## Addendum

Iowa Department of Transportation
Date of Letting: February 17, 2015
Office of Contracts
Date of Addendum: February 12, 2015
$\left.\begin{array}{|c|c|c|c|c|c|}\hline \text { B.O. } & \text { Proposal ID } & \begin{array}{c}\text { Proposal Work } \\ \text { Type }\end{array} & \text { County } & \text { Project Number } & \text { Addendum } \\ \hline 306 & 78-0293-102 & \text { GRADING } & \text { POTTAWATTAMIE } & \begin{array}{l}\text { IM-NHS-029-3(102)48--03-78 } \\ \text { IM-NHS-029-3(103)48--03-78 }\end{array} & \text { 17FEB306.A09 } \\ & & & \begin{array}{c}\text { IM-NHS-029-3(104)48--03-78 } \\ \text { IM-029-3(105)48--13-78 } \\ \text { NHS-029-3(106)48--11-78 }\end{array} & \\ & & & \begin{array}{l}\text { IM-NHS-029-3(110)48--03-78 } \\ \text { IM-NHS-029-3(122)48--03-78 }\end{array} & \\ \text { IM-NHS-029-3(146)48-03-78 }\end{array}\right]$

Make the following change to the Proposal Special Provisions Text and the Proposal Special Provisions List.:

Replace SP-120228 with attached SP-120228a
Add Attached DS-12027 PCC PAVEMENT NON-DESTRUCTIVE THICKNESS DETERMINATION
Make the following changes to the PROPOSAL SCHEDULE OF PRICES:
Change Proposal Line No. 1050 2519-1001000 FENCE, CHAIN LINK, VINYL COATED:
From: 5,337.600 LF
To: $\quad 4,706.000 \mathrm{LF}$
Add Proposal Line No. 1515 2502-8220197 SUBDRAIN OUTLET (RF-19F); 19.000 EACH
Estimate Reference Note: See Tab 104-5C in CS Sheets for locations and details.
Delete Proposal Line No. 0200 2301-6911722 PORTLAND CEMENT CONCRETE PAVEMENT SAMPLES; LUMP

If the above changes are not made, they will be made as shown here.

Make the following changes to the plans.
Sheet C. 4 ESTIMATE REFERENCE INFORMATION
2503-0134248 STORM SEWER GRAVITY MAIN WITH CASING PIPE, TRENCHED, REINFORCED CONCRETE PIPE (RCP), 2000D (CLASS III), 48 IN.

Add to Estimate Reference Note: For all joints use rubber O-ring or profile gasket complying with ASTM C 443/C 553M (AASHTO M 315/M 315M).

Sheet C. 7
Add Standard Road Plan BA-103 to Tab 105-4
Replace Sheet C. 13 with attached sheet.
Tab 104-8 Second "L2" in table heading under "Length" replace with "L3"
Replace Sheet C. 16 with attached sheet
Changed Tab for Fencing
Replace sheet J. 1 with attached sheet.
Add Note to J.1, Tab 108-23A, 2.C.
Extended durations of over 20 minutes to remove existing bridge or place bridge beams will be allowed as nighttime closures from 9:00 PM - 5:30 AM Monday -Saturday and 7:00 PM - 5:30 AM Sunday. Northbound traffic will be detoured onto Ramps A and C (I-29/US275 NB on and off ramps.) Southbound traffic will be detoured from I-29 SB to South Expressway to US275 to Ramp D (I-29 SB on ramp.) Southbound I-29 and
Northbound I-29 shall not be closed at the same time. The Contractor shall submit the traffic control plan 2 weeks in advance for Engineer approval.

Replace sheet J. 2 with attached sheet.
Adding note concerning the construction project for the Railroad.

Remove area 12-1 that should not have been on the sheet.

Replace Sheet Q. 60 with attached sheet.
Change note to say only one reading a day is required not every 8 inches.

# 8 Iowa Department of Transportation 

SPECIAL PROVISIONS<br>FOR<br>INSTRUMENTATION

Pottawattamie County
IM-NHS-029-3(102)48--03-78

Effective Date<br>December 16, 2014


#### Abstract

THE STANDARD SPECIFICATIONS, SERIES 2012, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE SPECIAL PROVISIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.


## 120228a. 01 DESCRIPTION.

A. Scope.

The work shall consist of installing, maintaining, and monitoring instrumentation designated on the project drawings and as specified herein. The settlement plates will be installed by the grading contractor; however, the monitoring of the settlement plates, shall be included in this work and monitored in accordance with Article 2526.03, G of the Standard Specification.
B. Definitions.

1. Inclinometers: Inclinometers shall be installed by a qualified instrumentation specialist as subcontractor to the Contractor with minimum 5 years of experience and installation of at least three similar projects within the last 3 years. The purpose of the inclinometers is to monitor potential slope/embankment/MSE wall lateral movements. It shall consist of Geokon, Micro-Electro-Mechanical Sensor (MEMS) 6150 In-Place Inclinometer with biaxial tilt sensors, RST Digital MEMS Inclinometer System ICB0021W, or approved equivalent.
2. Vibrating Wire Piezometers: Vibrating Wire Piezometers (VWP) shall be installed by a qualified instrumentation specialist as subcontractor to the Contractor with minimum 5 years of experience and installation of at least three similar projects within the last 3 years. The purpose of the VWP is to monitor excess pore water pressures in the soil to confirm that primary consolidation is complete, the rate has stabilized, and that clay gained enough shear strength to allow staged construction.
3. Push-In Pressure Cells: Push-In pressure cells (PPC) shall be installed by a qualified instrumentation specialist as subcontractor to the Contractor with minimum 5 years of experience and installation of at least three similar projects within the last 3 years. The purpose of the PPC is to monitor the effective stress in the clay layer to confirm that primary consolidation is complete, the rate has stabilized, and that clay gained enough shear strength to allow staged construction.
4. Multi-point Settlement Extensometers: Extensometers shall be installed by a qualified instrumentation specialist as subcontractor to the Contractor with minimum 5 years of experience and installation of at least three similar projects within the last 3 years. The purpose of the extensometers is to monitor vertical settlement at multiple points of the extensometers.
5. All boreholes, where either an extensometer, inclinometer or piezometer shall be installed shall be logged and boring log shall be submitted with the installation log of the instrument. Boring logs shall logged per ASTM D2488 standard with sampling at 5 foot intervals.
6. Real Time Monitoring: Real time monitoring is defined as automated, remote, and web-based monitoring and shall be provided for all instrumentation. The real time monitoring shall be performed by a qualified instrumentation specialist as subcontractor to the Contractor with minimum 5 years of experience and installation of at least three similar projects within the last 3 years. The real time monitoring shall consist of monitoring all instrumentation, including the strain gauges for the rigid inclusions that have been load tested prior to construction of production rigid inclusions. The real time monitoring frequency shall be of at least twice every 24 hours. All data collected shall be provided to the Engineer to an internet website. Link to the website and access instructions shall be provided to the Engineer. Provide necessary data collection box or points to facilitate real time monitoring. Ensure that any such data collection point(s) has a protective housing to prevent damage due to weather related events, vandalism, theft, etc. Any repairs or replacement to the real time monitoring system or the protective housing shall be done at no additional cost to the lowa DOT. The collection data box shall contain full backup power and backup for data on a 72 hour basis. Manual readings for the inclinometers will be acceptable only during fill placement as long as the frequency of reading is achieved.
7. Real Time Monitoring for Strain Gauges on Rigid Inclusions: Monitoring of the strain gauges for rigid inclusion load tested prior to construction shall be in accordance with Special provisions for Ground Improvement with Rigid Inclusions. After monitoring of the strain gauges during the load tests, the strain gauges wiring shall be routed through a buried schedule 80 PVC pipe and shall be connected to the real time monitoring system. Strain gauges shall be compatible with the real time monitoring system.
8. Any instrumentation that malfunctions or becomes inoperable or unreadable shall be replaced at no additional cost to the Iowa DOT.
9. If excessive lateral or vertical movements are detected during monitoring of the fill placement, the Engineer may elect to hold the grading activities up to 3 weeks to allow excess pore water pressures to dissipate and therefore, foundation soils to gain strength before resuming grading activities. Grading activities shall continue at other locations with no additional compensation to the Contractor or additional working days added.

## C. Subsurface Conditions.

1. Borings completed within the limits of the project encountered varying thicknesses of soft to medium stiff alluvial silt and clay. The explorations typically encountered medium dense to very dense alluvial sand and gravel with silt and clay below elevations shown in the plans.
2. Groundwater at the time of boring drilling was recorded between approximately 4 and 10 feet below the natural ground at the time of drilling, which was performed in November and December of 2010. It is anticipated that the groundwater level will rise during prolonged periods of precipitation or flooding, and perched groundwater may be present. For the purpose of installation, assume that the ground water is at the ground surface and make all necessary preparation to complete the installation under this condition at no additional cost to lowa DOT.

## D. Submittals.

1. Provide means and methods for installation of all instrumentation. Means and methods shall include a map with the locations of inclinometers, extensometers, PPC, VWP, and remote station for data loggers. This information shall be provided to the Engineer at least 20 days prior to installation.
2. Instrumentation type/model including ranges, operating principle, advantages and limitations shall be submitted to the Engineer at least 20 days prior to installation or with sufficient time to be able to replace any instrumentation without impacting the construction schedule. No additional time will be granted for any delays due to replacing type or range of instrumentation.

## 120228a. 02 MATERIALS.

A. Inclinometers.

1. Inclinometer casing shall be grooved plastic 2.75 inches outside diameter casing that is compatible with the inclinometer being provided. The casing shall be complete with necessary rigid self-aligning couplings and end plugs.
2. The inclinometer monitoring system shall include a suspension and wheel assemble, a support cable, string of biaxial tilt sensors, universal joint, spacer tubings, adequate cable length to facilitate the real time monitoring, and readout. The inclinometer readout shall measure inclinations at any depth selected by the operator and shall digitally store, process and report the data (by display and downloadable digital files) as lateral movements from a stored baseline reading.
3. All cables connected to the real-time read out equipment shall be protected and routed through schedule 80 PVC pipe to ensure that these are not damaged during construction activities.
4. The suspension assembly guide pulley shall mount to the top of the inclinometer casing.
5. Any other devices needed to facilitate and achieve the required real time monitoring shall be furnished and installed.

## B. Vibrating Wire Piezometers.

1. The vibrating wire piezometer (VWP) system shall include a pressure transducer rated for water pressure range from 50 to 150 psi, signal cable, adequate cable length to facilitate the real time monitoring, and real-time readout equipment. The VWP reading shall be obtained at the depth of the sensor specified. The readout equipment shall digitally store, process and report the data.
2. Each VWP location shall include two transducers levels sensors and shall be installed at approximately 15 and 25 feet below ground surface. Final depth shall be adjusted by the Engineer on site based on the confirmation borings.
3. All cables connected to the real-time read out equipment shall be protected and routed through schedule 80 PVC pipe to ensure that these are not damaged during construction activities.
4. Any other devices needed to facilitate and achieve the required real time monitoring shall be furnished and installed.

## C. Push-In Pressure Cells.

1. The Push-In pressure cells system shall include a pressure transducer rated for pressure range from 20 to 90 psi, signal cable, adequate cable length to facilitate the real time monitoring, and real-time readout equipment. The PPS reading shall be obtained at the depth of the sensor specified. The readout equipment shall digitally store, process and report the data.
2. Each PPS location shall include two transducers levels sensors and shall be installed at approximately 15 and 25 feet below ground surface. Final depth shall be adjusted by the Engineer on site based on the confirmation borings.
3. All cables connected to the real-time read out equipment shall be protected and routed through schedule 80 PVC pipe to ensure that these are not damaged during construction activities.
4. Any other devices needed to facilitate and achieve the required real time monitoring shall be furnished and installed.
D. Multi-point Settlement Extensometers.
5. The multi-point settlement extensometers monitoring system shall include adequate cable length to facilitate the monitoring readout. The extensometer readout shall measure multipoint settlements at the specified preliminary depth of the extensometer sensor and shall digitally store, process and report the data (by display and downloadable digital files) as settlement movements from a stored baseline reading.
6. The multi-point settlement extensometers shall be capable of measuring up to 2412 inches of settlement.
7. The multi-point settlement extensometers monitoring system shall include five levels of settlement sensors. Preliminary settlement extensometer sensor elevations are provided in the Table 120228a-3. Final elevation shall be adjusted by the Engineer on site based on the confirmation borings.

Table 120228a-3: Extensometer Sensor Level Preliminary Elevations

| Approximate <br> Depth (feet) | Approximate <br> Elevation (feet) | Sub-surface Layer |
| :---: | :---: | :---: |
| $2.0-5.0$ | $976.0-973.0$ | Medium Stiff to Stiff Fat Clay (near <br> ground surface) |
| 12.0 | 966.0 | Medium Stiff to Stiff Fat Clay / Very <br> Soft to Soft Fat Clay |
| 22.0 | 956.0 | Very Soft to Soft Fat Clay/Silt |
| 32.0 | 946.0 | Loose to Medium Dense Sand/Silty |
| Sand |  |  |

* Approximate elevations for strain gauges are based on an approximate ground surface elevation of 978 feet.

4. All cables connected to the real-time read out equipment shall be protected and routed through schedule 80 PVC pipe to ensure that these are not damaged during construction activities.
5. Any other devices needed to facilitate and achieve the required real time monitoring shall be furnished and installed.

## 120228a. 03 CONSTRUCTION.

A. Inclinometers Installation.

1. Install inclinometer casing at the locations shown on Q sheets. The Engineer may change the location of the inclinometers as needed during construction.
2. The inclinometers shall have a minimum length of 90 feet.
3. Drill, sample, and log soil borings drilled for the purpose of installing inclinometer casing. Borings for inclinometers shall be drilled using 6 inch minimum inside diameter casing and water or, where ground conditions permit, using drilling mud in a 6 inch diameter borehole. This boring shall be used as soil confirmation boring of the location.
4. Install inclinometer casings prior to the embankment fill being placed and extend as the embankment construction progresses. Install the inclinometer monitoring system for the depth of the casing before the casing is extended. This will include the biaxial sensors, joints, wheel assembly, spacer tubings and any other parts as necessary. In case of damage to the inclinometer casing or any other instruments, the damaged part(s) shall be replaced at no additional cost to lowa DOT. The casing shall protrude 3 feet above finished grade.
5. Flag and protect inclinometer locations. Provide the top of each inclinometer casing with a protective cap, and with a locked protective metal housing extending at least 3 feet below finished grade. All cables shall be protected and routed through a schedule 80 PVC pipe to ensure that these are not damaged during construction activities. Any repairs or replacement shall be done at no additional cost to the lowa DOT.
6. Cable splicing is acceptable.

## B. Vibrating Wire Piezometers Installation.

1. Install VWP at the locations shown on Q sheets.
2. Drill, sample, and log borings of soil drilled for the purpose of installing the piezometers casing. The borehole shall be drilled below the required depth of the piezometer. This boring shall be used as soil confirmation boring of the location.
3. Install the VWP prior to the embankment fill being placed. In case of damage to the VWP and cables, the damaged items shall be replaced at no additional cost to the lowa DOT.
4. Flag and protect VWP locations. The cables connecting to the real-time read out equipment shall be routed through a buried schedule 80 PVC pipe to ensure that these are not damaged or cut off during construction activities.
5. Cable splicing is acceptable.

## C. Push-In Pressure Cells Installation.

1. Install PPC at the locations shown on Q sheets.
2. Drill, sample, and log borings of soil drilled for the purpose of installing the PPC to within about 2 - ft of the desired location, and then push the cell the rest of the way. This boring shall be used as soil confirmation boring of the location.
3. When pushing the cell into the ground it is possible that pressure in excess of the sensors full scale range can be generated casing the sensor to experience a zero shift or even permanent damage. To prevent this, reading should be taken as the sensor is pushed and terminate the installation until the excess pressure is dissipated. Any damaged sensor should be replaced at no additional cost to the lowa DOT.
4. Install the PPC prior to the embankment fill being placed. In case of damage to the PPC and cables, the damaged items shall be replaced at no additional cost to the lowa DOT.
5. Flag and protect PPC locations. The cables connecting to the real-time read out equipment shall be routed through a buried schedule 80 PVC pipe to ensure that these are not damaged or cut off during construction activities.
6. Cable splicing is acceptable.

## D. Multi-Point Settlement Extensometers Installation.

1. Install multi-point settlement extensometer at the locations shown on Q sheets.
2. Multi-point settlement extensometers shall have a minimum length of 50 feet below existing ground surface. The extensometers sensors preliminary elevations are provided in Article 120228a.02, E, 3. Preliminary elevations will be modified based on the confirmation borings.
3. Drill, sample, and log borings of soil drilled for the purpose of installing extensometer casing. Borings for extensometer shall be drilled using 6 inch minimum inside diameter casing and water or, where ground conditions permit, using drilling mud in a 6 inch diameter borehole. This boring shall be used as soil confirmation boring of the location.
4. Attach grout tubing to the multi-point settlement extensometer.
5. Place the extensometer into the borehole. Grout the borehole from bottom to top.
6. After grout cures and installation is stable, install the readout unit system and take the initial readings.
7. Flag and protect all cables. The cables connecting to the real-time read out equipment shall be routed through a buried schedule 80 PVC pipe to ensure that these are not damaged or cut off during construction activities.
8. Cable splicing is acceptable.

## E. Contractor Quality Control.

## 1. Field Quality Control.

The following describes the minimum inspection and testing required in the Contractor's Quality Control (CQC) Plan and Program for the work of this section and is for CQC only. The implementation of the Contractor Quality Control Program does not relieve the Contractor from the responsibility to provide the work in accordance with the contract documents, applicable codes, regulations, and governing authorities.
2. Quality Control: Supervision, Inspection, and Records.
a. The Contractor shall have an onsite field engineer to manage all of the QC activities on the project. The installation of the inclinometers and extensometers shall be done under the direct supervision of a Professional geotechnical Engineer registered in the State of Iowa on the staff of the Contractor or a sub-consultant to the Contractor.

## b. Records.

1) Inclinometer, VWP, PPC, and Multi-point Settlement Extensometers Readings: Take initial readings 24 hours after completing installation and testing of each inclinometer, VWP, PPC and extensometer. At each inclinometer location, a total of eight, four of which biaxial sensors shall be placed above existing grade and up to the elevation of the finished grade with equal spacing between each other. The remaining four biaxial sensor shall be placed below existing grade. The elevation of the inclinometers will be determined based on the confirmation borings drilled prior to installation of the inclinometer. For the Inclinometers, readings shall consist of a minimum of two reading surveys per 24 hours using real time remote and automated monitoring operation, with each survey consisting of a set of readings in each of the two primary orientations. Manual readings for the inclinometers will be acceptable only during fill placement as long as the frequency of reading is achieved. Pfocess the survey results, graphically plot them, and furnish the results to the Engineer. Based on comparison of the plotted results, the Engineer will determine which survey will represent the initial set of measurements. Typically, the results are approximately the same for the two surveys, and the last set of readings is typically selected. For the VWP, PPC and Multi-point Extensometers, readings shall consist of a minimum of two readings surveys per 24 hours using real time remote and automated monitoring operations for each sensor.

For the duration of the project, inclinometers and multi-point settlement extensometers shall continue to be monitored after the completion of the fill placement and through 52 weeks from the start of the first reading. VWP and PPC shall continue to be monitored after the completion of the fill placement and through 25 weeks from the start of the first reading. The readings shall consist of real time monitoring with daily monitoring frequency and available online to the Engineer.
2) Real Time Monitoring Strain Gauges: Test rigid inclusion strain gauges shall continue to be monitored after the completion of the load test throughout the fill placement and beyond through a duration of 50 weeks. The readings shall consist of real time monitoring with daily frequency and available online to the Engineer.
3) Settlement plate readings shall be taken at the start and end of placing of each embankment lift with a maximum of one reading per day and at weekly intervals after the fill is placed to its final height for a period of 12 weeks, and at the end of fill placement and once every two weeks for 40 weeks thereafter. Additional readings over additional duration may be needed based on the settlement plate's readings.
4) Embankment Fill and MSE Wall Fill Heights at the locations of the instrumentation (Inclinometer, VWP, PPC, and Multi-point Settlement Extensometers) shall be taken at the start and end of placing of each embankment lift and at weekly intervals after the fill is placed to its final height for a period of 12 weeks, and at the end of fill placement and once every 2 weeks for 40 weeks thereafter. Additional readings over additional duration may be needed based on the instrumentation (Inclinometer, VWP, PPC, and Multi-point Settlement Extensometers) readings.

## 120228a. 04 METHOD OF MEASUREMENT.

Measurement for Installation of instrumentation including Real Time automated and web based monitoring, and the settlement plates monitoring as shown contract documents and herein shall be based on lump sum basis.

## 120228a. 05 BASIS OF PAYMENT.

Payment for Instrumentation will be acceptable installation, maintenance, and monitoring of instruments, including inclinometers, VWP, and PPC, multi-point settlement extensometers, shall include all materials, labor, installation equipment, real time monitoring, replacement, trouble shooting, and mobilization costs involved to install the instrumentation and protective housings, and to flag and protect each instrumentation location for the duration of the project. Instrumentation shall be paid on a lump sum basis and shall include the settlement plate monitoring for the duration of the project. Instrumentation
readings shall include all materials, labor, mobilization, monitoring equipment, and data collection, data reduction, data reporting, and engineering time costs required to present a letter report of the findings. All instrumentation data collection with the exception of the settlement plate shall be real time monitoring.

# 88 Iowa Department of Transportation 

DEVELOPMENTAL SPECIFICATIONS FOR<br>PCC PAVEMENT NON-DESTRUCTIVE THICKNESS DETERMINATION

Effective Date<br>October 16, 2012

## THE STANDARD SPECIFICATIONS, SERIES 2012, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE DEVELOPMENTAL SPECIFICATIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

Replace all of Articles 2301.04 and 2301.05 of the Standard Specifications with the following. Differences from the Standard Specifications are highlighted.
2301.04 METHOD OF MEASUREMENT.

Measurement will be as follows:
A. Portland Cement Concrete Pavement.

1. Square yards (square meters), of the type specified, shown in the contract documents.
2. The coring measurement requirements for thickness do not apply to detour pavements, paved drives, and temporary pavements. The thickness of pavement constructed will be determined from core depths thickness measurements as follows:
a. The division of sections, lots, and core measurement locations will be according to Materials I.M. 346 Appendix A.
b. At locations determined by the Engineer, cut samples from the pavement, as directed above, by drilling with a core drill that will provide samples with a 4 inch ( 101.6 mm ) outside diameter the Engineer will measure for thickness according to Appendix A. Restore the surface by tamping lowslump concrete into the hole, finishing, and texturing. The Engineer will witness the core drilling, and identify and measure the cores immediately. The Engineer will measure the cores and determine the thickness index according to Materials I.M. 346. After measurement on the grade, deliver the cores to the Engineer's office or field laboratory. When cores are not measured on the grade, the Engineer will take immediate possession of the cores.
c. Goring of pavement and other Measurement work for thickness determination may be waived by mutual agreement for sections of the same design thickness less than 5000 square yards (4200 $\mathrm{m}^{2}$ ).
d. Only sections which are cored measured for thickness will be included in the thickness index determination. Areas not cored measured for thickness will be paid for at the contract unit price.
B. Integral Curb.

Incidental to the other items of work. Not measured for payment.
C. Concrete Median.

Square yards (square meters) shown in the contract documents. This will be calculated to the nearest 0.1 foot $(0.1 \mathrm{~m})$ of the length along the surface and the overall width of median when no integral curb is involved, or the width from back to back of curb when integral curb is involved.
D. Bridge Approach Sections.

Square yards (square meters) shown in the contract documents.

## E. Excavation.

1. When the contract provides a unit price per station (meter) for earth shoulder finishing and a price per cubic yard (cubic meter) for excavation, the excavation required for preparation of natural subgrade will be measured as provided in Article 2102.04. The volume measured for payment will include only the materials actually removed above the elevation of the pavement subgrade and between vertical planes 1 foot ( 0.3 m ) outside the edge of the finished pavement.
2. Other work connected with preparation of natural subgrade will not be measured for payment.
3. When the contract provides a unit price for earth shoulder construction (whether or not a unit price per cubic yard (cubic meter) of excavation is provided in the contract), excavation required for preparation of natural subgrade will not be measured for payment. Unless otherwise provided in the contract documents, work connected with preparation of natural subgrade will not be measured for payment.
F. Driveway Surfacing Material.

Tons (megagrams) or cubic yards (cubic meters), as provided in the contract and in Section 2315, placed at intersecting roads, drives, and turnouts. Excavation required for placement of this material will not be measured for payment.
G. Portland Cement Concrete Pavement Samples:

Not individually counted for payment when furnished according to Article 2301.04, A, or when required in the contract documents.
H. Saw Cut and Joint Sealing.

1. Saw cut for constructing joints in new pavement will not be measured for payment.
2. Saw cut for cutting old existing pavement, which is to be abutted with new pavement, will not be measured for payment.
3. Joint sealing will not be measured for payment.
I. Safety Fence for Pavement.

Not measured for payment.
J. Rumble Strip Panel (PCC Surface)

By count for Rumble Strip Panels properly installed at locations designated in the contract documents.
2301.05 BASIS OF PAYMENT.

Payment will be as follows:
A. Portland Cement Concrete Pavement.

1. Contract unit price for Standard or Slip-Form Portland Cement Concrete Pavement of the type specified per square yard (square meter).
2. Payment for the quantities of pavement in square yards (square meters) will be at a percentage of the contract unit price according to Table 2301.05-1.
Table 2301.05-1: Payment Schedule for Quantities of Pavement

| Thickness Index <br> Range | Percent <br> Payment | Thickness Index <br> Range | Percent <br> Payment |
| :---: | :---: | :---: | :---: |
| English (Metric) |  | English (Metric) |  |
| 0.00 or more <br> $(0.00$ or more) | 103 | -0.56 to -0.60 <br> $(-13.98$ to -15.24$)$ | 91 |


| -0.01 to -0.05 <br> $(-0.01$ to -1.27$)$ | 102 | -0.61 to -0.65 <br> $(-15.25$ to -16.51$)$ | 90 |
| :---: | :---: | :---: | :---: |
| -0.06 to -0.10 <br> $(-1.28$ to -2.54$)$ | 101 | -0.66 to -0.70 <br> $(-16.52$ to -17.78$)$ | 89 |
| -0.11 to -0.15 <br> $(-2.55$ to -3.81$)$ | 100 | -0.71 to -0.75 <br> $(-17.79$ to -19.05$)$ | 88 |
| -0.16 to -0.20 <br> $(-3.82$ to -5.08$)$ | 99 | -0.76 to -0.80 <br> $(-19.06$ to -20.32$)$ | 87 |
| -0.21 to -0.25 <br> $(-5.09$ to -6.35$)$ | 98 | -0.81 to -0.85 <br> $(-20.33$ to -21.59$)$ | 86 |
| -0.26 to -0.30 <br> $(-6.36$ to -7.62$)$ | 97 | -0.86 to -0.90 <br> $(-21.69$ to -22.86$)$ | 85 |
| -0.31 to -0.35 <br> $(-7.63$ to -8.89$)$ | 96 | -0.91 to -0.95 <br> $(-22.87$ to -24.13$)$ | 84 |
| -0.36 to -0.40 <br> $(-8.90$ to -10.16$)$ | 95 | -0.96 to -1.00 <br> $(-24.14$ to -25.40$)$ | 83 |
| -0.41 to -0.45 <br> $(-10.17$ to -11.43$)$ | 94 | -1.01 to -1.05 <br> $(-25.41$ to -26.67$)$ | 82 |
| -0.46 to -0.50 <br> $(-11.44$ to -12.70$)$ | 93 | -1.06 to -1.10 <br> $(-26.68$ to -27.94$)$ | 81 |
| -0.51 to -0.55 <br> $(-12.71$ to -13.97$)$ | 92 | -1.11 or less <br> $(-27.95$ or less) | 80 |

3. Use the following formula to determine the thickness index for the section of pavement thickness:

$$
\mathrm{TI}=\overline{(\mathrm{X}}-\mathrm{S})-\mathrm{T}
$$

Where:
$\mathrm{TI}=$ thickness index for the section.
$\bar{X}=$ mean core length thickness for the section.
$\mathrm{T}=$ design thickness see Table 2301.05-2.
$S=$ core length measurement thickness standard deviation (of the sample) for the section.
Table 2301.05-2: Thickness Value for determining Thickness Index

| Type of Base, Subbase, Subgrade just below the concrete | Value of T in Inches |
| :--- | :--- |
| Natural Subgrade or Soil Aggregate Subbase | Design Thickness |
| HMA Base, PCC Base, or Asphalt or Cement Treated Base | Design Thickness |
| Modified Subbase or Special Subbase | Design Thickness minus 0.25 inches $(6 \mathrm{~mm})$ |
| Granular Subbase | Design Thickness minus 0.35 inches $(9 \mathrm{~mm})$ |

4. Replace pavement represented by cores deficient from design thickness by 1 inch ( 25 mm ) or greater. The deficient areas and the replacement of the deficient cores will be determined according to Materials H.M. 346 Appendix A. The cost for coring that confirms deficient pavement or determines deficient areas shall be incidental to the price paid for Portland Cement Concrete Pavement. The cost for coring that indicates that pavement is sufficient shall be paid as extra work, according to Article 1109.03, B of the Standard Specifications. The cost for coring replacement pavement to verify compliance shall be incidental to the price paid for Portland Cement Concrete Pavement.
5. At the Contractor's option, cores that are measurement readings that are larger than the thickness value (from Table 2301.05-2) by three standard deviations or greater than design thickness may be removed from analysis for thickness index determination. Do not remove more than $10 \%$ of the total cores measurements in a section. Do not replace eores measurements removed from the analysis.
6. Gaps in the pavement less than 500 feet ( 150 m ), required by staging, will be considered irregular areas for analysis of pavement thickness determinations.
7. The percent payment for projects which have all core lengths measurement readings greater than design thickness T in Table 2301.05-2 will be at least 100\%.
B. Integral Curb.

Not paid for separately.
C. Concrete Median

Contract unit price per square yard (square meter).
D. Bridge Approach Sections.

1. Contract unit price for bridge approach pavement per square yard (square meter).
2. Payment is full compensation for:

- Excavation for modified subbase and subdrain.
- Furnishing and installing subdrain.
- Furnishing and installing subdrain outlet.
- Furnishing and installing polymer grid.
- Furnishing and placing porous backfill material.
- Furnishing and placing modified subbase backfill material.
- Saw cutting.
- Furnishing and installing reinforcing steel, tie bars, and dowel assemblies.
- Placing, finishing, texturing, grooving, and curing.
- All joint construction.
- All other materials and labor to construct the Bridge Approach Section as shown in the contract documents.


## E. Excavation.

1. When the contract provides a unit price per station (meter) for earth shoulder finishing and the contract also provides a price per cubic yard (cubic meter) for excavation, payment will be the contract unit price per cubic yard (cubic meter) for excavation in connection with subgrade preparation and building shoulders.
2. When the contract provides a unit price for earth shoulder construction, the excavation required for preparation of subgrade and construction of shoulders will not be paid for as a separate item. It is incidental to pavement construction and earth shoulder construction and is to be included in those contract prices.
3. When no price per cubic yard (cubic meter) for excavation is provided in the contract and no unit price is provided for earth shoulder finishing or earth shoulder construction, excavation necessary for subgrade preparation is incidental to pavement construction and is to be included in that contract unit price.

## F. Driveway Surfacing Material.

Contract unit price as provided in Section 2315 for the quantity of driveway surfacing placed.
G. Portland Cement Concrete Pavement Samples.

1. Lump sum contract price for furnishing samples of finished pavement or other course according to Article 2301.04, A, or when required in the contract documents.
2. Payment is full compensation for furnishing all such samples for all courses or items of work.
H. Saw Cut and Joint Sealing

Incidental to the price for pavement.
I. Safety Fence for Pavement.

Incidental to the price for pavement.
J. Rumble Strip Panel (PCC Surface)

Each. Payment is full compensation for construction of the panels as detailed in the contract documents.

## K. General.

1. Deduction will not be made from the area of pavement for fixtures with an area less than 9 square feet ( $1 \mathrm{~m}^{2}$ ).
2. When any of the types of additional protection described in Article 2301.03, K, 3, is necessary, additional payment will be made as extra work at the rate of $\$ 1.00$ per square yard ( $\$ 1.20$ per square meter) of surface protected. Payment will be limited to protection necessary within the contract period. Protection necessary after November 15 will be paid for only when the Engineer authorizes the work.
3. Furnish concrete for test specimens and transport the specimens and molds between the grade and plant as directed by the Engineer, at no additional cost to the Contracting Authority.
4. The above prices are full compensation for furnishing all tools, equipment, labor, and materials necessary for construction of the pavement in accordance with the contract documents.
5. The cost of furnishing, installing, and monitoring vibrators, as well as the vibrator monitoring device itself, is incidental to the contract unit price for PCC pavement.

## APPENDIX A <br> EVALUATING PORTLAND CEMENT CONCRETE PAVEMENT THICKNESS

## SCOPE

Thickness measurements will be taken on Portland Cement Concrete (PCC) pavement, to determine the pavement thickness and the thickness index for each section. Refer to Specification DS-12027.

## APPARATUS

1. An MIT Scan T2 gauge will be used to perform thickness measures.
2. Steel Targets will be 11.81 inches $(300.0 \mathrm{~mm})$ in diameter, 24 gauge, meeting ASTM A 653, commercial steel with a G90 coating (about $275 \mathrm{~g} / \mathrm{m}^{2}$ total both sides).

## DEFINITIONS

Section: $\quad$ All Portland Cement Concrete in a project of the same bid item. Irregular areas, as defined herein, of the same bid item shall form a separate section.

Lot: $\quad$ A portion of a section normally 200 feet $(50 \mathrm{~m})$ in length and 2 traffic lanes wide.

## Regular area pavement sections:

- All mainline pavement for normal travel lanes. Includes middle (both direction) turn lanes
- Paved shoulder - if same thickness as pavement and part of pavement bid item include with pavement. If separate bid item, treat as separate section.
- Paved median - if same thickness as pavement and part of pavement bid item, and longer than 300 feet ( 100 m ), include with pavement.
- Auxiliary lanes of full width longer 300 feet ( 100 m ).
- Widening greater than 6 feet ( 2 m ).


## Irregular areas:

- Widening less than 6 feet ( 2 m ).
- Side street connections.
- Ramps, including gore areas, and collector distributor roads.
- Deceleration and acceleration lanes.
- Turn lanes, including taper sections.
- Tapers.
- Radiuses.
- Median crossovers


## PROCEDURES

The District Materials Engineer will determine the location of each lot, the random location of each metal target, and the random thickness measuring scheme for each section using an lowa DOT developed MSExcel spreadsheet.
A. Target Location for Regular Areas

1. Divide the section longitudinally into 200 foot ( 50 m ) long lots. One target will be located in each lot based on the spreadsheet selection (The targets should be placed half way between dowel baskets). See Figure 1. A minimum of ten targets will be tested. If a target location falls on a bridge or in an approach section, it will be eliminated.
2. The transverse location of the targets will be randomly determined by the spreadsheet program. The random locations will be either 6 or 10 feet ( 2 or 3 m ) left or right of centerline. When tie steel is present at the edge of the pavement or lane, the locations will be 5 or 9 feet ( 1.5 or 2.5 m ).
3. The program will randomly determine which targets to measure. If a measurement location falls on a bridge or bridge approach pavement, it will be eliminated and the next closest target not in the original random selection will be used for measurement.
4. Shoulders. Divide the section into 200 foot ( 50 m ) long lots. Place targets approximately mid-point transversely on shoulders wider than 6 feet ( 1.82 m ). On 6 foot ( 1.82 m ) shoulders, the targets should be 4 feet $(1.2 \mathrm{~m})$ from the edge of the pavement.

Figure1. Target Location

B. Target Location for Irregular Areas

1. All irregular areas of the same design thickness will be grouped together for determining the number of lots. The Engineer may waive sections of the same design thickness that total less than 5,000 square yards (4200 sq. m).
2. Place targets randomly in all irregular areas larger than 100 square feet $\left(10 \mathrm{~m}^{2}\right)$. One target will be randomly located in each selected irregular area, unless one or more of the areas are significantly larger than the others, then more than one target may be located in the large area. Targets must be placed at least 2 feet $(0.6 \mathrm{~m})$ away from tie steel and 4 feet $(1.2 \mathrm{~m})$ from dowel bars. A minimum of ten targets will be tested to represent each section of irregular areas. All targets will be measured.
C. Testing

Follow the manufacturer's instructions for operating the thickness gauge. It is important to avoid testing close to any steel including vehicles, equipment, steel toed shoes as well as tie bars, dowel bars and baskets, and manhole covers. When wearing steel toed shoes, always keep both toes at least 2 feet ( 0.6 m ) from the gauge during the test. Three repeat readings will be taken. The readings should all be within 1 to 2 mm of each other. If the difference between any of the readings is more than 3 mm , take 2 additional readings. If the two additional readings are within 3 mm of any of the first 3 readings, the measurement is valid for that location. If not, note that the location is not valid and select the next target location not originally selected for testing.

The US made targets produce a slight bias on the T2 unit (approximately 3 mm less than the actual thickness). The correction factor is programmed into the reporting spreadsheet. The correlation factor is:

Corrected Thickness Reading $=-0.00003723 X(T 2 \text { reading })^{2}+1.01629229 X(T 2$ reading $)+1.44772852$
D. Section Evaluation

1. Use the following formula to determine the mean thickness for the section:

$$
\overline{\mathrm{X}}=\frac{\sum \mathrm{X}}{n}
$$

Where: $\overline{\mathrm{X}}=$ mean length for the section

$$
\begin{aligned}
\sum \mathrm{X} & =\text { sum of core lengths for the section } \\
\mathrm{n} & =\text { number of cores taken within the section }
\end{aligned}
$$

Round the mean thickness to two decimal places.
2. Use the following formula to determine the sample standard deviation of the thickness of the section:

$$
S=\sqrt{\frac{\sum(X-\bar{X})^{2}}{n-1}}
$$

Where:

| S | $=$ thickness standard deviation for the section. |
| :--- | :--- |
| $\overline{\mathrm{X}}$ | $=$ mean thickness for the section |
| X | $=$ individual thickness values for the section. |
| n | $=$ number of tests representing the section. |

$$
\sum=\text { sign indicating the sum of all values of }(\mathrm{X}-\overline{\mathrm{X}})^{2}
$$

Round the sample standard deviation to two decimal places.
NOTE: Calculations of the standard deviation are best made with an electronic calculator with standard deviation capability that uses the formula containing the quantity ( $n-1$ ).
3. Use the following formula to determine the thickness index for the section of pavement thickness.

$$
\mathrm{TI}=(\overline{\mathrm{X}}-\mathrm{S})-\mathrm{T}
$$

Where:
TI = thickness index for the section
$\bar{X} \quad=$ mean thickness length for the section
$\mathrm{T}=$ from Table 2301.05-2
S = measurement thickness standard deviation (of the sample) for the section
Round the thickness index to two decimal places.
NOTE: If the mean thickness minus the standard deviation is less than $T$ of the section, the thickness index will be a negative number.
4. Basis of Payment. Payment for the quantities of pavement in square yards (square meters) in each section will be as shown in Article 2301.05 and based on the thickness index as determined in accordance with these instructions.
E. Deficient Areas

1. If any measurement is deficient from $T$ by 1 inch ( 25.4 mm ) or more, the measurement should be rechecked to confirm the reading and the equipment. If the repeat measurement is also 1 inch ( 25.4 mm ) or more below T , mark the location directly over the target. The Contractor shall drill a 4.0 inch ( 101.6 mm ) diameter core at that location. If the core length confirms the pavement is deficient by 1 inch or more, continue to drill cores as described below.
2. Deficient areas, represented by cores deficient in length by 1 inch ( 25.4 mm ) or more from design thickness, are to be replaced. These areas will be determined by drilling a core 60 feet ( 18 m ) in each direction longitudinally at the same transverse location from the deficient core. Drilling will be continued at 60 feet (18 m ) intervals until a core is obtained which is not deficient by 1 inch ( 25.4 mm ) or more from design thickness. Interpolate between this core and the adjacent core to determine the limits of the deficient area. This is the area to be removed and replaced at contractor's expense. These additional cores are to be used to define the deficient area and will not be used in the thickness index calculation. When an obstruction, such as a bridge, intersection, previous work, etc., prevents drilling a core at the required 60 feet ( 18 m ) interval in either direction longitudinally, continue the balance of the distance on the other side of the obstruction.
3. Any readings taken in the area for removal will be eliminated from the analysis for the entire section. After replacement, the contractor will take cores as directed by the engineer to verify the thickness.


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