Determination of Standard Density

4.2.1 Determine standard density of concrete (D_2) by AASHTO T-121. Fill and vibrate in 2 equal lifts. Insert the vibrator at three different points of each layer.

NOTE: Determine volume of air meter pot using the same procedure as determining the volume of box

MoDOT TM36 32

Procedure for Determination of Standard Density

Do not allow the vibrator to touch the bottom or sides of the pot. In compacting the top layer, the vibrator shall penetrate into the underlying layer approximately 1". Continue vibration only long enough to achieve proper consolidation.

Contractor should provide a vibrator for this purpose.

MoDOT TM36 33

MOBILE MIXER VERIFICATION SHEET

Date: _____
Project: _____
Route: _____

$$D_2 = \frac{(46.70 - 8.56)}{0.2501} = \frac{38.14}{0.2501} = 152.499 \approx 152.5\,pcf$$

$$D_2 = \frac{(Weight\ of\ filled\ pot - Weight\ of\ pot)}{Volume\ of\ the\ pot}$$

Weight of Pot & Concrete	46.70			
Weight of Pot	8.56	8.56	8.56	
Weight of Concrete	38.14			
Volume of Pot	.2501	.2501	.2501	
A. Density of Concrete	152.5			
Weight of Box & Concrete	180.70			
Weight of Box	80.42	80.42		
Weight of Concrete	100.28			
Volume of Box	1.31	1.31		
B. Density of Concrete	154.0		D.	

D. Weight of Concrete ÷ wt. of concrete/CF = Volume of Box

Nuclear Data for Correction Factor

Reading	Wet Density	Reading	Wet Density
#1	143.9	#1	
#2	144.1	#2	
#3	144.3	#3	
#4	143.1	#4	
Avg. Density	143.9 WD	Avg. Density	WD

G.

H. (G.D. - WD _____ Correction Factor *
* If K. is greater than D., Correction Factor is a minus (-).

Air					
Slump					
Time					

MoDOT TM36 34

Determination of In-Place Density

To be determined at a minimum passing test rate of one per 100 yd^2 or three per continuous pour, whichever is greater.

Procedure for Determination of In-Place Density

4.2.3 Select and record test locations immediately behind the finishing machine but prior to texturing and curing operations. Place the nuclear gauge on the plastic concrete surface at the selected location.

MoDOT TM36 36

Procedure for Determination of In-Place Density

4.2.4 Lower the source rod. Ideally the test depth should be such that there is about 0.5" but not more than 1" of plastic concrete between the bottom of the probe and the top of the existing concrete. For example, a 2" thick overlay requires lowering the rod to 1-1/2" depth.

MoDOT TM36 37

Procedure for Determination of In-Place Density

4.2.5 Pull the gauge slightly toward the scalar end; 1/8" to 1/4" maximum.

4.2.6 Obtain a one minute density count.

MoDOT TM36 38

Procedure for Determination of In-place Density

4.2.7 Without retracting the source rod, pick the gauge up and clean concrete from the source rod and bottom of the gauge using 24" minimum length swab.

MoDOT TM36 39

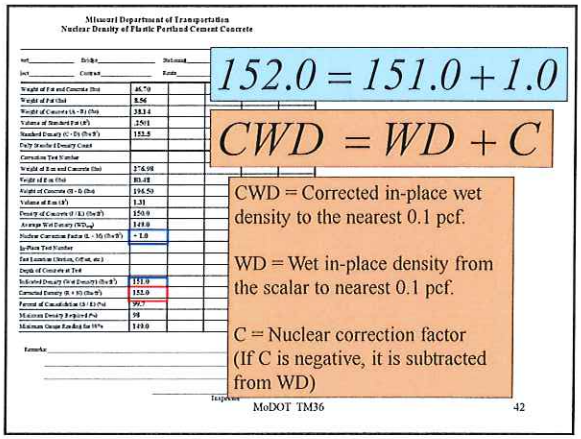
Procedure for Determination of In-place Density

During retraction of the source rod into the gauge, the cleaning ring wipes the rod clean. After the rod is retracted, wipe the bottom of the gauge clean. **SEE PRECAUTIONS** of this test method.

Procedure for Determination of In-Place Density

4.2.8 Using a probe and/or ruler, determine the depth of plastic concrete at the in-place test location.

4.2.9 Obtain the indicated in-place nuclear density value (WD) from gauge (in-place) reading.



Missouri Department of Transportation
Nuclear Density of Plastic Portland Cement Concrete

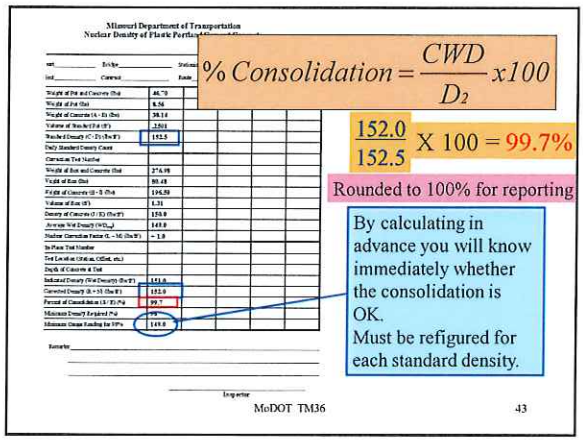
$$152.0 = 151.0 + 1.0$$

$$CWD = WD + C$$

CWD = Corrected in-place wet density to the nearest 0.1 pcf.

WD = Wet in-place density from the scalar to nearest 0.1 pcf.

C = Nuclear correction factor (If C is negative, it is subtracted from WD)



Documentation for Correction Factor

Date

Test Number

Location where concrete sample was obtained (deck location where material would have been placed; remarks on form)

Calibrated volume of the box = V_B; weight of empty box = W_B; weight of box, full of concrete = W_{BC}

Density of concrete in the box = D_1

MoDOT TM36 44

Documentation for Correction Factor

Density Standard Count

Four Nuclear Gauge Density readings and their average = WD_{avg}

Nuclear Correction Factor = C

Report these values on form C-710ND

MoDOT TM36 45

In-place Density Documentation

Date

Test Number

Location of in-place nuclear density

Depth of plastic concrete at test location

Density Standard Count

Indicated Density = WD

MoDOT TM36 46

In-place Density Documentation

Corrected nuclear density = CWD

Percent Consolidation = % SD

Report these values on form C-710ND

MoDOT TM36

106.3.2.36 TM-36, Density of Plastic Portland Cement Concrete by Nuclear Gauge

From Engineering Policy Guide

This test method determines a density correction factor for the nuclear gauge and for determining the in place density and the percent compaction of plastic portland cement concrete.

Contents

106.3.2.36.1 Precautions

Before operating a nuclear gauge, attendance at a course on gauge operation and safety is required.

Never touch the source rod with any part of your body.

At the end of each day's operation, remove the bottom cover plate from the nuclear gauge per manufacturer's instructions to assure that no concrete has been carried into the gauge.

Keep a light coat of oil and graphite on the probe, lead shield and gauge case to prevent concrete from adhering.

106.3.2.36.2 Apparatus

Scale or balance graduated in 0.01 pound, accurate within 0.3 percent of load at any point within the range of use. The range of use shall be considered to extend from the weight of the empty watertight box to the weight of the box filled with concrete weighing approximately 160 pounds per cubic foot.

Box (inside dimensions 27 in. long x 21 in. wide x 4 in. deep). Box should be constructed of steel of 0.10 in. minimum thickness and should have handles for lifting. All joints shall be welded and waterproof. The joint and top rim of the box may have to be reinforced as necessary to prevent distortion

when filled with concrete. The top rim shall be smooth and plane within 0.01 in. and shall be parallel to the bottom within 0.5 degrees. The top rim is satisfactory if a 0.01 in. feeler gauge cannot be inserted between the rim and the plate glass laid over the box. The top and bottom are satisfactorily parallel if the slope between pieces of plate glass in contact with the top and bottom does not exceed one percent in any direction. Boxes built after January 1984 shall be a minimum of 24 in. long x 24 in. wide x 4 in. deep. New boxes may be constructed of other materials, except wood, so long as the requirements for waterproofing and dimension tolerances are fulfilled.

Plate glass of sufficient size to cover the box and have at least one-inch overhang on all sides.

Square point shovel (approx. 10 in. wide).

Strike-off (1/4 in. x 1 in. x 1 in. steel angle or larger), straight and sufficiently long to strike off concrete in the box.

Calibrated thermometer, 1F increments.

Nuclear gauge, calibration standard, calibration charts and manufacturer's instruction manual.

106.3.2.36.3 Procedure

106.3.2.36.3.1 Nuclear Gauge Correction Factor

A correction factor shall be determined at the start of operations, after any change in materials, mix proportions, mixing procedures, placing procedures, as otherwise specified, or as deemed necessary by the engineer.

Weight the watertight box, empty, (W_B) to the nearest 0.01 pound. Weigh empty box with plate glass in place to the nearest 0.01 pound (W_{BG}).

Fill the box with water, determine the temperature of the water, then cover with a piece of plate glass in such a way as to eliminate bubbles and excess water. Weigh the box filled with water and plate glass in place, to the nearest 0.01 pound (W_{BGW}).

Calculate the volume of the box.

Empty the box of all free water, wipe with a cloth if necessary.

Place the box on a flat, solid level surface, preferably concrete.

Obtain a representative sample of concrete from the mixer discharge.

Fill the box in two approximately equal layers. Consolidate each layer by thoroughly spading from end to end and then side to side, with the square point shovel. When spading the top layer, penetrate into but not through the bottom layer.

After spading is complete, close the spading voids by raising one end of the box approximately 3 in. and dropping it. Repeat this procedure for each end until the voids are closed (should be 4 to 6 times for each end). An internal vibrator may be used in lieu of raising and dropping the box.

Strike off the consolidated concrete with a screeding motion of the strike-off. Repeat if necessary to obtain a smooth, voidless surface.

Weigh the box full of concrete, to the nearest 0.01 pound (W_{BC}).

Place the nuclear gauge on the concrete approximately the same distance from all sides of the box and obtain an average density value (W_{Davg}) to the same depth as the field tests by taking four one minute counts by the procedure in Steps 2 through 8 of EPG 106.3.2.36.2.

Carefully remove the gauge and using a 24 in. minimum length swab, clean concrete from the source rod and bottom of the gauge. See EPG 106.3.2.36.1 Precautions and Step 7 of EPG 106.3.2.36.2.

Calculate the volume of box.

$$V_B = (W_{BGW} - W_{BG}) / W_S$$

V_B = Calibrated Volume of Box, nearest 0.01 cubic foot.
W_S = Unit weight of water from following table, interpolate if necessary

Unit Weight of Water	
Temperature, °F	**Pounds per Cubic Foot**
60	62.37
65	62.34
70	62.30
73.4	62.27
75	62.26
80	62.22
85	62.17

Calculate the density of the concrete in the box.

$$D_I = (W_{BC} - W_B) / V_B$$

D_I = Density (unit weight) of concrete in the box to the nearest 0.1 pound per cubic foot.

W_{BC} = Weight of box full of concrete to nearest 0.01 pound.

W_B = Weight of box, nearest 0.01 pound.

V_B = Calibrated volume of box, nearest 0.01 cubic foot.

Calculate the nuclear correction factor.

$C = D_l - W_{Davg}$

C = Nuclear correction factor, nearest 0.1 pound per cubic foot. It is the difference between W_{Davg} and D_l. If W_{Davg} is greater than D_l, the correction factor will be negative. If W_{Davg} is less than D_l, the correction factor will be positive.

D_l = Density of concrete in box to nearest 0.1 pound per cubic foot.

W_{Davg} = Indicated nuclear density to nearest 0.1 pound per cubic foot.

106.3.2.36.3.2 Determination of In-place Density

Step 1 Determine Standard Density of Concrete, D_2, in accordance with AASHTO T121 except that an air meter pot may be used as a measure.

Step 2 Obtain density standard count per manufacturer's instruction.

Step 3 Select and record test locations immediately behind the finishing machine but prior to texturing and curing operations. Place the nuclear gauge on the plastic concrete surface at the selected location.

Step 4 Lower the source rod. Ideally the test depth should be such that there is approximately 0.5 in. but not more than one inch of plastic concrete between the bottom of the probe and the top of the hardened concrete, i.e., for a 2 in. thick overlay lower the rod to 1 1/2 in. depth.

Step 5 Pull the gauge slightly toward the scaler end.

Step 6 Obtain a one-minute density count.

Step 7 Without retracting the source rod, pick the gauge up and clean concrete from the source rod and bottom of the gauge, using 24 in. minimum length swab. During retraction of the source rod into the gauge, the cleaning ring wipes the rod clean. After the rod is retracted, wipe the bottom of the gauge clean. Refer to EPG 106.3.2.36.1 Precautions.

Step 8 Using a probe and ruler, determine the depth of plastic concrete at the in-place test location.

Step 9 Read and obtain the wet density (WD) from the gauge scalar.

Step 10 Calculate the corrected in-place density and percent of standard density.

CWD = Corrected in-place nuclear density to the nearest 0.1 pound per cubic foot.

CWD = WD + C (If C is negative, it is subtracted from WD.)

WD = Indicated nuclear in-place density to nearest 0.1 pound per cubic foot.

C = Nuclear correction factor to the nearest 0.1 pound per cubic foot.

% of Standard Density = (CWD x 100) / D_2

D_2 = Standard density of concrete to nearest 0.1 pound per cubic foot.

Calculate percent standard density to nearest 0.1 percent and round to nearest whole number for reporting.

106.3.2.36.4 Recording

Record the following information in the same field book used for recording Standard Density data:

Correction Factor

1) Date

2) Test Number

3) Location where concrete sample was obtained (deck location where material would have been placed)

4) Calibrated volume of the box. (= V_B)

5) Weight of box (= W_B)

6) Weight of box, full of concrete (= W_{BC})

7) Density of concrete in the box. (D_1)

8) Density Standard Count.

9) Indicated Density (Average of the four WD readings). (W_{Davg})

10) Nuclear Correction Factor (C)

In-Place Density

1) Date

2) Test Number

3) Location of in-place nuclear density.

4) Depth of plastic concrete at test location.

5) Density Standard Count.

6) Indicated density (WD)

7) Corrected nuclear density (CWD)

8) Percent consolidation (% of Standard Density).

106.3.2.36.5 Report

Report Correction Factor items 7–10 and all In-Place Density items on Form C-710ND (REV).

- This page was last modified on 30 June 2010, at 13:29.

SECTION 505

BRIDGE DECK CONCRETE WEARING SURFACE

SECTION 505.10 LOW SLUMP CONCRETE.

505.10.1 Description. This work shall consist of constructing a wearing surface of low slump, dense concrete on a prepared surface in accordance with these specifications, as shown on the plans or as directed by the engineer.

505.10.2 Material. All material shall be in accordance with Division 1000, Material Details, and specifically as follows:

Item	Section
Type I or II Cement	1019
Air-Entraining Admixture	1054
Water Reducing Admixture	1054
Burlap	1055
Polyethylene Sheeting	1058
Water	1070

505.10.2.1 Coarse aggregate shall be an approved crushed limestone, crushed quartzite, flint chat from the Joplin area or porphyry in accordance with Sec 1005.2, Gradation E, except that the sum of percentages of all deleterious substances shall not exceed one percent and the percentage of deleterious substances shall not exceed the following values:

Item	Percent by Weight
Deleterious Rock	1.0
Shale and Pyrite	0.2
Chert in Limestone	0.5
Other Foreign Material	0.1

505.10.2.2 Gradation D may be used when the plan thickness of the bridge deck overlay is 3 inches or greater.

505.10.2.3 Fine aggregate shall be in accordance with Sec 1005.3 and shall be Class A sand in accordance with Sec 501.

505.10.2.4 Pozzolanic material or Portland pozzolan cements shall not be used.

505.10.3 Concrete Mixture.

505.10.3.1 The contractor shall submit a mix design to Construction and Materials meeting the following properties:

Property	Requirement
Air Content, percent (minimum)	5.0
Slump, inches	1/2 ± 1/2
Percent Fine Aggregate as Percent of	50

Total Aggregate by Absolute Volume	
Cement Content, lbs./cubic yard	818 to 827

505.10.3.2 The cement content and percent fine aggregate shall not be changed. If total mixing water, including free water in aggregate and liquid admixtures, varies from design mixing water to cause a change in batch volume of more than two percent, a new mix design will be required.

505.10.3.3 A Type A water-reducing admixture will be required.

505.10.3.4 During placement, the mixture shall be compacted to no less than 98 percent of the standard density.

505.10.4 Testing.

505.10.4.1 Slump will be determined in accordance with AASHTO T 119. The sample for slump testing will be taken at the point of placement in the structure.

505.10.4.2 Air content will be determined by the pressure method in accordance with AASHTO T 152.

505.10.4.3 When required, standard density, unit weight, will be determined in accordance with AASHTO T 121. Standard density will be determined for at least each two hours of concrete production or any time significant fluctuations occur within the range of air content or slump.

505.10.4.4 Compressive strength will be determined from at least two 6- by 12- inch cylinders or from at least three 4- by 8- inch cylinders prepared in accordance with AASHTO T 23 and tested in accordance with AASHTO T 22. One set consisting of two cylinders will be made for 28-day compressive strength from each day's production. Cylinders made for determining when to permit traffic will be made at a frequency determined by the engineer, and will be cured in the near vicinity and in the same manner as the bridge deck.

505.10.4.5 Concrete taken as a sample for testing slump and air content shall be wasted and shall not be placed in the deck. If air content or slump test results are not in accordance with specifications, any concrete represented by those tests and any concrete in the mixer chute shall be wasted, and the necessary adjustments shall be made in the mix design or proportioning devices.

505.10.4.6 When concrete density is specified, in-place density of plastic concrete will be determined in accordance with MoDOT Test Method TM 36. In-place density will be determined at a minimum passing test rate of one per 100 square yards or three per continuous pour, whichever is greater. A nuclear gauge correction factor will be determined at least once for each day of concrete production. Work bridges spanning the plastic concrete shall be provided by the contractor to permit performing nuclear density tests.

505.10.5 Mixing.

505.10.5.1 Concrete shall be mixed in accordance with Sec 501.

505.10.5.2 Mixing time for rotating paddle type mixers shall be a minimum of 60 seconds after all ingredients have been added. All batches shall be mixed approximately the same length of time. Material for a batch of concrete shall not be placed in the mixing drum until the material for the previous batch has been discharged.

505.10.6 Surface Preparation.

505.10.6.1 On new concrete decks, the surface shall be given a very rough texture while still plastic by use of a wire comb or other approved texturing device which will produce a bondable surface acceptable to the engineer.

505.10.6.2 On old existing concrete decks with existing wearing surfaces, the wearing surface shall be removed in accordance with Sec 216. On existing concrete decks without existing wearing surfaces, the surface shall be scarified in accordance with Sec 216.

505.10.6.3 The textured or scarified deck shall be sandblasted followed by an air blast. The sandblast shall remove all dirt, oil and other foreign material, as well as any unsound concrete or laitance from the surface and edges against which new concrete is to be placed. The compressor shall be equipped to prevent oil in the air supply. That portion of the curb and previously placed overlays against which new concrete is to be placed shall be sandblasted. Any loose or foreign material detected on the concrete surface prior to placement of the overlay shall be removed by sand or air blasting. The concrete surface may require retexturing where penetration of foreign material is evident. No contamination of the retextured or scarified concrete surface will be permitted.

505.10.6.4 To assure that the thickness of the concrete overlay above the prepared surface will be as specified on the plans, the clearance shall be checked in the following manner before concrete is placed. A filler block having a thickness 1/8 inch less than the overlay thickness shall be attached to the bottom of the screed. With screed guides in place, the screed shall be passed over the area to be concreted. Where the intended clearance does not allow use of this method, a stringline or other means shall be used, subject to approval from the engineer. All old concrete that does not have sufficient clearance shall be removed.

505.10.7 Finishing Equipment.

505.10.7.1 The finishing machine shall be designed for striking off and finishing low slump concrete overlay. The machine shall be mechanically powered to operate forward and reverse in a smooth manner, under positive control of the operator. The basic machine shall be of a width to finish a basic 12-foot width of overlay and shall be adjustable for wider placements. The finishing machine shall be designed to allow the screeds to be extended with bolted units to match the extension of the basic unit. The drive wheels shall be of the type that may be replaced with solid rubber wheels to permit travel upon previously completed lanes of overlay when striking off the abutting lanes.

505.10.7.2 The finishing machine shall be equipped with two oscillating transverse screeds. The screeds shall oscillate in a straight line. A swinging pendulum stoke shall not be used. The front screed shall vibrate uniformly for the full length of the screed. The vibrators shall be placed such that the screed vibrates efficiently and the frequency of the vibrators shall be controlled by the operator from the console to achieve the required density.

505.10.7.2.1 Screeds shall be held positive to the machine with rollers and, unless otherwise approved by the engineer, shall be equipped with screed guides such as to control the profile grade of the finished overlay. The screed stroke shall be synchronized to speeds not exceeding 50 strokes per minute, with infinite variable control from the console. The screeds shall be capable of vertical lift when the machine is reversed for travel, and controlled for downward direction to the finishing position to permit feathering of the screeds to any previously finished surface.

505.10.7.2.2 The bottom face of the screeds shall be at least 5 inches wide, with an effective pressure to produce no less than 75 psf. The bottom face of the screeds shall have a turned up leading edge to prevent tearing of the screeded surface and shall be adjustable for tilt and crown. The screed lengths shall be such to produce positive strike off and density of the concrete for at least 6 inches beyond the line where the saw cut for the longitudinal joint is to be made and to within one inch of the curb reinforcing steel or face of any curb barrier already in place.

505.10.7.3 The machine shall be equipped with a mechanically-powered adjustable auger positioned in front of the lead screed. The strike-off shall travel back and forth for the full width to be screeded and shall be properly designed to meter the concrete to the screeds.

505.10.7.4 Heavy duty support rails shall be used to support the finishing machine. Support rails shall be adjustable and the rail shall not deflect more than 1/32 inch between adjustable supports. Support rails shall be placed outside the area and parallel to axis of the area to be concreted. Support rails shall extend a sufficient distance beyond the end of the deck to allow the finishing machine to be completely removed from the deck surface such that hand finishing may proceed without interruption. The support rails shall be set to produce the final profile grade of the surface of the overlay. A hold-down device shot into the concrete will not be permitted unless the concrete is to be subsequently resurfaced. The proposed method of anchoring the support rails shall be submitted to the engineer for approval.

505.10.8 Placing and Finishing Concrete.

505.10.8.1 A lateral support for the concrete such as 2 x 4-inch lumber attached to the deck will be required at least 6 inches beyond the line where the saw cut for the longitudinal joint is to be made.

505.10.8.2 In order to avoid locating the longitudinal construction joints in a wheelpath, the joints shall be placed between the designated traffic lanes. The location of the longitudinal joints shall be subject to the approval from the engineer.

505.10.8.3 At transverse and longitudinal joints, the surface course previously placed shall be sawn to a straight vertical edge before the adjacent course is placed.

505.10.8.4 Transverse joints in the overlay will be permitted if approved by the engineer. These joints shall be located a minimum of 10 feet from the centerline of bent.

505.10.8.5 The contractor shall take every reasonable precaution to secure a smooth riding bridge deck. Prior to placement operations, the contractor shall review with the engineer, equipment, procedures, personnel and previous results as well as inspection procedures to assure coordination. The contractor shall take every reasonable precaution to ensure that concrete can be produced and placed within the specified limits, continuously and with uniformity.

505.10.8.6 The areas of half-sole and full-depth repair shall have individual concrete placement up to bottom of the low slump concrete wearing surface.. These individual placements shall remain rough and shall be completed before the overlay course is started. Areas of half-sole, full-depth repair and all other patched areas shall be surface dried, sandblasted and cleaned prior to the placement of low slump concrete wearing surface.

505.10.8.7 Prior to placement of low slump concrete, the cleaned surface shall be thoroughly wetted for a minimum of three hours, then covered with polyethylene sheeting until the time

of concrete placement. The surface shall be damp at the time the overlay is placed. Any standing water in depressions, holes or areas of concrete removal shall be blown out with compressed air. No free water or puddles of standing water shall exist at the time of placement.

505.10.8.8 The wheels of rubber wheeled vehicles or transport containers for the concrete shall not be permitted to contact any portion of the existing concrete surface prior to placement of the concrete. Protection shall be provided for the concrete surface by means of plywood, mats or other suitable material placed on the surface. Any loose or foreign material or rubber marks accidentally deposited on the surface shall be removed by the contractor prior to low slump concrete placement.

505.10.8.9 Placement of the concrete shall be a continuous operation throughout the pour. Only the minimum amount of concrete necessary for proper placement shall be placed in front of the screeds. If the concrete paver is stopped for any reason, all plastic concrete in front of the paver shall be covered with wet burlap. Concrete shall be poured and finished at a minimum of 2.5 cubic yards per hour for a 12-foot wide pour, except when the contractor elects to pour a wider section, the rate of pour shall be increased proportionately. When concrete is being mixed and placed at the specified minimum rate under normal operations, the finishing machine shall be designed such that the elapsed time between depositing the concrete on the deck and final screeding shall not exceed 10 minutes.

505.10.8.10 If concrete is added to the overlay behind the finishing machine, the area shall be mechanically consolidated again by the finishing machine.

505.10.8.11 After finishing, the contractor shall check the surface with a lightweight 10-foot straightedge. Causes for irregularities exceeding 1/8 inch shall be eliminated and corrections shall be made.

505.10.8.12 The roadway surface finish shall be in accordance with Sec 703.3.5.5. The texture shall not extend into the areas within approximately 12 inches of curbs.

505.10.8.13 After texturing the concrete surface, but before applying the wet cure, all vertical joints with the adjacent concrete shall be sealed by painting with thinned grout consisting of equal parts cement, sand and sufficient water for the mixture to be the consistency of paint.

505.10.8.14 After the joint painting is completed, the freshly placed lane and joint shall be promptly covered with a single layer of clean, wet burlap. Care shall be exercised to ensure that the wet burlap is well drained and that the burlap is placed as soon as the surface will support the burlap without deformation.

505.10.8.15 The wet cure shall be applied within 30 minutes after the concrete has been placed on the deck, except when the surface will be excessively marred by doing so, as determined by the engineer. If the concrete requires refinishing because of failure to meet density requirements, the time will be extended 15 minutes. Failure to apply wet cure within the required time will be cause for rejecting the work affected. Surface concrete in the rejected area shall be removed and replaced by the contractor at the contractor's expense.

505.10.8.16 The surface shall receive a wet cure of at least 72 hours.

505.10.8.17 After placement and cure of the low slump concrete, the finished deck will be tested to detect unbonded areas.

505.10.8.18 As soon as curing has been completed, the riding surface will be thoroughly straightedged by the engineer and all variations exceeding 1/8 inch in 10 feet will be plainly

marked. Areas more than 1/8 inch high shall be removed by an approved device consisting of multiple cutting edges leaving a grooved surface finish comparable to that produced by the texturing device. A bush hammer or other impact device shall not be used.

505.10.8.19 The surface of low slump concrete shall be sealed in accordance with Sec 703.3.8 and payment for furnishing and placing shall be included in the contract unit price for other items.

505.10.9 Limitations of Operations.

505.10.9.1 Vehicle traffic shall not be permitted on the low slump concrete surface for 72 hours and until 3,000 psi compressive strength is attained.

505.10.9.2 No low slump concrete shall be placed at ambient temperatures below 45 F or above 85 F. Concrete placement may begin when the air temperature and deck temperature is 45 F and rising. Concrete shall not be exposed to freezing temperatures until a strength of 3,000 psi has been attained. Any concrete damaged by freezing shall be removed and replaced at the contractor's expense.

505.10.9.3 When the weather forecast predicts temperatures of 85 F or higher, the contractor shall schedule placing and finishing low slump concrete during hours in which the ambient temperature will be lower than 85 F. The mixed concrete when placed shall have a maximum temperature of 90 F.

505.10.9.4 Concrete shall not be placed adjacent to a parallel surface course that is less than 72 hours old. This restriction will not apply to a continuation of placement in a lane or strip beyond a joint in the same lane or strip.

505.10.9.5 Preparation of the area may be started in a lane or strip adjacent to a newly placed surface the day following placement of the new surface. If this work is started before the end of the 72-hour curing period, the work shall be restricted as follows:

(a) Sawing or other operations shall interfere with the curing process for the minimum practical time only, in the immediate work area only, and the curing shall be resumed promptly.

(b) No power-driven tools heavier than 15 pounds shall be used.

(c) Air compressors shall be operated on the deck only directly over the piers.

(d) No loads other than construction equipment shall be permitted on any portion of the bridge floor that has undergone preparation prior to placement and curing of new concrete.

505.10.10 Removal. All material removed shall be disposed of by the contractor at the contractor's expense in a location meeting the approval of the engineer.

505.10.11 Repair.

505.10.11.1 Unbonded areas will be marked by the engineer. The contractor shall saw cut and remove the affected area. All saw cuts shall be straight vertical lines and form square corners at all changes in direction. After removal of the concrete, the surface of the area to be repaired and vertical saw cuts shall be cleaned of all loose or foreign material by sandblasting and then air blasting. The surface shall be comparable to the original concrete surface prior to the original overlay being placed.

505.10.11.2 The concrete used for repair shall meet the same requirements as the original mixture. The concrete shall be vibrated with a surface or pan-type vibrator to obtain compaction. Spud type vibrators shall not penetrate to contact with the original concrete. Surface finish and curing shall be in accordance with the specifications for the mixture used.

505.10.12 Method of Measurement. Final measurement will not be made except for authorized changes during construction or where appreciable errors are found in the contract quantity. The area of concrete wearing surface will be measured and computed to the nearest square yard. This area will be measured longitudinally from end to end of bridge deck and transversely between roadway face of curbs, excluding from measurement the area of drains and expansion devices. The revision or correction will be computed and added to or deducted from the contract quantity.

505.10.13 Basis of Payment. Payment for the above described work shall be considered completely covered by the contract unit price per square yard of concrete wearing surface.

SECTION 505.20 LATEX MODIFIED CONCRETE.

505.20.1 Description. This work shall consist of constructing a wearing surface of latex modified concrete on a prepared surface in accordance with these specifications as shown on the plans or as directed by the engineer.

505.20.2 Material. All material shall be in accordance with Division 1000, Material Details, and specifically as follows:

Item	Section
Type I or II Cement	1019
Latex Emulsion Admixture	1054
Polyethylene Sheeting	1058
Water	1070

505.20.2.1 Aggregate shall be in accordance with Sec 505.10.2.

505.20.2.2 Pozzolanic material or Portland pozzolan cements shall not be used.

505.20.2.3 Latex admixture shall be kept in a suitable enclosure that will protect the admixture from freezing and from exposure to temperatures in excess of 85 F. Drums of latex admixture to be stored at the work site in direct sunlight shall be completely covered with a suitable insulating blanket material to maintain an enclosed temperature below 85 F.

505.20.3 Concrete Mixture.

505.20.3.1 The contractor shall submit a mix design to Construction and Materials meeting the following requirements:

Property	Requirement
Air Content, percent	0 to 6.5
Slump, inches	4 to 6
Percent Fine Aggregate as percent of Total Aggregate by Absolute Volume	50 to 55
Cement Content, lbs./cubic yard min.	658
Latex Emulsion Admixture, gallons/cubic yard. min.	24.5

Net Water/Cement Ratio, max., lbs.[a] water/lbs. cement	0.40

[a] Net water shall be considered the quantity of mixing water added, plus the non-solid portion of the latex emulsion.

505.20.3.2 Any change in mix design or proportions shall be approved by the engineer.

505.20.3.3 Anti-foam additives, as recommended by the latex emulsion manufacturer, may be required if the concrete mixture entrains air above the specified amount.

505.20.3.4 Air-entraining admixtures shall not be added.

505.20.4 Testing. Testing will be done in accordance with Sec 505.10.4, except the slump test will be conducted 4 to 5 minutes after discharge from the mixer. During the waiting period, concrete shall be deposited on the deck and shall not be disturbed.

505.20.5 Mixing.

505.20.5.1 The concrete shall be volumetrically mixed at the bridge site by a continuous mixer in accordance with Sec 501. In addition to other requirements, the mixer shall provide positive control of the latex emulsion into the mixing chamber and the latex emulsion shall calibrate to within ± 2 percent of that required. The mixer shall be capable of continuously circulating the latex emulsion and shall have a flow-through screen between the storage tank and the discharge.

505.20.5.2 The concrete discharged from the mixer shall be uniform in composition and consistency. Mixing capability shall be such that initial and final finishing operations can proceed at a steady pace. Final finishing shall be completed before the formation of a plastic surface film.

505.20.5.3 The moisture content of aggregate at the time of proportioning shall be such that water will not drain or drip from a sample. Coarse and fine aggregate shall be furnished and handled to avoid variations in the moisture content affecting the uniform consistency of the concrete.

505.20.5.4 Each drum of latex admixture shall be mechanically agitated or hand rolled until thoroughly mixed prior to being introduced into the mixer storage compartment. Latex admixture that is stored in the mixer storage compartment overnight or during delays in mixing of four hours or more shall be agitated by at least two complete cycles in a continuous circulating pump or by mechanical means in the storage compartment. The flow through screen shall be cleaned immediately prior to beginning proportioning and as often as necessary thereafter. Latex admixtures of different brands shall not be combined together in any manner.

505.20.6 Surface Preparation. Surface preparation shall be in accordance with Sec 505.10.6 except as specified herein.

505.20.6.1 Prior to scarifying or chipping on concrete adjacent to latex modified concrete, 96 hours of curing shall elapse. If practical, all scarifying by mechanical units shall be completed prior to placing any latex modified concrete, unless otherwise shown on the plans. Areas from which unsound concrete and patches have been removed shall be kept free of slurry produced by wet sawing or wet scarifying by planning the work such that this slurry will drain away from the completed areas of preparation.

505.20.6.2 On both old and new decks, within 24 hours prior to placing latex modified concrete, the entire surface shall be thoroughly cleaned by sandblasting followed by an air blast.

505.20.7 Finishing Equipment.

505.20.7.1 The finishing machine shall be self-propelled and shall be capable of forward and reverse movement under positive control, with a provision for raising all screeds to clear the screeded surface for traveling in reverse. A self-propelled finishing machine with one or more rollers, augers and 1,500 to 2,500 vpm vibratory pans shall be used. A drag float may be necessary. Any modifications will be subject to approval from the engineer.

505.20.7.2 Support rails shall be in accordance with Sec 505.10.7.4.

505.20.8 Placing and Finishing Concrete. Placing and finishing shall be in accordance with Sec 505.10.8 except as specified herein.

505.20.8.1 Prior to placement of latex modified concrete, the cleaned surface shall be thoroughly wetted for a minimum of three hours, then covered with polyethylene sheeting until time of concrete placement. The surface shall be damp at the time the overlay is placed. Any standing water in depressions, holes or areas of concrete removal shall be blown out with compressed air. No free water or puddles of standing water shall exist at the time of placement.

505.20.8.2 Expansion joints and dams shall be formed in the concrete overlay. Formation of the joint by sawing through the overlay will not be permitted.

505.20.8.3 Texturing shall occur immediately after finishing and before the plastic film forms on the surface. Texturing shall be performed in a manner to prevent pulling the concrete away from an existing vertical face. Care shall be taken not to texture too deep and not to tear the surface.

505.20.8.4 Screed rails and headers shall be separated from the newly placed material by passing a pointing trowel along the inside face. Metal expansion dams shall not be separated from the overlayment. The trowel cut shall be made for the entire depth and length of rails or headers after the mixture has stiffened sufficiently and shall prevent the concrete from flowing back into the cut.

505.20.8.5 During placement of the overlay, all joints with adjacent concrete shall be sealed with a mortar paste of equal parts cement and fine aggregate, using latex emulsion in lieu of mixing water.

505.20.8.6 The wet cure shall be applied promptly after the concrete has been placed on the deck without deforming the finished surface.

505.20.8.7 The surface shall receive a wet cure for at least 48 hours.

505.20.8.8 After placement and cure of the latex modified concrete, the finished deck will be tested to detect unbonded areas.

505.20.8.9 No surface sealing shall be applied to the latex modified concrete wearing surface.

505.20.9 Limitations of Operations.

505.20.9.1 No latex modified concrete shall be placed when the ambient or deck surface temperature is above 85 F. Deck temperature shall be determined in accordance with MoDOT Test Method TM 20.

505.20.9.2 No latex modified concrete shall be placed at ambient or deck surface temperatures below 45 F. Latex modified concrete shall be protected to maintain a minimum specified curing temperature of 45 F. Any concrete damaged by freezing or that is exposed to a temperature of less than 45 during the first 8 hours after placement shall be removed and replaced at the contractor's expense.

505.20.9.3 The temperature of the latex modified concrete at time of placement shall be between 45 F and 90 F. If either the aggregate or water is heated, the maximum temperature for each shall be 100 F at the time of addition to the mix. Any method of heating during the mixing of concrete may be used provided the heating apparatus will heat the mass uniformly and avoid hot spots that will burn the material. Cement or aggregate containing lumps or crusts of hardened material or frost shall not be used.

505.20.9.4 No vehicular traffic shall be permitted on the latex modified concrete surface until the concrete is at least 96 hours old and has attained a minimum compressive strength of 3,000 psi.

505.20.9.5 Concrete shall not be placed adjacent to a parallel surface course that is less than 96 hours old; however, this restriction will not apply to a continuation of placement in a lane or strip beyond a joint in the same lane or strip.

505.20.9.6 Preparation of the area, except scarifying, may be started in a lane or strip adjacent to a newly placed surface the day following the surface placement. If this work is started before the end of the 48-hour wet curing period, the work will be restricted such that any interference with the curing process is held to the minimum practical time.

505.20.9.7 Longitudinal construction joints shall be placed between designated traffic lanes. The location of the longitudinal joints will be subject to the approval from the engineer.

505.20.9.8 Transverse joints in the overlay may be permitted if approved by the engineer. These joints shall be located a minimum of 10 feet from the centerline of bent.

505.20.9.9 A header shall be installed in case of delay in the placement operations exceeding one-half hour in duration. During minor delays of one-half hour or less, the end of the placement shall be protected from drying with several layers of wet burlap.

505.20.9.10 Adequate precautions shall be taken to protect freshly placed concrete from rain. All placing operations shall cease when rain begins. The engineer may order removal of any material damaged by rainfall and such material shall be replaced in accordance with these specifications at the contractor's expense.

505.20.10 Removal. Material removal and disposal shall be in accordance with Sec 505.10.10.

505.20.11 Repair. Repair shall be in accordance with Sec 505.10.11.

505.20.12 Method of Measurement. Measurement of latex modified concrete will be in accordance with Sec 505.10.12.

505.20.13 Basis of Payment. Payment for latex modified concrete will be made in accordance with Sec 505.10.13.

505.30.12 Method of Measurement. Measurement of silica fume concrete will be in accordance with Sec 505.10.12.

505.30.13 Basis of Payment. Payment for silica fume concrete will be made in accordance with Sec 505.10.13.

SECTION 505.40 LATEX MODIFIED HIGH EARLY STRENGTH CONCRETE.

505.40.1 Description. This work shall consist of a wearing surface of latex modified high early strength concrete constructed on a prepared surface in accordance with this specification and in accordance with lines, grades, thickness and typical cross sections shown on the plans or as directed by the engineer.

505.40.2 Material. All material shall be in accordance with Sec 505.10, Division 1000, Materials Details and specifically as follows:

Item	Section
Latex Emulsion Admixture	1054
Polyethylene Sheeting	1058
Water	1070

505.40.2.1 With approval of the engineer, a Type HE high-early-strength cement, in accordance with ASTM C 1157, may be used. Type III cement will not be permitted.

505.40.2.2 Coarse aggregate shall be an approved crushed limestone, crushed quartzite, flint chat from the Joplin area, or porphyry in accordance with Sec 1005, Gradation E or Gradation F, except the percentage of deleterious substances shall not exceed the following values, and the sum of percentages of all deleterious substances shall not exceed one percent.

Item	Percent by Weight (Mass)
Deleterious Rock	1.0
Shale and Pyrite	0.2
Chert in Limestone	0.5
Other Foreign Material	0.1

505.40.2.3 Fine aggregate shall be in accordance with Sec 1005 and shall be Class A sand in accordance with Sec 501.

505.40.2.4 With approval of the engineer, other gradations of coarse or fine aggregate may be used, however all quality requirements, including a maximum of 2.0 percent passing the No. 200 for fine and coarse aggregate, shall apply and the maximum aggregate size shall not exceed that of Sec 1005, Grade E aggregate.

505.40.2.5 Pozzoloanic material or Portland pozzolan cements shall not be used.

505.40.2.6 Latex admixture shall be kept in suitable enclosures which will protect it from freezing and from exposure to temperatures in excess of 85 F.

505.40.3 Concrete Mixture.

505.40.3.1 The concrete mixture shall meet the following requirements:

Property	Specific Value
Air Content percent	0 to 6.5
Slump, inches	3 to 6
Percent Fine Aggregate as percent of total aggregate by weight	50 to 55
Cement Content, lb/cu yd min.	658
Latex Emulsion Admixture, gal/cu yd	24.5
Net Water-Cement Ratio, max. Lbs.[a] of water/lbs. of cement	0.40

[a]Net water shall be considered the quantity of mixing water added plus the non-solid portion of the latex emulsion.

505.40.3.2 Chloride permeability shall not be greater than 1000 coulombs when tested in accordance with AASHTO T 277. Tests shall be performed on specimens at 28-days. This test shall be performed on each mixture submitted for approval. The tests are to be performed by a qualified commercial laboratory.

505.40.3.3 The mixture shall be designed to develop a minimum 28-day compressive strength of 4,500 psi.

505.40.3.4 Anti-foam additives as recommended by the latex emulsion manufacturer may be required if the concrete mixture entrained air is above the specified amount.

505.40.3.5 Air-entraining admixtures shall not be added.

505.40.3.6 A set control in accordance with the cement manufacturer's recommendation may be considered.

505.40.3.7 Admixtures containing calcium chloride shall not be used.

505.40.4 Mix Design. The contractor shall submit the mix design to Construction and Materials for approval. The mix design shall be within the limits specified in this provision. The mix design shall also include actual test results for the following information:

(a) Air.

(b) Slump.

(c) Compressive strengths at 4-hours, 8-hours, 12-hours, 24-hours, 7-days and 28-days. Compressive strengths determined using 6 x 12 inch cylinders.

(d) Results of chloride permeability testing.

505.40.4.1 If other aggregate gradations than standard specifications are utilized, the contractor shall designate the intended target gradation and allowable gradation range for each fraction. The target gradations and allowable gradation ranges will be used for inspection and quality control of the aggregates.

505.40.4.2 Any change in mix design or proportions shall be approved by the engineer.

505.40.5 Testing. Testing will be done in accordance with Sec 505.10, except that the slump test will be conducted 4 to 5 minutes after discharge from the mixer. During the waiting period, concrete shall be deposited on the deck and shall not be disturbed.

505.40.6 Mixing.

505.40.6.1 The concrete shall be volumetrically mixed at the bridge site by a continuous mixer in accordance with Sec 501. In addition to other requirements, the mixer shall provide positive control of the latex emulsion into the mixing chamber, and the latex emulsion shall calibrate to within ±2 percent of that required. The mixer shall be capable of continuously circulating the latex emulsion and have a flow-through screen between the storage tank and the discharge.

505.40.6.2 The concrete discharged from the mixer shall be uniform in composition and consistency. Mixing capability shall be such that initial and final finishing operations can proceed at a steady pace. Final finishing shall be completed before the formation of a plastic surface film on the surface.

505.40.6.3 The moisture content of aggregates at the time of proportioning shall be such that water will not drain or drip from a sample. Coarse and fine aggregate shall be furnished and handled to avoid variations in the moisture content affecting the uniform consistency of the concrete.

505.40.6.4 Each drum of latex admixture shall be mechanically agitated or hand rolled until thoroughly mixed prior to being introduced into the mixer storage compartment. Latex admixture that is stored in the mixer storage compartment overnight or during delays in mixing of four hours or more shall be agitated by at least two complete cycles in a continuous circulating pump or by mechanical means in the storage compartment. The flow through screen shall be cleaned immediately prior to beginning proportioning and as often as necessary thereafter. Latex admixtures of different brands shall not be combined together in any manner.

505.40.6.5 The water/cement ratio shall be within 0.02 of that specified in the approved mix design. If adjustments for water content beyond that are necessary, a previously tested and approved mixture shall be used.

505.40.6.6 Prior to placement of concrete in the work, the contractor shall be required to prepare trial batches of concrete for testing. Trial batches shall comply with the limits specified in this provision.

505.40.7 Surface Preparation. Surface preparation shall be in accordance with Sec 505.10 except as specified herein.

505.40.7.1 Prior to scarifying or chipping on concrete adjacent to latex modified high early strength concrete, 24 hours of curing shall elapse. If practical, or unless otherwise shown on the plans, all scarifying by mechanical units shall be completed prior to placing any latex modified high early strength concrete. Areas from which unsound concrete and patches have been removed shall be kept free of slurry produced by wet sawing or wet scarifying by planning the work such that this slurry will drain away from the completed areas of preparation.

505.40.7.2 On both old and new decks within 24 hours before latex modified high early strength concrete placement begins, the entire surface shall be thoroughly cleaned by hydro blasting followed by an air blast in accordance with Sec 505.10.

505.40.8.0 Finishing Equipment.

505.40.8.1 The finishing machine shall be self-propelled with one or more rollers, augers and vibratory pans capable of 1,500 to 2,500 vpm. It shall also be capable of forward and reverse

movement under positive control, with a provision for raising all screeds to clear the screeded surface for traveling in reverse. A drag float may be necessary. Any modifications shall be subject to approval from the engineer.

505.40.8.2 Support rails shall be in accordance with Sec 505.10.

505.40.9 Placing and Finishing Concrete. Placing and finishing shall be in accordance with Sec 505.10 except as specified herein.

505.40.9.1 Prior to placement of latex modified high early strength concrete, the cleaned surface shall be thoroughly wetted for a minimum of one hour, then covered with polyethylene sheeting until time of concrete placement. The surface shall be damp at the time the overlay is placed. Any standing water in depressions, holes or areas of concrete removal shall be blown out with compressed air. No free water or puddles of standing water shall exist at the time of placement.

505.40.9.2 Expansion joints and dams shall be formed in the concrete overlay. Formation of the joint by sawing through the overlay will not be allowed.

505.40.9.3 Water shall not be added to the surface of the concrete during finishing. A commercially available evaporation retardant may be used judiciously with a misting device during the finishing process until the wet burlap is applied only to prevent the surface of the concrete from drying out. The evaporation retardant shall not be used to increase surface workability.

505.40.9.4 Texturing shall occur immediately after finishing and before the plastic film forms on the surface. Texturing shall be performed in a manner to prevent pulling the concrete away from an existing vertical face Care shall be taken not to texture too deep and not to tear the surface.

505.40.9.5 Screed rails and headers shall be separated from the newly placed material by passing a pointing trowel along their inside face. Metal expansion dams shall not be separated from the new overlay. The trowel cut shall be made for the entire depth and length of rails or headers after the mixture has stiffened sufficiently and shall prevent the concrete from flowing back into the cut.

505.40.9.6 During placement of the overlay, all joints with adjacent concrete shall be sealed with a mortar paste of equal parts cement and fine aggregate, using latex emulsion in lieu of mixing water.

505.40.9.7 The overlay concrete shall be moist cured from the time placed until opened to traffic.

505.40.9.8 The wet cure shall be applied promptly after the concrete has been placed on the deck without deforming the finished surface.

505.40.9.9 Within one hour of covering with wet burlap, a layer of white polyethylene sheeting shall be placed on the wet burlap. The surface shall receive a wet cure until the latex modified high early strength concrete has attained a compressive strength of at least 3,200 psi.

505.40.9.10 The thickness of the overlay shall not exceed 3 inches, unless otherwise approved by the engineer.

505.40.9.11 The finished deck will be examined for cracking. If cracking is found, the engineer will determine whether cracking is detrimental, whether remedial surface repairs are

needed or whether the overlay in the cracked area should be removed and replaced. All remedial surface repairs, removal or replacement shall be done by the contractor at the contractor's expense.

505.40.9.12 After placement and curing of the latex modified high early strength concrete, the finished deck will be tested to detect unbonded areas.

505.40.9.13 No surface sealing shall be applied to the latex modified high early strength concrete wearing surface.

505.40.10 Limitations of Operations.

505.40.10.1 No latex modified high early strength concrete shall be placed when the ambient or deck surface temperature is above 85 F. Deck temperature shall be determined in accordance with MoDOT Test Method T20.

505.40.10.2 Since latex modified high early strength concrete may not exhibit bleed water, the probability of plastic shrinkage cracking is increased. At surface evaporation rates above 0.1 pounds per square foot per hour plastic shrinkage cracking is probable and the contractor should take precautions such as erecting windbreaks, lowering the mix temperature or delaying operations until ambient temperatures are lower. Fogging the concrete surface will only be allowed, as provided for in this specification. Surface evaporation rates can be predicted from mix temperature, air temperature, relative humidity and wind velocity using Figure 1 of ACI 308-81 (revised 1986) "Standard Practice for Curing Concrete".

505.40.10.3 A fogging system shall be in-place prior to concrete placement. The fogging system shall consist of pressurized equipment that distributes water at minimum rate of 0.10 gallon per hour per square foot. The fogging system shall apply the fog uniformly over the entire surface of the bridge deck. The fogging system shall produce atomized water that has a droplet with a maximum diameter of 0.003 inches and which keeps the finished deck surface saturated without producing standing water. The contractor shall submit a letter certifying that their fogging system is in accordance with this provision.

505.40.10.4 The fogging system shall be started progressively along the length of the deck, during or immediately after floating.

505.40.10.5 No latex modified high early strength concrete shall be placed at ambient or deck surface temperatures below 45 F. Latex modified high early strength concrete shall be protected to maintain a minimum specified curing temperature of 45 F. The contractor shall provide a method, meeting the approval of the engineer, of monitoring the concrete that demonstrates that the concrete has been maintained above the minimum curing temperature and has been protected from freezing. Any concrete damaged by freezing or which is exposed to a temperature of less than 45 F during the first 8 hours after placement shall be removed and replaced at the contractor's expense.

505.40.10.6 The temperature of the latex modified high early strength concrete at time of placement shall be between 45 F and 90 F. If either the aggregate or water is heated, the maximum temperature for each shall be 100 F at the time of addition to the mix. Any method of heating during the mixing of concrete may be used provided the heating apparatus will heat the mass uniformly and avoid hot spots which will burn the material. Cement or aggregate containing lumps or crusts of hardened material or frost shall not be used.

505.40.10.7 No vehicle traffic shall be permitted on the latex modified high early strength concrete surface until the latex modified high early strength concrete has attained a minimum

compressive strength of 3,200 psi. Compressive strength will be determined by tests conducted in accordance with MoDOT test methods.

505.40.10.8 Concrete shall not be placed adjacent to a parallel surface course which is less than 24 hours old; however, this restriction will not apply to a continuation of placement in a lane or strip beyond a joint in the same lane or strip.

505.40.10.9 Preparation of the area, except scarifying, may be started in a lane or strip adjacent to newly placed surface the day following the surface placement. If this work is started before the end of the curing period, the work will be restricted such that any interference with the curing process is held to the minimum practical time only.

505.40.10.10 Longitudinal construction joints shall be placed between designated traffic lanes. The location of the longitudinal joints shall be subject to the approval from the engineer.

505.40.10.11 Transverse joints in the overlay may be permitted if approval by the engineer. Transverse joints shall be located a minimum of 10 feet from the centerline of bent.

505.40.10.12 A header shall be installed in case of delay in the placement operations exceeding one-half hour in duration. During minor delays of one-half hour or less, the end of the placement shall be protected from drying with several layers of wet burlap.

505.40.10.13 Adequate precautions shall be taken to protect freshly placed concrete from rain. All placing operations shall stop when rain begins. The engineer may order removal of any material damaged by rainfall and such material shall be replaced in accordance with this specification at the contractor's expense.

505.40.11 Removal. Material removal and disposal shall be in accordance with Sec 505.10.

505.40.12 Repair. Repair shall be in accordance with Sec 505.10.

505.40.13 Method of Measurement. Measurement will be in accordance with Sec 505.10.

505.40.14 Basis of Payment. The basis for payment will be in accordance with Sec 505.10.

MoDOT TM 36: Nuclear Density for Concrete Overlays
PROFICIENCY CHECKLIST

Applicant:_____

Employer:_____

Trial#	1	2
Volume of Box		
1. Weigh empty watertight box alone. Weight empty watertight box and glass.		
2. Fill box with water. Measure water temperature. Cover box with glass to ensure completely filled with water.		
3. Weigh box with water and glass. Empty and dry box.		
4. Calculate volume of box.		
Correction Factor		
1. Obtain representative concrete sample.		
2. Fill box in 2 layers and consolidate with square nosed shovel.		
3. Remove voids by raising box 3". Repeat until voids are closed (approximately 4-6 times for each end) by dropping or using internal vibrator (preferred method for low slump)		
4. Weigh box and concrete. Calculate unit weight of concrete in box (D_1)		
5. Obtain average nuclear density value by performing four (4) one minute counts on concrete in box.		
6. Calculate Correction Factor (C).		
Standard Density		
1. Fill pre-weighed and verified pot with fresh concrete.		
2. Weigh pot with concrete		
3. Calculate standard unit weight (D_2).		
In-Place Density		
1. Select test location after finishing machine, but prior to texturing & curing		
2. Lower nuclear source rod so there is ½" to 1" of concrete between bottom of probe and top of existing concrete.		
3. Obtain one 1 minute density count for in-place plastic concrete.		
4. Determine depth of in-place plastic concrete.		
5. Read and record wet in-place density (WD) from gauge scalar.		
6. Calculate corrected in-place density (CWD) and % consolidation.		

Pass Pass

Fail Fail

Examiner:_____ Date:_____