

097.13 DPWH  
06-09-2017



REPUBLIC OF THE PHILIPPINES  
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS  
OFFICE OF THE SECRETARY  
MANILA

08 JUN 2017

DEPARTMENT ORDER ) SUBJECT : DPWH Standard Specification on the  
No. **78** ) Use of Forta-Ferro Fibers on Portland  
Series of 2017 ) Cement Concrete Pavement  
06.09.17

In line with the continuing efforts to upgrade the construction technology thru adoption of successful research studies, this Department has approved the use of **Forta-Ferro Fibers** on Portland Cement Concrete Pavement, subject to the specifications hereto attached.

A Certificate of Conditional Approval has been issued by this Department accrediting the use of Forta-Ferro in DPWH road projects from April 25, 2017 until April 24, 2022.

This Order takes effect immediately.

  
**MARK A. VILLAR**  
Secretary

14.1.2 FET/RGT

Department of Public Works and Highways  
Office of the Secretary



WIN7U01484

# **STANDARD SPECIFICATION ON THE USE OF FORTA-FERRO FIBERS ON PORTLAND CEMENT CONCRETE PAVEMENT**

## **1. Description**

This Specification shall consist of Portland Cement Concrete, with Forta-Ferro Fibers, constructed on the prepared base in accordance with this Specification and in conformity with lines, grades, thickness and typical cross-section shown on the Plans.

## **2. Material Requirements**

### **2.1 Portland Cement**

Cement shall conform to the applicable requirements of Subsection 311.2.1, "Portland Cement" of the DPWH Standard Specifications for Highways, Bridges and Airports, Volume II, 2012 Edition.

### **2.2 Fine Aggregate**

Fine Aggregate shall conform to the applicable requirements of Subsection 311.2.2, "Fine Aggregate" of the DPWH Standard Specifications for Highways, Bridges and Airports, Volume II, 2012 Edition.

### **2.3 Coarse Aggregate**

"Coarse Aggregate" shall conform to the applicable requirements of Subsection 311.2.3, Coarse Aggregate of the DPWH Standard Specifications for Highways, Bridges and Airports, Volume II, 2012 Edition.

### **2.4 Water**

Water shall conform to the applicable requirements of Subsection 311.2.4, "Water" of the DPWH Standard Specifications for Highways, Bridges and Airports, Volume II, 2012 Edition.

### **2.5 Reinforcing Steel**

Reinforcing Steel shall conform to the applicable requirements of Subsection 311.2.5, "Reinforcing Steel" of the DPWH Standard Specifications for Highways, Bridges and Airports, Volume II, 2012 Edition.

### **2.6 Joint Fillers**

Joint fillers shall conform to the applicable requirements of Subsection 311.2.7, "Joint Fillers" of the DPWH Standard Specifications for Highways, Bridges and Airports, Volume II, 2012 Edition.

### **2.7 Chemical Admixtures**

Chemical admixtures, if specified or permitted, shall conform to the requirements of AASHTO M 194, Standard Specification for Chemical Admixtures for Concrete.

Fly Ash, if specified or permitted as a mineral admixture and not exceeding 20% partial replacement of Portland Cement in concrete mix shall conform to the requirements of ASTM C 618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.

## **2.8 Forta-Ferro fibers**

It shall be added to the concrete mix to produce some desired modifications to the properties of concrete, but not as partial replacement of cement. It shall be applied in the dosage rate of 1.0 kg of Forta-Ferro fibers for every one (1) cubic meter of concrete.

## **2.9 Curing Materials**

It shall conform to the applicable requirements of Subsection 311.2.9, "Curing Materials" of the DPWH Standard Specifications for Highways, Bridges and Airports, Volume II, 2012 Edition.

## **2.10 Calcium Chloride/Calcium Nitrate**

It shall conform to AASHTO M 144, Standard Specification for Calcium Chloride if specified or permitted by the Engineer, as accelerator.

## **2.11 Storage of Cement and Aggregate**

It shall conform to the applicable requirements of Subsection 311.2.11, "Storage of Cement and Aggregate" of the DPWH Standard Specifications for Highways, Bridges and Airports, Volume II, 2012 Edition.

## **2.12 Proportioning, Consistency and Strength of Concrete**

It shall conform to the applicable requirements of Subsection 311.2.12, "Proportioning, Consistency and Strength of Concrete" of the DPWH Standard Specifications for Highways, Bridges and Airports, Volume II, 2012 Edition.

To achieve smooth pavements with values for International Roughness Index (IRI) of not more than 3.0 m/km, the Contractor shall consider tightening the ranges and tolerances of mix design components to produce a more consistent mix and include revised target values in the Contractor's Quality Control Plan and Method Statement.

## **3. Construction Requirements**

### **3.1 Quality Control of Concrete**

It shall conform to the applicable requirements of Subsection 311.3.1, "Quality Control of Concrete" of the DPWH Standard Specifications for Highways, Bridges and Airports, Volume II, 2012 Edition.

### **3.2 Equipment**

Equipment shall conform to the applicable requirements of Subsection 311.3.2, "Equipment" of the DPWH Standard Specifications for Highways, Bridges and Airports, Volume II, 2012 Edition.

### **3.3 Preparation of Grade**

It shall conform to the applicable requirements of Subsection 311.3.3, "Preparation of Grade" of the DPWH Standard Specifications for Highways, Bridges and Airports, Volume II, 2012 Edition.

To achieve smooth pavements with values for International Roughness Index (IRI) of not more than 3.0 m/km, the Contractor shall ensure that the subgrade or base is prepared using equipment with a control system capable of smooth adjustments to automatically follow the surface shape (elevations and grades) required. The preferred method is laser control following a surface shape input to the onboard computer.

### **3.4 Setting Forms**

It shall conform to the applicable requirements of Subsection 311.3.4, Setting Forms of the DPWH Standard Specifications for Highways, Bridges and Airports, Volume II, 2012 Edition.

To ensure compliance to the maximum International Roughness Index (IRI), check using appropriate surveying instruments shall be used at 5.0 m intervals along the top portion of the forms with a tolerance of +/- 0.001 m.

If any of the form is disturbed or any grade has become unstable, the form shall be reset and rechecked.

### **3.5 Conditioning of Subgrade or Base Course**

It shall conform to the applicable requirements of Subsection 311.3.5., "Conditioning of Subgrade or Base Course" of the DPWH Standard Specifications for Highways, Bridges and Airports, Volume II, 2012 Edition.

### **3.6 Handling, Measuring and Batching Materials**

It shall conform to the applicable requirements of Subsection 311.3.6, "Handling, Measuring and Batching Materials" of the DPWH Standard Specifications for Highways, Bridges and Airports, Volume II, 2012 Edition.

### **3.7 Mixing Concrete**

It shall conform to the applicable requirements of Subsection 311.3.7, "Mixing Concrete" of the DPWH Standard Specifications for Highways, Bridges and Airports, Volume II, 2012 Edition.

### **3.8 Limitation of Mixing**

It shall conform to the applicable requirements of Subsection 311.3.8, "Limitation of Mixing" of the DPWH Standard Specifications for Highways, Bridges and Airports, Volume II, 2012 Edition.

### **3.9 Placing Concrete**

It shall conform to the applicable requirements of Subsection 311.3.9, "Placing Concrete" of the DPWH Standard Specifications for Highways, Bridges and Airports, Volume II, 2012 Edition.

### **3.10 Test Specimens**

It shall conform to the applicable requirements of Subsection 311.3.10, "Test Specimens" of the DPWH Standard Specification for Highways, Bridges and Airports, Volume II, 2012 Edition.

### **3.11 Strike-off of Concrete and Placement of Reinforcement**

It shall conform to the applicable requirements of Subsection 311.3.11, "Strike-off of Concrete and Placement of Reinforcement" of the DPWH Standard Specifications for Highways, Bridges and Airports, Volume II, 2012 Edition.

### **3.12 Joints**

Joints shall conform to the applicable requirements of Subsection 311.3.12, "Joints" of the DPWH Standard Specifications for Highways, Bridges and Airports, Volume II, 2012 Edition.

### **3.13 Final Strike-off (Consolidation and Finishing)**

It shall conform to the applicable requirements of Subsection 311.3.13, "Final Strike-off (Consolidation and Finishing)" of the DPWH Standard Specifications for Highways, Bridges and Airports, Volume II, 2012 Edition.

### **3.14 Surface Test**

Paved shoulders shall be subjected to surface test using a 3-m straight-edge. All areas within the carriageway shall be subjected to surface test using an approved profiling system. The profiling system shall qualify as Class 1 roughness measurement device and shall conform to the latest version ASTM E 950M, Standard Test Method for Measuring the Longitudinal Profile of Traveled Surfaces with an Accelerometer Established Inertial Profiling Reference.

The components of the profiling system shall be validated on regular basis per manufacturer's recommendations to ensure that the system is properly calibrated. Validation reports shall be generated, for presentation to the Engineer, confirming that the validations are current and within tolerances specified by the manufacturer.

The acceptable International Roughness Index (IRI) for concrete pavements shall be not more than 3.0 m/km for National Primary Road, measured in 100 meter sections, at the time of completion.

Prior to any testing, the road surface for test shall be cleaned of loose or deleterious material by brooming or other approved means. Survey shall only be conducted on dry pavement surfaces only. Wide-beam lasers are recommended for textured surfaces like diamond ground, diamond grooved or tyned surfaces where they yield lower IRI values than single point or spot lasers.

Prior to data collection, a test segment with a length of 500 meters will be selected at site for repeatability test. The repeatability test shall be witnessed by the authorized representative of the Contractor and the Engineer. Five profile runs will be made on the test segment for repeatability test. The profile runs for repeatability are acceptable if the average IRI of the two wheelpaths satisfy the following criteria:

- a. The IRI values of each of the five (5) runs are within 1% of the mean IRI of the selected runs.
- b. The standard deviation of IRI of the selected runs are within 2% of the mean IRI.

If the runs do not meet the above criteria, the Profiling Team shall determine if the variability between runs are due to operator or equipment error, and make additional runs until five (5) runs free of equipment or operator errors are obtained. Where necessary an accuracy calibration test shall be conducted in comparison with a Class 1 Profiler (Walking Profiler, or similar) to resolve said errors.

If the IRI values from the profile runs (for repeatability) meet the above criteria, three (3) runs per lane per site should be conducted for acceptance measurement. The IRI value for the lane shall be the average IRI of the two wheelpaths for the three (3) runs combined.

If the IRI value of the whole concrete pavement meets the required value regardless if there are areas found to have exceeded the required IRI value, no correction shall be required, provided that the areas with exceedance have an IRI value within the tolerance limit of 0.5 m/km.

However, if the IRI value of the whole concrete pavement falls beyond the prescribed IRI of 3.0 m/km for National Primary Roads and exceeds the allowable tolerance, the Contractor may opt to undertake corrective action, otherwise, pay adjustment shall be made. The completed concrete pavement shall be accepted on a LOT basis. A LOT shall be considered as 100 linear meters of a lane of pavement. If the length of the last lot is less than 100m, it shall be considered as a separate lot. LOT disincentive pay/pay deduction will be calculated as described in the table below:

<b>Portland Cement Concrete Pavement (PCCP) Pay Adjustment Table IRI Acceptance Tolerance</b>	
LOT IRI Value (m/km)	LOT Pay Adjustment, % of Item Cost
3.50 and below	100%
3.51 to 4.00	90%
4.01 to 4.50	70%
4.51 to 5.00	55%
5.01 to 5.50	35%
5.51 to 6.00	15%
Above 6.00	0%

If the contractor undertakes corrective action, further IRI Survey will be conducted to validate if the pavement irregularities had been eliminated. Only one IRI survey will be done after the corrective action takes place. If the IRI value of the whole concrete pavement meets the prescribed IRI value of 3.0/km for National Primary Road and any 100 m sections exceeding the prescribed value are within the allowable tolerance after correction, no reduction in payment will be made; otherwise, pay adjustment shall be made based on the above Pay Adjustment Table.

**3.15 Curing**

Curing shall conform to the applicable requirements of Subsection 311.3.15, "Curing" of the DPWH Standard Specifications for Highways, Bridges and Airports, Volume II, 2012 Edition.

**3.16 Removal of Forms**

It shall conform to the applicable requirements of Subsection 311.3.16, Removal of Forms of the DPWH Standard Specifications for Highways, Bridges and Airports, Volume II, 2012 Edition.

**3.17 Sealing Joints**

It shall conform to the applicable requirements of Subsection 311.3.17, Sealing Joints of the DPWH Standard Specifications for Highways, Bridges and Airports, Volume II, 2012 Edition.

Joint sealer equipment/machine capable of efficiently blowing up dust from transverse contraction/weakened plane and longitudinal joints and pressure filling the same with an appropriate sealing compound shall be used for this purpose.

**3.18 Protection of Pavement**

It shall conform to the applicable requirements of Subsection 311.3.18, Protection of Pavement of the DPWH Standard Specifications for Highways, Bridges and Airports.

### **3.19 Concrete Pavement - Slip Form Method**

It shall conform to the applicable requirements of Subsection 311.3.19, Concrete Pavement-Slip Form Method of the DPWH Standard Specifications for Highways, Bridges and Airports, Volume II, 2012 Edition.

The preferred method in establishing proper grade profile is by laser control following a surface shape input to the onboard computer.

Where the alternative of guide wires are to be used, they should be properly tensioned, installed parallel to the edges of the construction at both sides of the work area and maintained at fixed height and tension in order to meet the maximum IRI. For flat terrain, guide wire shall be supported at 10.0 m intervals. For curves and tie-ins to existing pavement, guide wire shall be supported at 5.0 m intervals. Appropriate surveying instruments shall be used to check guide wire elevations at 5.0 m intervals with a tolerance of +/- 0.001 m.

### **3.20 Acceptance of Concrete**

No acceptance and final payment shall be made for the completed concrete pavement unless core test for thickness determination is conducted, except for Barangay Roads where the Implementing Office is allowed to waive such test, and for National Primary Roads where the concrete pavement shall also meet the International Roughness Index (IRI) criteria at the time of completion. The concrete pavement shall only be considered accepted if it meets the specified IRI value at the time of completion.

The strength level of the concrete will be considered satisfactory if the averages of all sets of three (3) consecutive strength test results equal or exceed the specified strength,  $f_c'$  and no individual strength test result is deficient by more than 15% of the specified strength,  $f_c'$ . A set shall consist of a minimum of three (3) concrete beam specimens.

Concrete deemed to be not acceptable using the above criteria may be rejected unless the Contractor can provide evidence, by means of core tests, that the quality of concrete represented by failed test results is acceptable in place. At least three (3) representative cores shall be taken from each member or area of concrete in place that is considered deficient. The location of cores shall be determined by the Engineer so that there will be at least impairment of strength of the structure. The obtaining and testing of drilled cores shall be in accordance with AASHTO T 24, Standard Method of Test for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.

Concrete in the area represented by the cores will be considered adequate if the average strength of the cores is equal to at least 85% of, and if no single core is less than 75% of, the specified strength,  $f_c'$ .

If the strength of control specimens does not meet the requirements of this Subsection, and it is not feasible or not advisable to obtain cores from the structure due to structural considerations, payment of the concrete will be made at an adjusted price due to strength deficiency of concrete specimens as specified hereunder:

Deficiency in Strength of Concrete Specimens, Percent (%)	Percent (%) of Contract Price Allowed
Less than 5	100
5 to less than 10	80
10 to less than 15	70
15 to less than 20	60
20 to less than 25	50
25 or more	0

**3.21 Opening to Traffic**

It shall conform to the applicable requirements of Subsection 311.3.21, "Opening to Traffic" of DPWH Standard Specifications for Highways, Bridges and Airports, Volume II, 2012 Edition.

**3.22 Tolerance in Pavement Thickness**

It shall conform to the applicable requirements of Subsection 311.3.22, "Tolerance in Pavement Thickness" of DPWH Standard Specifications for Highways, Bridges and Airports, Volume II, 2012 Edition.

**4. Method of Measurement**

The area to be paid for under this Specification shall be the number of square meters (m<sup>2</sup>) of concrete placed and accepted in the completed pavement with or without rebar reinforcement. The width for measurements will be the width from outside edge to outside edge of completed pavement as placed in accordance with the Plans or as otherwise required by the Engineer in writing. The length will be measured horizontally along the center line of each roadway or ramp. Any curb and gutter placed shall not be included in the area of concrete pavement measured.

**5. Basis of Payment**

The accepted quantity, measured as prescribed in Section 4, Method of Measurement, shall be paid for at the contract unit price for Portland Cement Concrete Pavement with Forta-Ferro fibers which price and payment shall be full compensation for furnishing all materials, for mixing, placing, finishing all concrete, for furnishing and placing all joint materials, for sawing weakened plane joints, for fitting the prefabricated center metal joint, for facilitating and controlling traffic, and for furnishing all labor, equipment, tools and incidentals necessary to complete the Specification.

Payment will be made under:

Pay Item Number	Description	Unit of Measurement
	Portland Cement Concrete with Forta-Ferro fibers	Square Meter