# Illinois Department of Transportation

## Memorandum

| | |
|---|---|
| To: | * |
| From: | Rich Dotson |
| Subject: | **Special Provision Changes** |
| Date: | August 28, 2013 |

The following special provisions have been revised for the November 8, 2013 letting. Please revise your special provision books as indicated.

### Recurring Special Provisions

No changes.

### Interim Special Provisions

| ISP Number | Description |
|---|---|
| Alphabetic ISP Index (Revised) | Remove existing alphabetic index and insert revised index. |
| Numerical ISP Index (Revised) | Remove existing numeric index and insert revised index. |

### Interim Special Provisions

| ISP Number | Description |
|---|---|
| 312.26 (Revised) | **"Portland Cement Concrete (BDE)"** Revised to require the use of wetted burlap or wetted cotton mat curing for abutments and piers. |
| 406.00 (Revised) | **"Warm Mix Asphalt (BDE)"** Revised to eliminate redundant requirements. |
| 406.01 (New) | **"Hot-Mix Asphalt – Mixture Design Verification and Production (BDE)"** Contains Hamburg Wheel and tensile strength requirements and redefines test strip requirements. |
| 406.14 (New) | **"Hot-Mix Asphalt – Mixture Design Composition and Volumetric Requirements (BDE)"** This special provision was developed by the Bureau of Materials and Physical Research to 1) define an acceptable range of air voids for determing acceptability of a test strip, 2) revise the minimum percent passing the #8 sieve requirements for IL-9.5 surface mixtures, 3) increase VMA requirement to 15.0 percent for IL-9.5 surface mixtures, and 4) add in the missing field VMA control limits for IL-4.75 mixtures. |

## Interim Special Provisions

| ISP Number | Description |
|---|---|
| 508.05 (New) | **"Reinforcement Bars (BDE)"**<br>Clarifies the use of molded plastic clips, plastic chairs, and welding of reinforcement bars. |
| 542.02 (New) | **"LRFD Pipe Culvert Burial Tables (BDE)"**<br>Provides new burial table to agree with AASHTO LRFD Design Code. |
| 543.00 (Revised) | **"Insertion Lining of Culverts (BDE)"**<br>Replaces Section 543 of the Specification Book. |
| 550.00 (New) | **"LRFD Storm Sewer Burial Tables (BDE)"**<br>Provides new burial table to agree with AASHTO LRFD Design Code. |
| 1020.16 (Revised) | **"Quality Control/Quality Assurance of Concrete Mixtures (BDE)"**<br>Revised to allow 4 in. x 8 in. test cyclinders. |
| 1031.00 (Revised) | **"Reclaimed Asphalt Pavement and Reclaimed Asphalt Shingles (BDE)"**<br>Revised to eliminate redundant requirements and create a separate special for the Hamburg Wheel. |
| 1103.03 (New) | **"Portland Cement Concrete Equipment (BDE)"**<br>Provides an alternative to locking the mixing time adjusting control. |

## District Special Provisions

| District Number | Description |
|---|---|
| Alphabetic District Index (Revised) | Remove existing alphabetic index and insert revised index. |
| Numerical District Index (Revised) | Remove existing numeric index and insert revised index. |
| 105.07b (Revised) | **"Utilities – Locations/Information on Plans"**<br>Moved from General Notes to District Special Provisions. |
| 440.03a (Revised) | **"Hot-Mix Asphalt Surface Removal, _____"**<br>(_____ mm)"<br>Revised maximum depth of milling at edge of pavement. |
| 440.03b (Revised) | **"Hot-Mix Asphalt Surface Removal, _____"**<br>(_____ mm)"<br>Revised maximum depth of milling at edge of pavement. |

## District Special Provisions *(continued)*

| District Number | Description |
|---|---|
| 602.00n (Revised) | **"Inlets, Type "__*__", with Special Frame and Grate"**<br>Revised title and created to include appropriate inlet type and either specify the casting to be installed within this special provision or provide a table in the plans. "*" Shall be replaced by "A" or "B". |
| 602.00o (Revised) | **"Manhole, Type A, of the Diameter Specified with Special Frame and Grate"**<br>Revised title and created to include the diameter and either specify the casting to be installed within this special provision or provide a table in the plans. "*" Shall be replaced by diameter in feet. |
| 1103.03 (Revised) | **"PCC Automatic Batching Equipment"**<br>Revised Designer Note. |

## General Notes

| | |
|---|---|
| Section 100 Index | Remove old Index and replace. |
| Alphabetic District Index (Revised) | Remove existing alphabetic index and insert revised index. |
| 105.06 (Revised) | **"Availability of Electronic Files"**<br>Revised first sentence. |
| 105.07 (Deleted) | **"Utilities – Locations/Information on Plans"**<br>Moved to District Special Provisions. |
| 204.00 (Revised) | **"Environmental Reviews"**<br>Updated timeframes and removed a form. |

RJD:tdp:\mgr1\winword\progdev\special provisions\interim spec provs\specprovchngsmemo.doc

Attachment(s)

cc: * N. Jack, K. Emert, T. Phillips, Team 1, Team 2, Team 3, Team 4, Team 5, Team 6, Team 7, Team 8, Team 9, Team 10, Team 11, Geometrics (L. Crespo), Bridge (T. Inglis), Monmouth Campus (T. Skaggs), Local Roads (M. Augspurger), Local Roads (T. Sassine/K. Park), Materials (L. Williams)

# Special Provisions Generated Checklist
# Generated - 8/27/13 2:34 PM

## November 8, 2013 Letting

# SPECIAL PROVISIONS CHECK LIST
## Generated - 8/27/13 2:34 PM

**Designer:** _____ **FAP:** _____
**Contract No.:** _____ **Section:** _____
**County:** _____

**Note: Specials that go in every contract have already been marked with an "√" for you.**

| √ | Dir | File Name | Spec Title | Spec Dates |
|---|---|---|---|---|
| | BRG\ | APSLRP-1.DOC | Approach Slab Repair | E 3/13/97 |
| | DES\ | 10500.doc | Construction Station Layout | E 7/30/10 |
| | DES\ | 10506.doc | Prestage Site Construction Meetings | E 6/1/92 |
| | DES\ | 10507.doc | Removal of Abandoned Underground Utilities | E 1/15/96 R 11/21/96 |
| | DES\ | 10507a.doc | Status of Utilities/Utilities To Be Adjusted | E 1-21-05 |
| | DES\ | 10507b.doc | Utilities - Locations/Information on Plans | E 11/8/13 |
| | DES\ | 10700a.doc | Nationwide 404 Permit Requirements | E 1/22/01 R 8/2/02 |
| √ | DES\ | 10731.doc | Location of Underground State Maintained Facilities | E 8/3/07 R 7/31/09 |
| | DES\ | 10732.doc | Right-of-Way Restrictions | E 7/1/94 |
| | DES\ | 10803.doc | Delayed Start of Multiple Contracts | E 11/1/01 |
| | DES\ | 10805a.doc | Date of Completion | E 3/1/90 R 4/28/08 |
| | DES\ | 10805b.doc | Date of Completion (Plus Working Days) | E 3/1/90 R 7/1/94 |
| | DES\ | 20400.doc | Borrow and Furnished Excavation | E 3/7/00 R 4/27/07 |
| | DES\ | 20500.doc | Geotechnical Reinforcement | E 6/10/93 R 1/1/07 |
| | DES\ | 20504.doc | Embankment (Restrictions) | E 1/21/05 R 8/3/07 |
| | DES\ | 20505.doc | Embankment | E 7/1/90 R 8/3/07 |
| | DES\ | 20505a.doc | Embankment (Small Embankment) | E 10/1/99 R 1/1/07 |
| | DES\ | 25000.doc | Seeding, Minor Areas | E 7/1/90 R 1/1/07 |
| | DES\ | 25006a.doc | Mowing | E 12/11/01 R 1/1/12 |
| | DES\ | 25006b.doc | Mowing | E 12/11/01 R 1/1/12 |
| | DES\ | 25300.doc | Tree Whip Mixture | E 8/15/91 R 4/25/08 |
| | DES\ | 25300b.doc | Seedling Mixture A | E 5/5/00 R 11/1/08 |
| | DES\ | 28100.doc | Grout for Use With Riprap | E 7/30/10 |
| | DES\ | 28104.doc | Stone Dumped Riprap* | E 4/15/91 R 1/1/07 |
| | DES\ | 28106.doc | Stone Riprap | E 11/5/10 |
| | DES\ | 28303.doc | Aggregate Ditch | E 4/15/91 R 10/15/01 |
| | DES\ | 30101.doc | Proof Rolling | E 4/23/04 R 1/1/07 |
| | DES\ | 30103.doc | Subgrade Treatment | E 7/1/90 R 4/28/08 |
| | DES\ | 30200.doc | Soil Modification | E 7/1/90 R 7/30/10 |
| | DES\ | 31100.doc | Rock Fill | E 10/15/95 R 4/26/13 |
| | DES\ | 31101.doc | Subbase Granular Material | E 11/5/04 |
| | DES\ | 35500d.doc | Temporary Pavement | E 10/1/95 R 4/23/10 |
| | DES\ | 35600.doc | Temporary Base Course Widening ___" | E 4/26/13 |
| | DES\ | 40600.doc | Clean Existing Pavement Edge Joint | E 1/3/00 R 1/1/07 |
| | DES\ | 40601.doc | Anti-Strip Additive for Hot-Mix Asphalt | E 7/30/10 |
| | DES\ | 40602.doc | Hot-Mix Asphalt - Prime Coat | E 4/29/11 R 4/26/13 |
| | DES\ | 40604a.doc | Hot-Mix Asphalt Surface Course Surface Tests | E 11/1/03 R 1/1/07 |
| | DES\ | 40613.doc | Payment for Use of Material Transfer Device | E 4/23/10 |

# SPECIAL PROVISIONS CHECK LIST
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**Designer:** _____ **FAP:** _____
**Contract No.:** _____ **Section:** _____
**County:** _____

| | | | | |
|---|---|---|---|---|
| | DES\ | 40706.doc | Bituminous Prime Coat for Hot-Mix Asphalt Pavement (Full-Depth) | E 8/3/07 R 4/23/10 |
| | DES\ | 40713.doc | Grooved-in Rumble Strip | E 11/16/07 R 7/30/10 |
| | DES\ | 42020.doc | Railroad Approach Pavement | E 10/1/95 R 1/1/07 |
| | DES\ | 42401.doc | Sidewalk Drains | E 3/1/91 R 1/1/07 |
| | DES\ | 42402.doc | Temporary Sidewalks | E 3/1/91 R 2/1/96 |
| | DES\ | 44000.doc | Partial Depth Patching | E 4/26/13 |
| | DES\ | 44001.doc | Bridge Wearing Surface Removal | E 7/1/90 R 1/1/07 |
| | DES\ | 44002.doc | Longitudinal Joint Repair | E 4/26/13 |
| | DES\ | 44003.doc | Protection of Frames and Lids of Utility Structures | E 3/6/91 R 1/1/07 |
| | DES\ | 44003a.doc | Hot-Mix Asphalt Surface Removal, **" (** mm) | E 3/1/93 R 11/8/13 |
| | DES\ | 44003b.doc | Hot-Mix Asphalt Surface Removal, **" (** mm) | E 2/5/93 R 11/8/13 |
| | DES\ | 44003c.doc | Center Joint Repair System | E 3/1/91 R 1/1/07 |
| | DES\ | 44003d.doc | Pavement Drainage After Cold Milling | E 3/15/96 R 1/1/07 |
| | DES\ | 44003e.doc | Pavement Patching with Hot-Mix Asphalt Surface Removal | E 3/1/97 R 1/1/07 |
| | DES\ | 44003f.doc | Hot-Mix Asphalt Concrete Milling Material | E 11/1/03 R 8/3/07 |
| | DES\ | 44200.doc | Class (*) Patches, Type (**),(***) " | E 1/1/99 R 11/1/07 |
| | DES\ | 44300.doc | Reflective Crack Control Treatment | E 3/1/96 R 1/1/07 |
| | DES\ | 45100.doc | Crack and Joint Sealing | E 6/15/97 R 1/1/07 |
| | DES\ | 48205.doc | Hot-Mix Asphalt Shoulder Resurfacing Required to be Constructed Simultaneously with Mainline Paving | E 4/23/10 |
| | DES\ | 48206.doc | Hot-Mix Asphalt Shoulder Resurfacing Constructed Simultaneously with Mainline Paving | E 1/22/01 R 1/1/07 |
| | DES\ | 50103.doc | Concrete Headwall Removal | E 7/1/90 |
| | DES\ | 50104.doc | Concrete Handrail Removal | E 7/1/90 R 1/1/07 |
| | DES\ | 50300.doc | Bin-Type Retaining Wall | E 7/1/90 R 1/1/07 |
| | DES\ | 50301.doc | Concrete Wearing Surface | E 7/1/90 R 1/1/07 |
| | DES\ | 50302.doc | Surface Filler, Special (Gallon) | E 4/23/10 |
| | DES\ | 50312.doc | Plug Existing Deck Drains | E 1/1/96 R 3/22/01 |
| | DES\ | 50312a.doc | Floor Drain Extension | E 3/22/01 |
| | DES\ | 50317.doc | Bridge Floor Finishing Machine | E 5/1/95 R 1/1/07 |
| | DES\ | 50319.doc | Protective Coat, Special | E 4/23/10 |
| | DES\ | 52100b.doc | Jack and Reposition Bearings | E 11/15/93 R 1/1/09 |
| | DES\ | 52100c.doc | Jacking and Cribbing | E 1/1/94 R 1/1/07 |
| | DES\ | 54200.doc | Seepage Collar | E 12/1/96 |
| | DES\ | 54201.doc | Remove and Relay Pipe Culverts | E 7/1/90 R 1/1/07 |
| | DES\ | 54204.doc | Pipe Culverts | E 7/1/90 R 1/1/07 |
| | DES\ | 54204e.doc | Backfill - Pipe Culverts | E 10/15/95 R 1/1/07 |
| | DES\ | 55000.doc | Storm Sewer, (Water Main Quality Pipe) | E 1/1/11 R 1/1/12 |
| | DES\ | 55007.doc | Backfill, Building Removal | E 8/20/91 R 1/1/07 |

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**County:** _____

| | | | | |
|---|---|---|---|---|
| | DES\ | 55200.doc | Steel Pipe Culvert, Special (Jacked) * inches (* mm) | E 7/1/94 R 1/1/07 |
| | DES\ | 55201.doc | (*Storm Sewer/Pipe Culvert) Jacked in Place, ** inches (** mm) | E 7/1/94 R 1/1/07 |
| | DES\ | 56100.doc | Steel Casings * Inches | E 7/1/90 R 1/1/13 |
| | DES\ | 56101.doc | Steel Casings * Inches | E 7/1/90 R 1/1/13 |
| | DES\ | 60101.doc | Pipe Underdrain | E 8/1/03 |
| | DES\ | 60200a.doc | Inlets, Type G-1 | E 10/1/95 R 1/1/07 |
| | DES\ | 60200b.doc | Inlets, Type G-1, Special | E 10/1/95 R 1/1/07 |
| | DES\ | 60200c.doc | Inlets, Type G-1, Double, Special | E 10/1/95 R 1/1/07 |
| | DES\ | 60200d.doc | Inlet Manhole, Type G-1, 4' (1.2 m) Diameter | E 10/1/95 R 1/1/07 |
| | DES\ | 60200e.doc | Inlet-Manhole, Type G-1, 4' (1.2 m) Diameter, Special | E 10/1/95 R 1/1/07 |
| | DES\ | 60200f.doc | Inlet-Manhole, Type G-1, 5' (1.5 m) Diameter | E 10/1/95 R 1/1/07 |
| | DES\ | 60200g.doc | Inlet-Manhole, Type G-1, 5' (1.5 m) Diameter, Special | E 10/1/95 R 1/1/07 |
| | DES\ | 60200h.doc | Inlet-Manhole, Type G-1, 5' (1.5 m) Diameter, Double, Special | E 10/1/95 R 1/1/07 |
| | DES\ | 60200i.doc | Inlet-Manhole, Type G-1, 8' (2.4 m) Diameter, Double, Special | E 10/1/95 R 1/1/07 |
| | DES\ | 60200j.doc | Manhole to be Adjusted with New Type G-1 Frame and Grate | E 10/1/95 R 1/1/07 |
| | DES\ | 60200k.doc | Temporary Inlet Drainage Treatment | E 1/1/97 |
| | DES\ | 60200l.doc | Inlets, Type G-2 | E 11/1/03 R 1/1/07 |
| | DES\ | 60200m.doc | Inlets, Type G-1, Double | E 7/31/09 |
| | DES\ | 60200n.doc | Inlets, Type " * ", With Special Frame and Grate | E 8/2/13 |
| | DES\ | 60200o.doc | Manhole, Type A, of the Diameter Specified with Special Frame and Grate | E 8/2/13 |
| | DES\ | 60504.doc | Filling Existing Inlets | E 7/1/90 R 7/1/94 |
| | DES\ | 60504a.doc | Filling Existing Culverts | E 10/15/95 R 1/1/07 |
| | DES\ | 60504b.doc | Filling Existing Drainage Structures | E 10/15/95 R 1/1/07 |
| | DES\ | 60608.doc | Island Pavement Constructed on Existing Pavement | E 1/1/97 R 1/1/07 |
| | DES\ | 60612.doc | Drainage Holes | E 7/1/90 R 1/1/07 |
| | DES\ | 63000.doc | Erosion Control Curb | E 4/1/91 R 1/1/07 |
| | DES\ | 63001.doc | Guardrail Aggregate Erosion Control | E 2/1/93 R 1/1/07 |
| | DES\ | 63008.doc | Steel Plate Beam Guardrail, Type A, 6.75 Foot Posts | E 7/31/09 R 4/27/12 |
| | DES\ | 63104.doc | Traffic Barrier Terminals, Type 1, Special (Flared) or (Tangent) | E 7/31/09 R 4/26/13 |
| | DES\ | 63107.doc | Traffic Barrier Terminals, Type 6 | E 7/31/09 |
| | DES\ | 63111c.doc | Traffic Barrier Terminals | E 2/1/96 R 11/5/04 |
| | DES\ | 63114.doc | Traffic Barrier Terminals, Type 2 | E 7/31/09 |
| | DES\ | 63200.doc | Guard Post Removal | E 7/1/90 R 1/1/07 |
| | DES\ | 63500.doc | Flexible Delineator Maintenance | E 5/5/92 R 1/1/94 |

# SPECIAL PROVISIONS CHECK LIST
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**Contract No.:** _____ **Section:** _____
**County:** _____

| | | | | |
|---|---|---|---|---|
| | DES\ | 63501.doc | Flexible Delineators | E 10/1/95 R 1/1/07 |
| | DES\ | 66704.doc | Permanent Survey Marker, Type 1, Bridge Placement | E 7/1/90 R 3/11/11 |
| | DES\ | 66802.doc | Permanent Survey Ties | E 4/1/91 R 4/27/12 |
| | DES\ | 67005.doc | Equipment Vault for Nuclear Testing Equipment | E 6/24/93 R 7/1/94 |
| | DES\ | 68000.doc | Railroad Track Removal | E 11/1/94 R 1/1/07 |
| | DES\ | 68000a.doc | Railroad Ties Removal and Disposal | E 11/1/94 R 10/1/95 |
| | DES\ | 68300.doc | Mortared Stone Wall | E 3/1/91 R 1/1/07 |
| √ | DES\ | 70100.doc | Traffic Control Plan | E R |
| | DES\ | 70106.doc | Speeding Penalty | E 1/21/05 |
| | DES\ | 70108b.doc | Traffic Control and Protection Standard 701331 (Special) | E 10/15/95 R 7/31/09 |
| | DES\ | 70114.doc | Width Restriction Signing | E 11/1/07 R 1/1/12 |
| | DES\ | 70120.doc | Traffic Control and Protection BLR 21 and BLR 21 (Special) | E 4/25/08 |
| | DES\ | 70121.doc | Traffic Control and Protection BLR 22 and BLR 22 (Special) | E 4/25/08 R 7/31/09 |
| | DES\ | 70122.doc | Traffic Control and Protection Standard 701606 (Special) | E 7/31/09 |
| | DES\ | 70300.doc | Pavement Marking Removal/Work Zone Pavement Marking Removal | E 4/29/05 |
| | DES\ | 70400.doc | Temporary Concrete Barrier, State Owned and Temporary Concrete Barrier Terminal Sections, State Owned | E 5/1/91 R 1/1/07 |
| | DES\ | 70400a.doc | Temporary Concrete Barrier Reflectors | E 1/21/05 |
| | DES\ | 78000.doc | Thermoplastic Pavement Marking Equipment | E 7/1/90 R 1/1/07 |
| | DES\ | 78001.doc | Thermoplastic Pavement Marking Equipment | E 7/1/90 R 1/1/07 |
| | DES\ | 78002.doc | Thermoplastic Pavement Marking Equipment | E 7/1/90 R 1/1/07 |
| | DES\ | 78100.doc | Temporary Raised Reflective Pavement Marker | E 10/1/95 R 1/1/07 |
| | DES\ | 81000.doc | Conduit, Pushed or Trenched | E 10/1/91 R 1/1/07 |
| | DES\ | 81500.doc | Trench & Backfill, Special for Conduit Installation Beneath Bituminous Shoulders | E 3/21/94 R 1/1/07 |
| | DES\ | 86300.doc | Terminal Facility | E 3/21/94 R 1/1/07 |
| | DES\ | 87300.doc | Electric Cable in Conduit, Lead-In, No. 18 | E 3/21/94 R 10/15/01 |
| | DES\ | 88600.doc | Detector Loop, Special for Traffic Counters | E 3/21/94 R 1/1/07 |
| | DES\ | 88600a.doc | Detector Loops, Type 1 | E 3/1/96 R 8/3/07 |
| | DES\ | 100400.doc | Aggregate Optimization of Class PV Mix for Slipform Paving | E 8/3/12 |
| | DES\ | 100401.doc | Coarse Aggregate Fill | E 4/29/11 |
| | DES\ | 100402.doc | Concrete Superstructure Aggregate Optimization | E 8/4/06 R 8/3/12 |
| | DES\ | 100403b.doc | Coarse Aggregate for Bituminous Courses, | E 6/29/93 R 1/1/07 |

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**Designer:** _____ **FAP:** _____
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| | | | | |
|---|---|---|---|---|
| | | | Class A | |
| | DES\ | 100404.doc | Aggregate Quality | E 7/1/90 R 4/26/13 |
| | DES\ | 103000.doc | Hot Mix Asphalt Quality Control for Performance (D4) | E 4/26/13 |
| | DES\ | 103001.doc | Hot-Mix Asphalt - Pay for Performance Using Percent within Limits - Jobsite Sampling (D4) | E 4/26/13 |
| | DES\ | 103004.doc | Hot-Mix Asphalt - Mixture Design Verification and Production | E 8/3/12 R 4/26/13 |
| | DES\ | 103100.doc | Reclaimed Asphalt Pavement and Reclaimed Shingles (D4) | E 4/26/13 |
| | DES\ | 110300.doc | PCC QC/QA Electronic Report Submittal | E 4/26/13 |
| | DES\ | 110303.doc | PCC Automatic Batching Equipment | E 4/23/10 R 11/8/13 |

# BDE Special Provisions Checklist

## November 8, 2013 Letting

**Note: Specials that go in every contract have already been marked with an "X" for you.**

**Designer:** _____ **FAP:** _____

**Contract No.:** _____ **Section:** _____

**Letting:** November 8, 2013 **County:** _____

BDE SPECIAL PROVISIONS
For the November 8, 2013 Letting

The following special provisions indicated by an "x" are applicable to this contract and will be included by the Project Development and Implementation Section of the BD&E. An * indicates a new or revised special provision for the letting.

| | File Name | # | | Special Provision Title | Effective | Revised |
|---|---|---|---|---|---|---|
| | 80240 | 1 | | Above Grade Inlet Protection | July 1, 2009 | Jan. 1, 2012 |
| | 80099 | 2 | | Accessible Pedestrian Signals (APS) | April 1, 2003 | Jan. 1, 2007 |
| | 80274 | 3 | | Aggregate Subgrade Improvement | April 1, 2012 | Jan. 1, 2013 |
| | 80309 | 4 | | Anchor Bolts | Jan. 1, 2013 | |
| | 80192 | 5 | | Automated Flagger Assistance Device | Jan. 1, 2008 | |
| | 80173 | 6 | | Bituminous Materials Cost Adjustments | Nov. 2, 2006 | Aug. 1, 2013 |
| | 80241 | 7 | | Bridge Demolition Debris | July 1, 2009 | |
| | 80276 | 8 | | Bridge Relief Joint Sealer | Jan. 1, 2012 | Aug. 1, 2012 |
| | 5026I | 9 | | Building Removal-Case I (Non-Friable and Friable Asbestos) | Sept. 1, 1990 | April 1, 2010 |
| | 5048I | 10 | | Building Removal-Case II (Non-Friable Asbestos) | Sept. 1, 1990 | April 1, 2010 |
| | 5049I | 11 | | Building Removal-Case III (Friable Asbestos) | Sept. 1, 1990 | April 1, 2010 |
| | 5053I | 12 | | Building Removal-Case IV (No Asbestos) | Sept. 1, 1990 | April 1, 2010 |
| | 80292 | 13 | | Coarse Aggregate in Bridge Approach Slabs/Footings | April 1, 2012 | April 1, 2013 |
| | 80310 | 14 | | Coated Galvanized Steel Conduit | Jan. 1, 2013 | |
| | 80198 | 15 | | Completion Date (via calendar days) | April 1, 2008 | |
| | 80199 | 16 | | Completion Date (via calendar days) Plus Working Days | April 1, 2008 | |
| | 80293 | 17 | | Concrete Box Culverts with Skews > 30 Degrees and Design Fills ≤ 5 Feet | April 1, 2012 | |
| | 80294 | 18 | | Concrete Box Culverts with Skews ≤ 30 Degrees Regardless of Design Fill and Skews > 30 Degrees with Design Fills > 5 Feet | April 1, 2012 | |
| | 80311 | 19 | | Concrete End Sections for Pipe Culverts | Jan. 1, 2013 | |
| | 80277 | 20 | | Concrete Mix Design – Department Provided | Jan. 1, 2012 | |
| | 80261 | 21 | | Construction Air Quality – Diesel Retrofit | June 1, 2010 | |
| | 80029 | 22 | | Disadvantaged Business Enterprise Participation | Sept. 1, 2000 | Aug. 2, 2011 |
| | 80312 | 23 | | Drain Pipe, Tile, Drainage Mat, and Wall Drain | Jan. 1, 2013 | |
| | 80313 | 24 | | Fabric Bearing Pads | Jan. 1, 2013 | |
| | 80265 | 25 | | Friction Aggregate | Jan. 1, 2011 | |
| | 80229 | 26 | | Fuel Cost Adjustment | April 1, 2009 | July 1, 2009 |
| | 80303 | 27 | | Granular Materials | Nov. 1, 2012 | |
| | 80304 | 28 | | Grooving for Recessed Pavement Markings | Nov. 1, 2012 | Jan. 1, 2013 |
| | 80169 | 29 | | High Tension Cable Median Barrier | Jan. 1, 2007 | Jan. 1, 2013 |
| | 80246 | 30 | | Hot-Mix Asphalt – Density Testing of Longitudinal Joints | Jan. 1, 2010 | April 1, 2012 |
| * | 80322 | 31 | | Hot-Mix Asphalt – Mixture Design Composition and Volumetric Requirements | Nov. 1, 2013 | |
| * | 80323 | 32 | | Hot-Mix Asphalt – Mixture Design Verification and Production | Nov. 1, 2013 | |
| * | 80315 | 33 | | Insertion Lining of Culverts | Jan. 1, 2013 | Nov. 1, 2013 |
| | 80320 | 34 | X | Liquidated Damages | April 1, 2013 | |
| * | 80324 | 35 | | LRFD Pipe Culvert Burial Tables | Nov. 1, 2013 | |
| * | 80325 | 36 | | LRFD Storm Sewer Burial Tables | Nov. 1, 2013 | |
| | 80045 | 37 | | Material Transfer Device | June 15, 1999 | Jan. 1, 2009 |
| | 80297 | 38 | | Modified Urethane Pavement Marking | April 1, 2012 | |
| | 80165 | 39 | | Moisture Cured Urethane Paint System | Nov. 1, 2006 | Jan. 1, 2010 |
| | 80253 | 40 | | Movable Traffic Barrier | Jan. 1, 2010 | Jan. 1, 2013 |
| | 80231 | 41 | | Pavement Marking Removal | April 1, 2009 | |
| | 80298 | 42 | | Pavement Marking Tape Type IV | April 1, 2012 | |

**Note: Specials that go in every contract have already been marked with an "X" for you.**

**Designer:** _____ **FAP:** _____

**Contract No.:** _____ **Section:** _____

**Letting:** November 8, 2013 **County:** _____

| | File Name | # | | Special Provision Title | Effective | Revised |
|---|---|---|---|---|---|---|
| | 80254 | 43 | | Pavement Patching | Jan. 1, 2010 | |
| | 80321 | 44 | | Pavement Removal | April 1, 2013 | |
| | 80022 | 45 | X | Payments to Subcontractors | June 1, 2000 | Jan. 1, 2006 |
| | 80316 | 46 | | Placing and Consolidating Concrete | Jan. 1, 2013 | |
| | 80278 | 47 | | Planting Woody Plants | Jan. 1, 2012 | Aug. 1, 2012 |
| | 80305 | 48 | | Polyurea Pavement Markings | Nov. 1, 2012 | Jan. 1, 2013 |
| * | 80279 | 49 | | Portland Cement Concrete | Jan. 1, 2012 | Nov. 1, 2013 |
| * | 80326 | 50 | | Portland Cement Concrete Equipment | Nov. 1, 2013 | |
| | 80300 | 51 | | Preformed Plastic Pavement Marking Type D - Inlaid | April 1, 2012 | |
| | 80218 | 52 | | Preventive Maintenance – Bituminous Surface Treatment | Jan. 1, 2009 | April 1, 2012 |
| | 80219 | 53 | | Preventive Maintenance – Cape Seal | Jan. 1, 2009 | April 1, 2012 |
| | 80220 | 54 | | Preventive Maintenance – Micro-Surfacing | Jan. 1, 2009 | April 1, 2012 |
| | 80221 | 55 | | Preventive Maintenance – Slurry Seal | Jan. 1, 2009 | April 1, 2012 |
| * | 80281 | 56 | | Quality Control/Quality Assurance of Concrete Mixtures | Jan. 1, 2012 | Nov. 1, 2013 |
| | 3426I | 57 | | Railroad Protective Liability Insurance | Dec. 1, 1986 | Jan. 1, 2006 |
| | 80157 | 58 | | Railroad Protective Liability Insurance (5 and 10) | Jan. 1, 2006 | |
| * | 80306 | 59 | | Reclaimed Asphalt Pavement (RAP) and Reclaimed Asphalt Shingles (RAS) | Nov. 1, 2012 | Nov. 1, 2013 |
| * | 80327 | 60 | | Reinforcement Bars | Nov. 1, 2013 | |
| | 80283 | 61 | | Removal and Disposal of Regulated Substances | Jan. 1, 2012 | Nov. 2, 2012 |
| | 80319 | 62 | | Removal and Disposal of Surplus Materials | Nov. 2, 2012 | |
| | 80224 | 63 | | Restoring Bridge Approach Pavements Using High-Density Foam | Jan. 1, 2009 | Jan. 1, 2012 |
| | 80307 | 64 | | Seeding | Nov. 1, 2012 | |
| | 80127 | 65 | | Steel Cost Adjustment | April 2, 2004 | April 1, 2009 |
| | 80255 | 66 | | Stone Matrix Asphalt | Jan. 1, 2010 | Aug. 1, 2013 |
| | 80143 | 67 | X | Subcontractor Mobilization Payments | April 2, 2005 | April 1, 2011 |
| | 80317 | 68 | | Surface Testing of Hot-Mix Asphalt Overlays (NOTE: This special provision was previously named "*Surface Testing of Pavements*".) | Jan. 1, 2013 | |
| | 80308 | 69 | | Synthetic Fibers in Concrete Gutter, Curb, Median and Paved Ditch | Nov. 1, 2012 | |
| | 80286 | 70 | | Temporary Erosion and Sediment Control | Jan. 1, 2012 | |
| | 80225 | 71 | | Temporary Raised Pavement Marker | Jan. 1, 2009 | |
| | 80256 | 72 | | Temporary Water Filled Barrier | Jan. 1, 2010 | Jan. 1, 2013 |
| | 80301 | 73 | X | Tracking the Use of Pesticides | Aug. 1, 2012 | |
| | 80273 | 74 | | Traffic Control Deficiency Deduction | Aug. 1, 2011 | |
| | 20338 | 75 | | Training Special Provisions | Oct. 15, 1975 | |
| | 80318 | 76 | | Traversable Pipe Grate | Jan. 1, 2013 | April 1, 2013 |
| | 80270 | 77 | X | Utility Coordination and Conflicts | April 1, 2011 | Jan. 1, 2012 |
| * | 80288 | 78 | | Warm Mix Asphalt | Jan. 1, 2012 | Nov. 1, 2013 |
| | 80302 | 79 | X | Weekly DBE Trucking Reports | June 2, 2012 | |
| | 80289 | 80 | | Wet Reflective Thermoplastic Pavement Marking | Jan. 1, 2012 | |
| | 80071 | 81 | | Working Days | Jan. 1, 2002 | |

The following special provisions have been deleted from use:

80271 Safety Edge

The following special provisions are either in the 2013 Standard Specifications, the 2013 Recurring Special Provisions, or the special provisions Portland Cement Concrete, QC/QA of Concrete Mixtures, or Placing and Consolidating Concrete:

| File Name | Special Provision Title | New Location | Effective | Revised |
|---|---|---|---|---|
| 80275 | Agreement to Plan Quantity | Article 202.07 | Jan. 1, 2012 | |

**Note: Specials that go in every contract have already been marked with an "X" for you.**

**Designer:** _____ **FAP:** _____

**Contract No.:** _____ **Section:** _____

**Letting:** November 8, 2013 **County:** _____

| File Name | Special Provision Title | New Location | Effective | Revised |
|---|---|---|---|---|
| 80291 | Calcium Chloride Accelerator for Class PP-2 Concrete | Recurring CS #28 | April 1, 2012 | |
| 80237 | Construction Air Quality – Diesel Vehicle Emissions Control | Articles 105.03 and 107.41 | April 1, 2009 | Jan. 2, 2012 |
| 80239 | Construction Air Quality – Idling Restrictions | Articles 105.03 and 107.41 | April 1, 2009 | |
| 80177 | Digital Terrain Modeling for Earthwork Calculations | Recurring CS #32 | April 1, 2007 | |
| 80272 | Drainage and Inlet Protection Under Traffic | Articles 603.02 and 603.07 | April 1, 2011 | Jan. 1, 2012 |
| 80228 | Flagger at Side Roads and Entrances | Articles 701.13 and 701.20 | April 1, 2009 | |
| 80109 | Impact Attenuators | Section 643 | Nov. 1, 2003 | Jan. 1, 2012 |
| 80110 | Impact Attenuators, Temporary | Section 706 | Nov. 1, 2003 | Jan. 1, 2012 |
| 80203 | Metal Hardware Cast into Concrete | Articles 503.02, 504.02, and 1006.13 | April 1, 2008 | Jan. 1, 2012 |
| 80290 | Payrolls and Payroll Records | Recurring CS #5 | Jan. 2, 2012 | |
| 80299 | Portland Cement Concrete Inlay or Overlay | Recurring CS #29 | April 1, 2012 | |
| 80280 | Portland Cement Concrete Sidewalk | Article 424.07 | Jan. 1, 2012 | |
| 80152 | Self-Consolidating Concrete for Cast-In-Place Construction | The following special provisions: Portland Cement Concrete, QC/QA of Concrete Mixtures and Placing and Consolidating Concrete | Nov. 1, 2005 | April 1, 2012 |
| 80132 | Self-Consolidating Concrete for Precast and Precast Prestressed Products | The following special provisions: Portland Cement Concrete, QC/QA of Concrete Mixtures and Placing and Consolidating Concrete | July 1, 2004 | April 1, 2012 |
| 80284 | Shoulder Rumble Strips | Article 642.05 | Jan. 1, 2012 | |
| 80285 | Sidewalk, Corner or Crosswalk Closure | Articles 701.03, 701.15, and 1106.02 | Jan. 1, 2012 | |
| 80075 | Surface Testing of Pavements (Section 406 overlay portion will remain a special provision and will now be called "Surface Testing of HMA Overlays".) | Articles 407.09, 407.12, 420.10, 420.20, and 1101.10 | April 1, 2002 | Jan. 1, 2007 |
| 80287 | Type G Inlet Box | Article 610.09 | Jan. 1, 2012 | |

The following special provisions require additional information from the designer. The additional information needs to be included in a separate document attached to this check sheet. The Project Development and Implementation section will then include the information in the applicable special provision. The Special Provisions are:

- Bridge Demolition Debris
- Building Removal-Case I
- Building Removal-Case II
- Building Removal-Case III
- Building Removal-Case IV
- Completion Date
- Completion Date Plus Working Days
- DBE Participation
- Material Transfer Device
- Railroad Protective Liability Insurance
- Training Special Provisions
- Working Days

# Index for
# Supplemental Specifications
# and
# Recurring Special Provisions

INDEX
FOR
SUPPLEMENTAL SPECIFICATIONS
AND RECURRING SPECIAL PROVISIONS

Adopted January 1, 2013

This index contains a listing of SUPPLEMENTAL SPECIFICATIONS, frequently used RECURRING SPECIAL PROVISIONS, and LOCAL ROADS AND STREETS RECURRING SPECIAL PROVISIONS.

ERRATA Standard Specifications for Road and Bridge Construction (Adopted 1-1-12) (Revised 1-1-13)

SUPPLEMENTAL SPECIFICATIONS

## RECURRING SPECIAL PROVISIONS

The following RECURRING SPECIAL PROVISIONS indicated by an "X" are applicable to this contract and are included by reference:

# BDE Special Provisions

# BDE Special Provisions

# Alphabetic Index

# REVISED INDEX

## ALPHABETIC LIST OF DESIGN INTERIM SPECIAL PROVISIONS (ISP's)

Get a copy of the current check list from the Program Development Secretary, indicate which ISP's are to be included in your set of special provisions, fill in any blanks as indicated on the check list, and include with your set of special provisions to be sent to Springfield where they will be inserted.

| Standard Spec. No. | PC No. | Item |
|---|---|---|
| 280.02 | 28002 | Above Grade Inlet Protection |
| 888.00 | 88800 | Accessible Pedestrian Signals (APS) |
| 303.00 | 30300 | Aggregate Subgrade Improvement |
| 1006.09 | 100609 | Anchor Bolts |
| 701.00 | 70100 | Automated Flagger Assistance Devices |
| 109.01 | 10901 | Bituminous Materials Cost Adjustment |
| 107.38 | 10738 | Bridge Demolition Debris |
| 503.19 | 50319 | Bridge Relief Joint Sealer |
| 107.19a | 10719a | Building Removal Case I |
| 107.19b | 10719b | Building Removal Case II |
| 107.19c | 10719c | Building Removal Case III |
| 107.19d | 10719d | Building Removal Case IV |
| 1004.02 | 100402 | Coarse Aggregate in Bridge Approach Slabs/Footings |
| 1088.01 | 108801 | Coated Galvanized Steel Conduit |
| 108.05a | 10805a | Completion Date (Via Calendar Days) |
| 108.05b | 10805b | Completion Date (Via Calendar Days) Plus working Days |
| 504.00 | 50400 | Concrete Box Culverts with Skews > 30 Degrees and Design Fills ≤ 5 Feet |
| 504.04 | 50404 | Concrete Box Culverts with Skews ≤ 30 Degrees Regardless of Design Fill and Skews >30 Degrees with Design Fills > 5 Feet |
| 542.00 | 54200 | Concrete End Sections for Pipe Culverts |
| 503.19 | 50319 | Concrete Joint Sealer |

REVISED INDEX

ALPHABETIC LIST OF DESIGN INTERIM SPECIAL PROVISIONS (ISP's)

| Standard Spec. No. | PC No. | Item |
|---|---|---|
| 1020.05a | 102005a | Concrete Mix Design – Department Provided |
| 107.01 | 10701 | Construction Air Quality – Diesel Retrofit |
| 108.06a | 10806a | Disadvantaged Business Enterprise Participation |
| 1040.03 | 104003 | Drain Pipe, Tile, Drainage Mat, and Wall Drain |
| 100.00 | 10000 | Errata for the 2012 Standard Specifications |
| 1082.01 | 108201 | Fabric Bearing Pads |
| 1004.01 | 100401 | Friction Aggregate |
| 109.03 | 10903 | Fuel Cost Adjustment |
| 1003.04 | 100304 | Granular Materials |
| 780.03 | 780.03 | Grooving for Recessed Pavement Markings |
| 643.00 | 64300 | High Tension Cable Median Barrier |
| 406.07 | 40607 | Hot-Mix Asphalt-Density Testing of Longitudinal Joints |
| 406.14 | 40614 | Hot-Mix Asphalt – Mixture Design Composition and Volumetric Requirements |
| 406.01 | 40601 | Hot-Mix Asphalt – Mix Design Verification and Production |
| 543.00 | 54300 | Insertion Lining of Culverts |
| 542.02 | 54202 | LRFD Pipe Culvert Burial Tables |
| 550.00 | 55000 | LRFD Storm Sewer Burial Tables |
| 108.09 | 10809 | Liquidated Damages |
| 406.00f | 40600f | Material Transfer Device |
| 780.01 | 78001 | Modified Urethane Pavement Marking |
| 1008.27 | 100827 | Moisture Cured Urethane Paint System |
| 1106.02i | 110602i | Movable Traffic Barrier |

REVISED INDEX

ALPHABETIC LIST OF DESIGN INTERIM SPECIAL PROVISIONS (ISP's)

| Standard Spec. No. | PC No. | Item |
|---|---|---|
| 783.03 | 78303 | Pavement Marking Removal |
| 703.02 | 70302 | Pavement Marking Tape Type IV |
| 701.17 | 70117 | Pavement Patching |
| 440.00 | 44000 | Pavement Removal |
| 109.07 | 10907 | Payments to Subcontractors |
| 503.06 | 50306 | Placing and Consolidating Concrete |
| 253.00 | 25300 | Planting Woody Plants |
| 780.13 | 78013 | Polyruea Pavement Markings |
| 312.26 | 31226 | Portland Cement Concrete |
| 1103.03 | 110303 | Portland Cement Concrete Equipment |
| 780.00 | 78000 | Preformed Plastic Pavement Marking Type D - Inlaid |
| 400.04 | 40004 | Preventive Maintenance - Bituminous Surface Treatment |
| 400.01 | 40001 | Preventive Maintenance – Cape Seal |
| 400.02 | 40002 | Preventive Maintenance – Micro-Surfacing |
| 400.03 | 40003 | Preventive Maintenance – Slurry Seal |
| 1020.16 | 102016 | Quality Control/Quality Assurance of Concrete Mixtures |
| 107.11 | 10711a | Railroad Protective Liability Insurance |
| 107.11 | 10711b | Railroad Protective Liability Insurance (5 and 10) |
| 1031.00 | 103100 | Reclaimed Asphalt Pavement and Reclaimed Asphalt Singles |
| 508.05 | 50805 | Reinforcement Bars |
| 669.01 | 66901 | Removal and Disposal of Regulated Substances |
| 202.03 | 20203 | Removal and Disposal of Surplus Materials |
| 420.16 | 42016 | Restoring Bridge Approach Pavements Using High-Density Foam |

REVISED INDEX

ALPHABETIC LIST OF DESIGN INTERIM SPECIAL PROVISIONS (ISP's)

| Standard Spec. No. | PC No. | Item |
|---|---|---|
| 250.07 | 25007 | Seeding |
| 109.00 | 10900a | Steel Cost Adjustment |
| 406.06 | 40606 | Stone Matrix Asphalt |
| 671.00 | 67100 | Subcontractor Mobilization Payments |
| 406.03 | 40603 | Surface Testing of Hot-Mix Asphalt Overlays |
| 606.02 | 60602 | Synthetic Fibers in Concrete Gutters, Curb, Median, and Paved Ditch |
| 280.04 | 28004 | Temporary Erosion and Sediment Control |
| 703.00 | 70300 | Temporary Raised Pavement Marker |
| 1106.02k | 110602k | Temporary Water Filled Barrier |
| 107.23 | 10723 | Tracking the Use of Pesticides |
| 280.04 | 28004 | Temporary Erosion and Sediment Control |
| 105.04 | 10504 | Traffic Control Deficiency Deduction |
| 108.06 | 10806 | Training Special Provision |
| 542.01 | 54201 | Traversable Pipe Grate |
| 105.07 | 10507 | Utility Coordination and Conflicts |
| 406.00 | 40600 | Warm Mix Asphalt |
| 108.06b | 10806b | Weekly DBE Trucking Reports (BDE) |
| 780.00 | 78000 | Wet Reflective Thermoplastic Pavement Marking |
| 108.05 | 10805 | Working Days |

# BDE Special Provisions

# Numeric Index

# REVISED INDEX

## NUMERIC DESIGN INTERIM SPECIAL PROVISIONS (ISP's)

Get a copy of the current check list from the Program Development Secretary, indicate which ISP's are to be included in your set of special provisions, fill in any blanks as indicated on the check list, and include with your set of special provisions to be sent to Springfield where they will be inserted.

| Standard Spec. No. | PC No. | Item |
|---|---|---|
| 100.00 | 10000 | Errata for the 2012 Standard Specifications |
| 105.04 | 10504 | Traffic Control Deficiency Deduction |
| 105.07 | 10507 | Utility Coordination and Conflicts |
| 107.01 | 10701 | Construction Air Quality – Diesel Retrofit |
| 107.11a | 10711a | Railroad Protective Liability Insurance |
| 107.11b | 10711b | Railroad Protective Liability Insurance (5 and 10) |
| 107.19a | 10719a | Building Removal Case I |
| 107.19b | 10719b | Building Removal Case II |
| 107.19c | 10719c | Building Removal Case III |
| 107.19d | 10719d | Building Removal Case IV |
| 107.23 | 10723 | Tracking the Use of Pesticides |
| 107.38 | 10738 | Bridge Demolition Debris |
| 108.05 | 10805 | Working Days |
| 108.05a | 10805a | Completion Date (Via Calendar Days) |
| 108.05b | 10805b | Completion Date (Via Calendar Days) Plus Working Days |
| 108.06 | 10806 | Training Special Provision |
| 108.06a | 10806a | Disadvantaged Business Enterprise Participation |
| 108.06b | 10806b | Weekly DBE Trucking Reports |
| 108.09 | 10809 | Liquidated Damages |

NUMERIC DESIGN INTERIM SPECIAL PROVISIONS (ISP's)

| Standard Spec. No. | PC No. | Item |
|---|---|---|
| 109.00a | 10900a | Steel Cost Adjustment |
| 109.01 | 10901 | Bituminous Materials Cost Adjustments |
| 109.03 | 10903 | Fuel Cost Adjustment |
| 109.07 | 10907 | Payments to Subcontractors |
| 202.03 | 20203 | Removal and Disposal of Surplus Materials |
| 250.07 | 25007 | Seeding |
| 253.00 | 25300 | Planting Woody Plants |
| 280.02 | 28002 | Above Grade Inlet Protection |
| 280.04 | 28004 | Temporary Erosion and Sediment Control |
| 303.00 | 30300 | Aggregate Subgrade Improvement |
| 312.26 | 31226 | Portland Cement Concrete |
| 400.01 | 40001 | Preventive Maintenance – Cape Seal |
| 400.02 | 40002 | Preventive Maintenance – Micro-Surfacing |
| 400.03 | 40003 | Preventive Maintenance – Slurry Seal |
| 400.04 | 40004 | Preventive Maintenance – Bituminous Surface Treatment |
| 406.00 | 40600 | Warm Mix Asphalt |
| 406.01 | 40601 | Hot-Mix Asphalt – Mixture Design Verification and Production |
| 406.00f | 40600f | Material Transfer Device |
| 406.03 | 40603 | Surface Testing of Hot-Mix Asphalt Overlays |
| 406.06 | 40606 | Stone Matrix Asphalt |
| 406.07 | 40607 | Hot-Mix Asphalt – Density Testing of Longitudinal Joints |
| 406.14 | 40614 | Hot-Mix Asphalt – Mixture Design Composition and Volumetric Requirements |
| 420.16 | 42016 | Restoring Bridge Approach Pavements Using High-Density Foam |
| 440.00 | 44000 | Pavement Removal |

NUMERIC DESIGN INTERIM SPECIAL PROVISIONS (ISP's)

| Standard Spec. No. | PC No. | Item |
|---|---|---|
| 503.06 | 50306 | Placing and Consolidating Concrete |
| 503.19 | 50319 | Bridge Relief Joint Sealer |
| 504.00 | 50400 | Concrete Box Culverts with Skews > 30 Degrees and Design Fills ≤ 5 Feet |
| 504.04 | 50404 | Concrete Box Culverts with Skews ≤ 30 Degrees Regardless of Design Fill and Skews >30 Degrees with Design Fills > 5 Feet |
| 508.05 | 50805 | Reinforcement Bars |
| 542.00 | 54200 | Concrete End Sections for Pipe Culverts |
| 542.01 | 54201 | Traversable Pipe Grate |
| 542.02 | 54202 | LRFD Pipe Culvert Burial Tables |
| 543.00 | 54300 | Insertion Lining of Culverts |
| 550.00 | 55000 | LRFD Storm Sewer Burial Tables |
| 606.02 | 60602 | Synthetic Fibers in Concrete Gutter, Curb, Median, and Paved Ditch |
| 643.00 | 64300 | High Tension Cable Median Barrier |
| 669.01 | 69901 | Removal and Disposal of Regulated Substances |
| 671.00 | 67100 | Subcontractor Mobilization Payments |
| 701.00 | 70100 | Automated Flagger Assistance Devices |
| 701.17 | 70117 | Pavement Patching |
| 703.00 | 70300 | Temporary Raised Pavement Marker |
| 703.02 | 70302 | Pavement Marking Tape Type IV |
| 780.00 | 780.00 | Wet Reflective Thermoplastic Pavement Marking |
| 780.01 | 78001 | Modified Urethane pavement Marking |
| 780.02 | 78002 | Preformed Plastic Pavement Marking Type D - Inlaid |
| 780.03 | 780.03 | Grooving for Recessed Pavement Markings |

# NUMERIC DESIGN INTERIM SPECIAL PROVISIONS (ISP's)

| Standard Spec. No. | PC No. | Item |
|---|---|---|
| 780.13 | 78013 | Polyurea Pavement Markings |
| 783.03 | 78303 | Pavement Marking Removal |
| 888.00 | 88800 | Accessible Pedestrian Signals (APS) |
| 1003.04 | 100304 | Granular Materials |
| 1004.01 | 100401 | Friction Aggregate |
| 1004.02 | 100402 | Coarse Aggregate in Bridge Approach Slabs/Footings |
| 1006.09 | 100609 | Anchor Bolts |
| 1008.27 | 100827 | Moisture Cured Urethane Paint System |
| 1020.05a | 102005a | Concrete Mix Design – Department Provided |
| 1020.16 | 102016 | Quality Control/Quality Assurance of Concrete Mixtures |
| 1031.00 | 103100 | Reclaimed Asphalt Pavement and Reclaimed Asphalt Shingles |
| 1040.03 | 104003 | Drain Pipe, Tile, Drainage Mat, and Wall Drain |
| 1082.01 | 108201 | Fabric Bearing Pads |
| 1088.01 | 108801 | Coated Galvanized Steel Conduit |
| 1103.03 | 110303 | Portland Cement Concrete Equipment |
| 1106.02i | 110602i | Movable Traffic Barrier |
| 1106.02k | 110602k | Temporary Water Filled Barrier |

Designer Note: Insert in all contracts using cast-in-place concrete, precast concrete, or precast pre-stressed concrete.

**PORTLAND CEMENT CONCRETE (BDE)**

Effective: January 1, 2012
Revised: November 1, 2013

Revise Notes 1 and 2 of Article 312.24 of the Standard Specifications to read:

"Note 1. Coarse aggregate shall be gradation CA 6, CA 7, CA 9, CA 10, or CA 11, Class D quality or better. Article 1020.05(d) shall apply.

Note 2. Fine aggregate shall be FA 1 or FA 2. Article 1020.05(d) shall apply."

Revise the first paragraph of Article 312.26 of the Standard Specifications to read:

"**312.26 Proportioning and Mix Design.** At least 60 days prior to start of placing CAM II, the Contractor shall submit samples of materials for proportioning and testing. The mixture shall contain a minimum of 200 lb (90 kg) of cement per cubic yard (cubic meter). Portland cement may be replaced with fly ash according to Article 1020.05(c)(1), however the minimum portland cement content in the mixture shall be 170 lbs/cu yd (101 kg/cu m). Blends of coarse and fine aggregates will be permitted, provided the volume of fine aggregate does not exceed the volume of coarse aggregate. The Engineer will determine the proportions of materials for the mixture. However, the Contractor may substitute their own mix design. Article 1020.05(a) shall apply and a Level III PCC Technician shall develop the mix design."

Revise the second paragraph of Article 503.22 of the Standard Specifications to read:

Other cast-in-place concrete for structures will be paid for at the contract unit price per cubic yard (cubic meter) for CONCRETE HANDRAIL, CONCRETE ENCASEMENT, and SEAL COAT CONCRETE."

Add the following to Article 1003.02 of the Standard Specifications:

(e) Alkali Reaction.

(1) ASTM C 1260. Each fine aggregate will be tested by the Department for alkali reaction according to ASTM C 1260. The test will be performed with Type I or II

portland cement having a total equivalent alkali content ($Na_2O + 0.658K_2O$) of 0.90 percent or greater. The Engineer will determine the assigned expansion value for each aggregate, and these values will be made available on the Department's Alkali-Silica Potential Reactivity Rating List. The Engineer may differentiate aggregate based on ledge, production method, gradation number, or other factors. An expansion value of 0.03 percent will be assigned to limestone or dolomite fine aggregates (manufactured stone sand). However, the Department reserves the right to perform the ASTM C 1260 test.

(2) ASTM C 1293 by Department. In some instances, such as chert natural sand or other fine aggregates, testing according to ASTM C 1260 may not provide accurate test results. In this case, the Department may only test according to ASTM C 1293.

(3) ASTM C 1293 by Contractor. If an individual aggregate has an ASTM C 1260 expansion value that is unacceptable to the Contractor, an ASTM C 1293 test may be performed by the Contractor to evaluate the Department's ASTM C 1260 test result. The laboratory performing the ASTM C 1293 test shall be approved by the Department according to the current Bureau of Materials and Physical Research Policy Memorandum "Minimum Laboratory Requirements for Alkali-Silica Reactivity (ASR) Testing".

The ASTM C 1293 test shall be performed with Type I or II portland cement having a total equivalent alkali content ($Na_2O + 0.658K_2O$) of 0.80 percent or greater. The interior vertical wall of the ASTM C 1293 recommended container (pail) shall be half covered with a wick of absorbent material consisting of blotting paper. If the testing laboratory desires to use an alternate container, wick of absorbent material, or amount of coverage inside the container with blotting paper, ASTM C 1293 test results with an alkali-reactive aggregate of known expansion characteristics shall be provided to the Engineer for review and approval. If the expansion is less than 0.040 percent after one year, the aggregate will be assigned an ASTM C 1260 expansion value of 0.08 percent that will be valid for two years, unless the Engineer determines the aggregate has changed significantly. If the aggregate is manufactured into multiple gradation numbers, and the other gradation numbers have the same or lower ASTM C 1260 value, the ASTM C 1293 test result may apply to multiple gradation numbers.

The Engineer reserves the right to verify a Contractor's ASTM C 1293 test result. When the Contractor performs the test, a split sample shall be provided to the Engineer. The Engineer may also independently obtain a sample at any time. The aggregate will be considered reactive if the Contractor or Engineer obtains an expansion value of 0.040 percent or greater.

Revise the first paragraph of Article 1004.01(e)(5) of the Standard Specifications to read:

"Crushed concrete, crushed slag, or lightweight aggregate for portland cement concrete shall be stockpiled in a moist condition (saturated surface dry or greater) and the moisture content shall be maintained uniformly throughout the stockpile by periodic sprinkling."

Revise Article 1004.02(d) of the Standard Specifications to read:

"(d) Combining Sizes. Each size shall be stored separately and care shall be taken to prevent them from being mixed until they are ready to be proportioned. Separate compartments shall be provided to proportion each size.

(1) When Class BS concrete is to be pumped, the coarse aggregate gradation shall have a minimum of 45 percent passing the 1/2 in. (12.5 mm) sieve. The Contractor may combine two or more coarse aggregate sizes, consisting of CA 7, CA 11, CA 13, CA 14, and CA 16, provided a CA 7 or CA 11 is included in the blend.

(2) If the coarse aggregate is furnished in separate sizes, they shall be combined in proportions to provide a uniformly graded coarse aggregate grading within the following limits.

| Class of Concrete 1/ | Combined Sizes | Sieve Size and Percent Passing | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 2 1/2 in. | 2 in. | 1 3/4 in. | 1 1/2 in. | 1 in. | 1/2 in. | No. 4 |
| PV 2/ | | | | | | | | |
| | CA 5 & CA 7 | --- | --- | 100 | 98±2 | 72±22 | 22±12 | 3±3 |
| | CA 5 & CA 11 | --- | --- | 100 | 98±2 | 72±22 | 22±12 | 3±3 |
| SI and SC 2/ | | | | | | | | |
| | CA 3 & CA 7 | 100 | 95±5 | --- | --- | 55±25 | 20±10 | 3±3 |
| | CA 3 & CA 11 | 100 | 95±5 | --- | --- | 55±25 | 20±10 | 3±3 |
| | CA 5 & CA 7 | --- | --- | 100 | 98±2 | 72±22 | 22±12 | 3±3 |
| | CA 5 & CA 11 | --- | --- | 100 | 98±2 | 72±22 | 22±12 | 3±3 |

| Class of Concrete 1/ | Combined Sizes | Sieve Size (metric) and Percent Passing | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 63 mm | 50 mm | 45 mm | 37.5 mm | 25 mm | 12.5 mm | 4.75 mm |
| PV 2/ | | | | | | | | |
| | CA 5 & CA 7 | --- | --- | 100 | 98±2 | 72±22 | 22±12 | 3±3 |
| | CA 5 & CA 11 | --- | --- | 100 | 98±2 | 72±22 | 22±12 | 3±3 |
| SI and SC 2/ | | | | | | | | |
| | CA 3 & CA 7 | 100 | 95±5 | --- | --- | 55±25 | 20±10 | 3±3 |
| | CA 3 & CA 11 | 100 | 95±5 | --- | --- | 55±25 | 20±10 | 3±3 |
| | CA 5 & CA 7 | --- | --- | 100 | 98±2 | 72±22 | 22±12 | 3±3 |
| | CA 5 & CA 11 | --- | --- | 100 | 98±2 | 72±22 | 22±12 | 3±3 |

1/ See Table 1 of Article 1020.04.

2/ Any of the listed combination of sizes may be used."

Add the following to Article 1004.02 of the Standard Specifications:

(g) Alkali Reaction.

(1) ASTM C 1260. Each coarse aggregate will be tested by the Department for alkali reaction according to ASTM C 1260. The test will be performed with Type I or II portland cement having a total equivalent alkali content ($Na_2O + 0.658K_2O$) of 0.90 percent or greater. The Engineer will determine the assigned expansion value for each aggregate, and these values will be made available on the Department's Alkali-Silica Potential Reactivity Rating List. The Engineer may differentiate aggregate based on ledge, production method, gradation number, or other factors. An expansion value of 0.05 percent will be assigned to limestone or dolomite coarse aggregates. However, the Department reserves the right to perform the ASTM C 1260 test.

(2) ASTM C 1293 by Department. In some instances testing a coarse aggregate according to ASTM C 1260 may not provide accurate test results. In this case, the Department may only test according to ASTM C 1293.

(3) ASTM C 1293 by Contractor. If an individual aggregate has an ASTM C 1260 expansion value that is unacceptable to the Contractor, an ASTM C 1293 test may be performed by the Contractor according to Article 1003.02(e)(3).

Revise the first paragraph of Article 1019.06 of the Standard Specifications to read:

"**1019.06 Contractor Mix Design.** A Contractor may submit their own mix design and may propose alternate fine aggregate materials, fine aggregate gradations, or material proportions. Article 1020.05(a) shall apply and a Level III PCC Technician shall develop the mix design."

Revise Section 1020 of the Standard Specifications to read:

## "SECTION 1020. PORTLAND CEMENT CONCRETE

**1020.01 Description.** This item shall consist of the materials, mix design, production, testing, curing, low air temperature protection, and temperature control of concrete.

**1020.02 Materials.** Materials shall be according to the following.

| Item | Article/Section |
|---|---|
| (a) Cement | 1001 |
| (b) Water | 1002 |
| (c) Fine Aggregate | 1003 |
| (d) Coarse Aggregate | 1004 |
| (e) Concrete Admixtures | 1021 |
| (f) Finely Divided Minerals | 1010 |
| (g) Concrete Curing Materials | 1022 |
| (h) Straw | 1081.06(a)(1) |
| (i) Calcium Chloride | 1013.01 |

**1020.03 Equipment.** Equipment shall be according to the following.

| Item | Article/Section |
|---|---|
| (a) Concrete Mixers and Trucks | 1103.01 |
| (b) Batching and Weighing Equipment | 1103.02 |
| (c) Automatic and Semi-Automatic Batching Equipment | 1103.03 |
| (d) Water Supply Equipment | 1103.11 |
| (e) Membrane Curing Equipment | 1101.09 |
| (f) Mobile Portland Cement Concrete Plants | 1103.04 |

**1020.04 Concrete Classes and General Mix Design Criteria.** The classes of concrete shown in Table 1 identify the various mixtures by the general uses and mix design criteria. If the class of concrete for a specific item of construction is not specified, Class SI concrete shall be used.

For the minimum cement factor in Table 1, it shall apply to portland cement, portland-pozzolan cement, and portland blast-furnace slag except when a particular cement is specified in the Table.

The Contractor shall not assume that the minimum cement factor indicated in Table 1 will produce a mixture that will meet the specified strength. In addition, the Contractor shall not assume that the maximum finely divided mineral allowed in a mix design according to Article 1020.05(c) will produce a mixture that will meet the specified strength. The Contractor shall select a cement factor within the allowable range that will obtain the specified strength. The Contractor shall take into consideration materials selected, seasonal temperatures, and other factors which may require the Contractor to submit multiple mix designs.

For a portland-pozzolan cement, portland blast-furnace slag cement, or when replacing portland cement with finely divided minerals per Articles 1020.05(c) and 1020.05(d), the portland cement content in the mixture shall be a minimum of 375 lbs/cu yd (222 kg/cu m).

When the total of organic processing additions, inorganic processing additions, and limestone exceed 5.0 percent in the cement, the minimum portland cement content in the mixture shall be 400 lbs/cu yd (237 kg/cu m). When calculating the portland cement portion in the portland-pozzolan or portland blast-furnace slag cement, the AASHTO M 240 tolerance may be ignored.

Special classifications may be made for the purpose of including the concrete for a particular use or location as a separate pay item in the contract. The concrete used in such cases shall conform to this section.

## TABLE 1. CLASSES OF CONCRETE AND MIX DESIGN CRITERIA

| Class of Conc. | Use | Specification Section Reference | Cement Factor cwt/cu yd (3) | | Water / Cement Ratio lb/lb | Slump in. (4) | Mix Design Compressive Strength (Flexural Strength) psi, minimum | | | Air Content % | Coarse Aggregate Gradations (14) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Days | | | | |
| | | | Min. | Max | | | 3 | 14 | 28 | | |
| PV | Pavement<br>Base Course<br>Base Course Widening<br>Driveway Pavement<br>Shoulders<br>Shoulder Curb | 420 or 421<br>353<br>354<br>423<br>483<br>662 | 5.65 (1)<br>6.05 (2) | 7.05 | 0.32 - 0.42 | 2 - 4 (5) | Ty III 3500 (650) | 3500 (650) | | 5.0 - 8.0 (5) | CA 5 & CA 7, CA 5 & CA 11, CA 7, CA 11, or CA 14 |
| PP | Pavement Patching<br>Bridge Deck Patching (10) | 442 | | | | | 3200 (600) Article 701.17(e)(3)b. | | | | CA 7, CA 11, CA 13, CA 14, or CA 16 |
| | PP-1 | | 6.50<br>6.20 (Ty III) | 7.50<br>7.20 (Ty III) | 0.32 - 0.44 | 2 - 4 | at 48 hours | | | 4.0 - 7.0 | |
| | PP-2 | | 7.35 | 8.20 | 0.32 - 0.38 | 2 - 6 | at 24 hours | | | 4.0 - 6.0 | |
| | PP-3 | | 7.35 (Ty III) (8) | 7.35 (Ty III) (8) | 0.32 - 0.35 | 2 - 4 | at 16 hours | | | 4.0 - 6.0 | |
| | PP-4 | | 6.00 (9) | 6.25 (9) | 0.32 - 0.50 | 2 - 6 | at 8 hours | | | 4.0 - 6.0 | |
| | PP-5 | | 6.75 (9) | 6.75 (9) | 0.32 - 0.40 | 2 - 8 | at 4 hours | | | 4.0 - 6.0 | |
| RR | Railroad Crossing | 422 | 6.50<br>6.20 (Ty III) | 7.50<br>7.20 (Ty III) | 0.32 - 0.44 | 2 - 4 | 3500 (650) at 48 hours | | | 4.0 - 7.0 | CA 7, CA 11, or CA 14 |
| BS | Bridge Superstructure<br>Bridge Approach Slab | 503 | 6.05 | 7.05 | 0.32 - 0.44 | 2 - 4 (5) | | 4000 (675) | | 5.0 - 8.0 (5) | CA 7, CA 11, or CA 14 (7) |
| PC | Various Precast Concrete Items<br>Wet Cast<br>Dry Cast | 1042 | 5.65<br>5.65 (TY III) | 7.05<br>7.05 (TY III) | 0.32 - 0.44<br>0.25 - 0.40 | 1 - 4<br>0 - 1 | See Section 1042 | | | 5.0 - 8.0<br>N/A | CA7, CA11,CA 13, CA 14, CA 16, or CA 7 & CA 16 |
| PS | Precast Prestressed Members | 504 | 5.65<br>5.65 (TY III) | 7.05<br>7.05 (TY III) | 0.32 - 0.44 | 1 - 4 | | | Plans | 5.0 - 8.0 | CA 11 (11), CA 13, CA 14 (11), or CA 16 |
| | Precast Prestressed Piles and Extensions | 512 | | | | | | | 5000 | | |
| | Precast Prestressed Sight Screen | 639 | | | | | | | 3500 | | |

TABLE 1. CLASSES OF CONCRETE AND MIX DESIGN CRITERIA

| Class of Conc. | Use | Specification Section Reference | Cement Factor cwt/cu yd (3) | | Water / Cement Ratio lb/lb | Slump in. (4) | Mix Design Compressive Strength (Flexural Strength) psi, minimum | | | Air Content % | Coarse Aggregate Gradations (14) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Days | | | | |
| | | | Min. | Max | | | 3 | 14 | 28 | | |
| DS | Drilled Shaft (12)<br>Metal Shell Piles (12)<br>Sign Structures<br>Drilled Shaft (12)<br>Light Tower Foundation (12) | 516<br>512<br>734<br><br>837 | 6.65 | 7.05 | 0.32 - 0.44 | 6 - 8 (6) | | 4000 (675) | | 5.0 - 8.0 | CA 13, CA 14, CA 16, or a blend of these gradations. |
| SC | Seal Coat | 503 | 5.65 (1)<br>6.05 (2) | 7.05 | 0.32 - 0.44 | 3 - 5 | | 3500 (650) | | Optional 6.0 max. | CA 3 & CA 7,<br>CA 3 & CA 11,<br>CA 5 & CA 7,<br>CA 5 & CA 11,<br>CA 7, or CA 11 |
| SI | Structures (except Superstructure)<br>Sidewalk<br>Slope Wall<br>Encasement<br>Box Culverts<br>End Section and Collar<br>Curb, Gutter, Curb & Gutter, Median, and Paved Ditch<br>Concrete Barrier<br>Sign Structures<br>Spread Footing<br>Concrete Foundation<br>Pole Foundation (12)<br>Traffic Signal Foundation<br>Drilled Shaft (12)<br>Square or Rectangular | 503<br>424<br>511<br>512<br>540<br>542<br><br>606<br>637<br>734<br><br><br>836<br>878 | 5.65 (1)<br>6.05 (2) | 7.05 | 0.32 - 0.44 | 2 - 4 (5) | | 3500 (650) | | 5.0 - 8.0 (5) | CA 3 & CA 7,<br>CA 3 & CA 11,<br>CA 5 & CA 7,<br>CA 5 & CA 11,<br>CA 7, CA 11, CA 13, CA 14, or CA 16 (13) |

Notes:

(1) Central-mixed.

(2) Truck-mixed or shrink-mixed.

(3) For Class SC concrete and for any other class of concrete that is to be placed underwater, except Class DS concrete, the cement factor shall be increased by ten percent.

(4) The maximum slump may be increased to 7 in. when a high range water-reducing admixture is used for all classes of concrete, except Class PV, SC, and PP. For Class SC, the maximum slump may be increased to 8 in. For Class PP-1, the maximum slump may be increased to 6 in. For Class PS, the 7 in. maximum slump may be increased to 8 1/2 in. if the high range water-reducing admixture is the polycarboxylate type.

(5) The slump range for slipform construction shall be 1/2 to 2 1/2 in. and the air content range shall be 5.5 to 8.0 percent.

(6) If concrete is placed to displace drilling fluid, or against temporary casing, the slump shall be 8 - 10 in. at the point of placement. If a water-reducing admixture is used in lieu of a high range water-reducing admixture according to Article 1020.05(b)(7), the slump shall be 2 - 4 in.

(7) For Class BS concrete used in bridge deck patching, the coarse aggregate gradation shall be CA 13, CA 14, or CA 16, except CA 11 may be used for full-depth patching.

(8) In addition to the Type III portland cement, 100 lb/cu yd of ground granulated blast-furnace slag and 50 lb/cu yd of microsilica (silica fume) shall be used. For an air temperature greater than 85 °F, the Type III portland cement may be replaced with Type I or II portland cement.

(9) The cement shall be a rapid hardening cement from the Department's "Approved List of Packaged, Dry, Rapid Hardening Cementitious Materials for Concrete Repairs" for PP-4 and calcium aluminate cement for PP-5.

(10) For Class PP concrete used in bridge deck patching, the coarse aggregate gradation shall be CA 13, CA 14, or CA 16, except CA 11 may be used for full-depth patching. In addition, the mix design shall have 72 hours to obtain a 4,000 psi compressive or 675 psi flexural strength for all PP mix designs.

(11) The nominal maximum size permitted is 3/4 in. Nominal maximum size is defined as the largest sieve which retains any of the aggregate sample particles.

(12) The concrete mix shall be designed to remain fluid throughout the anticipated duration of the pour plus one hour. At the Engineer's discretion, the Contractor may be required to conduct a minimum 2 cu yd trial batch to verify the mix design.

(13) CA 3 or CA 5 may be used when the nominal maximum size does not exceed two-thirds the clear distance between parallel reinforcement bars, or between the reinforcement bar and the form. Nominal maximum size is defined in Note 11.

(14) Alternate combinations of gradation sizes may be used with the approval of the Engineer. Refer also to Article 1004.02(d) for additional information on combining sizes.

TABLE 1. CLASSES OF CONCRETE AND MIX DESIGN CRITERIA (metric)

| Class of Conc. | Use | Specification Section Reference | Cement Factor kg/cu m (3) | | Water / Cement Ratio kg/kg | Slump mm (4) | Mix Design Compressive Strength (Flexural Strength) kPa, minimum | | | Air Content % | Coarse Aggregate Gradations (14) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Days | | | | |
| | | | Min. | Max | | | 3 | 14 | 28 | | |
| PV | Pavement<br>Base Course<br>Base Course Widening<br>Driveway Pavement<br>Shoulders<br>Shoulder Curb | 420 or 421<br>353<br>354<br>423<br>483<br>662 | 335 (1)<br>360 (2) | 418 | 0.32 - 0.42 | 50 - 100<br>(5) | Ty III<br>24,000<br>(4500) | 24,000<br>(4500) | | 5.0 - 8.0<br>(5) | CA 5 & CA 7,<br>CA 5 & CA 11,<br>CA 7, CA 11, or<br>CA 14 |
| PP | Pavement Patching<br>Bridge Deck Patching (10) | 442 | | | | | 22,100<br>(4150)<br>Article 701.17(e)(3)b. | | | | |
| | PP-1 | | 385<br>365 (Ty III) | 445<br>425 (Ty III) | 0.32 - 0.44 | 50 - 100 | at 48 hours | | | 4.0 - 7.0 | CA 7, CA 11,<br>CA 13, CA 14,<br>or CA 16 |
| | PP-2 | | 435 | 485 | 0.32 - 0.38 | 50 - 150 | at 24 hours | | | 4.0 - 6.0 | |
| | PP-3 | | 435 (Ty III) (8) | 435 (Ty III) (8) | 0.32 - 0.35 | 50 - 100 | at 16 hours | | | 4.0 - 6.0 | |
| | PP-4 | | 355 (9) | 370 (9) | 0.32 - 0.50 | 50 - 150 | at 8 hours | | | 4.0 - 6.0 | |
| | PP-5 | | 400 (9) | 400 (9) | 0.32 – 0.40 | 50 - 200 | at 4 hours | | | 4.0 – 6.0 | |
| RR | Railroad Crossing | 422 | 385<br>365 (Ty III) | 445<br>425 (Ty III) | 0.32 - 0.44 | 50 - 100 | 24,000 (4500)<br>at 48 hours | | | 4.0 - 7.0 | CA 7, CA 11,<br>or CA 14 |
| BS | Bridge Superstructure<br>Bridge Approach Slab | 503 | 360 | 418 | 0.32 - 0.44 | 50 - 100<br>(5) | | 27,500<br>(4650) | | 5.0 - 8.0<br>(5) | CA 7, CA 11,<br>or CA 14 (7) |
| PC | Various Precast Concrete Items<br>Wet Cast<br>Dry Cast | 1042 | 335<br>335 (TY III) | 418<br>418 (TY III) | 0.32 - 0.44<br>0.25 - 0.40 | 25 - 100<br>0 - 25 | See Section 1042 | | | 5.0 - 8.0<br>N/A | CA7, CA11, CA13,<br>CA 14, CA 16, or<br>CA 7 & CA 16 |
| PS | Precast Prestressed Members | 504 | 335<br>335 (TY III) | 418<br>418 (TY III) | 0.32 - 0.44 | 25 - 100 | | | Plans | 5.0 - 8.0 | CA 11 (11),<br>CA 13, CA 14 (11),<br>or CA 16 |
| | Precast Prestressed Piles and Extensions | 512 | | | | | | | 34,500 | | |
| | Precast Prestressed Sight Screen | 639 | | | | | | | 24,000 | | |

| TABLE 1. CLASSES OF CONCRETE AND MIX DESIGN CRITERIA (metric) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Class of Conc. | Use | Specification Section Reference | Cement Factor kg/cu m (3) | | Water / Cement Ratio kg/kg | Slump mm (4) | Mix Design Compressive Strength (Flexural Strength) kPa, minimum Days | | | Air Content % | Coarse Aggregate Gradations (14) |
| | | | Min. | Max | | | 3 | 14 | 28 | | |
| DS | Drilled Shaft (12)<br>Metal Shell Piles (12)<br>Sign Structures<br>Drilled Shaft (12)<br>Light Tower Foundation (12) | 516<br>512<br>734<br><br>837 | 395 | 418 | 0.32 - 0.44 | 150 -200 (6) | | 27,500 (4650) | | 5.0 - 8.0 | CA 13, CA 14, CA 16, or a blend of these gradations. |
| SC | Seal Coat | 503 | 335 (1)<br>360 (2) | 418 | 0.32 - 0.44 | 75 - 125 | | 24,000 (4500) | | Optional 6.0 max. | CA 3 & CA 7, CA 3 & CA 11, CA 5 & CA 7, CA 5 & CA 11, CA 7, or CA 11 |
| SI | Structures (except Superstructure)<br>Sidewalk<br>Slope Wall<br>Encasement<br>Box Culverts<br>End Section and Collar<br>Curb, Gutter, Curb & Gutter,<br>Median, and Paved Ditch<br>Concrete Barrier<br>Sign Structures<br>Spread Footing<br>Concrete Foundation<br>Pole Foundation (12)<br>Traffic Signal Foundation<br>Drilled Shaft (12)<br>Square or Rectangular | 503<br>424<br>511<br>512<br>540<br>542<br><br>606<br>637<br>734<br><br><br>836<br>878 | 335 (1)<br>360 (2) | 418 | 0.32 - 0.44 | 50 - 100 (5) | | 24,000 (4500) | | 5.0 - 8.0 (5) | CA 3 & CA 7, CA 3 & CA 11, CA 5 & CA 7, CA 5 & CA 11, CA 7, CA 11, CA 13, CA 14, or CA 16 (13) |

Notes:

(1) Central-mixed.

(2) Truck-mixed or shrink-mixed.

(3) For Class SC concrete and for any other class of concrete that is to be placed underwater, except Class DS concrete, the cement factor shall be increased by ten percent.

(4) The maximum slump may be increased to 175 mm when a high range water-reducing admixture is used for all classes of concrete except Class PV, SC, and PP. For Class SC, the maximum slump may be increased to 200 mm. For Class PP-1, the maximum slump may be increased to 150 mm. For Class PS, the 175 mm maximum slump may be increased to 215 mm if the high range water-reducing admixture is the polycarboxylate type.

(5) The slump range for slipform construction shall be 13 to 64 mm and the air content range shall be 5.5 to 8.0 percent.

(6) If concrete is placed to displace drilling fluid, or against temporary casing, the slump shall be 200 - 250 mm at the point of placement. If a water-reducing admixture is used in lieu of a high range water-reducing admixture according to Article 1020.05(b)(7), the slump shall be 50 – 100 mm.

(7) For Class BS concrete used in bridge deck patching, the coarse aggregate gradation shall be CA 13, CA 14, or CA 16, except CA 11 may be used for full-depth patching.

(8) In addition to the Type III portland cement, 60 kg/cu m of ground granulated blast-furnace slag and 30 kg/cu m of microsilica (silica fume) shall be used. For an air temperature greater than 30 °C, the Type III portland cement may be replaced with Type I or II portland cement.

(9) The cement shall be a rapid hardening cement from the Department's "Approved List of Packaged, Dry, Rapid Hardening Cementitious Materials for Concrete Repairs" for PP-4 and calcium aluminate cement for PP-5.

(10) For Class PP concrete used in bridge deck patching, the coarse aggregate gradation shall be CA 13, CA 14, or CA 16, except CA 11 may be used for full-depth patching. In addition, the mix design shall have 72 hours to obtain a 27,500 kPa compressive or 4,650 kPa flexural.

(11) The nominal maximum size permitted is 19 mm. Nominal maximum size is defined as the largest sieve which retains any of the aggregate sample particles.

(12) The concrete mix shall be designed to remain fluid throughout the anticipated duration of the pour plus one hour. At the Engineer's discretion, the Contractor may be required to conduct a minimum 1.5 cu m trial batch to verify the mix design.

(13) CA 3 or CA 5 may be used when the nominal maximum size does not exceed two-thirds the clear distance between parallel reinforcement bars, or between the reinforcement bar and the form. Nominal maximum size is defined in Note 11.

(14) Alternate combinations of gradation sizes may be used with the approval of the Engineer. Refer also to Article 1004.02(d) for additional information on combining sizes.

Self-consolidating concrete is a flowable mixture that does not require mechanical vibration for consolidation. Self-consolidating concrete mix designs may be developed for Class BS, PC, PS, DS, and SI concrete. Self-consolidating concrete mix designs may also be developed for precast concrete products that are not subjected to Class PC concrete requirements according to Section 1042. The mix design criteria for the concrete mixture shall be according to Article 1020.04 with the following exceptions.

(a) The slump requirements shall not apply.

(b) The concrete mixture should be uniformly graded, and information in the "Portland Cement Concrete Level III Technician Course – Manual of Instructions for Design of Concrete Mixtures" may be used to develop the uniformly graded mix design. The coarse aggregate gradations shall be CA 11, CA 13, CA 14, CA 16, or a blend of these gradations. However, the final gradation when using a single coarse aggregate or combination of coarse aggregates shall have 100 percent pass the 1 in. (25 mm) sieve, and minimum 95 percent pass the 3/4 in. (19 mm) sieve. The fine aggregate proportion shall be a maximum 50 percent by weight (mass) of the total aggregate used.

(c) The slump flow range shall be 22 in. (560 mm) minimum to 28 in. (710 mm) maximum and tested according to Illinois Test Procedure SCC-2.

(d) The visual stability index shall be a maximum of 1 and tested according to Illinois Test Procedure SCC-2.

(e) The J-Ring value shall be a maximum of 2 in. (50 mm) and tested according to Illinois Test Procedure SCC-3. The L-Box blocking ratio shall be a minimum of 80 percent and tested according to Illinois Test Procedure SCC-3. The Contractor has the option to select either test.

(f) The hardened visual stability index shall be a maximum of 1 and tested according to Illinois Test Procedure SCC-6.

(g) If Class PC concrete requirements do not apply to the precast concrete product according to Section 1042, the maximum cement factor shall be 7.05 cwt/cu yd (418 kg/cu m) and the maximum allowable water/cement ratio shall be 0.44.

(h) If the measured slump flow, visual stability index, J-Ring value, or L-Box blocking ratio fall outside the limits specified, a check test will be made. In the event of a second failure, the Engineer may refuse to permit the use of the batch of concrete represented.

The Contractor may use water or self-consolidating admixtures at the jobsite to obtain the specified slump flow, visual stability index, J-ring value, or L-box blocking ratio. The maximum design water/cement ratio shall not be exceeded.

**1020.05 Other Concrete Criteria.** The concrete shall be according to the following.

(a) Proportioning and Mix Design. For all Classes of concrete, it shall be the Contractor's responsibility to determine mix design material proportions and to proportion each batch of concrete. A Level III PCC Technician shall develop the mix design for all Classes of concrete, except Classes PC and PS. The mix design, submittal information, trial batch, and Engineer verification shall be according to the "Portland Cement Concrete Level III Technician" course material.

The Contractor shall provide the mix designs a minimum of 45 calendar days prior to production. More than one mix design may be submitted for each class of concrete.

The Engineer will verify the mix design submitted by the Contractor. Verification of a mix design shall in no manner be construed as acceptance of any mixture produced. Once a mix design has been verified, the Engineer shall be notified of any proposed changes.

Tests performed at the jobsite will determine if a mix design can meet specifications. If the tests indicate it cannot, the Contractor shall make adjustments to a mix design, or submit a new mix design if necessary, to comply with the specifications.

(b) Admixtures. The Contractor shall be responsible for using admixtures and determining dosages for all Classes of concrete, cement aggregate mixture II, and controlled low-strength material that will produce a mixture with suitable workability, consistency, and plasticity. In addition, admixture dosages shall result in the mixture meeting the specified plastic and hardened properties. The Contractor shall obtain approval from the Engineer to use an accelerator when the concrete temperature is greater than 60 °F (16 °C). However, this accelerator approval by the Engineer will not be required for Class PP, RR, PC, and PS concrete. The accelerator shall be the non-chloride type unless otherwise specified in the contract plans.

The Department will maintain an Approved List of Corrosion Inhibitors. Corrosion inhibitor dosage rates shall be according to Article 1020.05(b)(10). For information on approved controlled low-strength material air-entraining admixtures, refer to Article 1019.02. The Department will also maintain an Approved List of Concrete Admixtures, and an admixture technical representative shall be consulted by the Contractor prior to the pour when determining an admixture dosage from this list or when making minor admixture dosage adjustments at the jobsite. The dosage shall be within the range indicated on the approved list unless the influence by other admixtures, jobsite

conditions (such as a very short haul time), or other circumstances warrant a dosage outside the range. The Engineer shall be notified when a dosage is proposed outside the range. To determine an admixture dosage, air temperature, concrete temperature, cement source and quantity, finely divided mineral sources and quantity, influence of other admixtures, haul time, placement conditions, and other factors as appropriate shall be considered. The Engineer may request the Contractor to have a batch of concrete mixed in the lab or field to verify the admixture dosage is correct. An admixture dosage or combination of admixture dosages shall not delay the initial set of concrete by more than one hour. When a retarding admixture is required or appropriate for a bridge deck or bridge deck overlay pour, the initial set time shall be delayed until the deflections due to the concrete dead load are no longer a concern for inducing cracks in the completed work. However, a retarding admixture shall not be used to further extend the pour time and justify the alteration of a bridge deck pour sequence.

When determining water in admixtures for water/cement ratio, the Contractor shall calculate 70 percent of the admixture dosage as water, except a value of 50 percent shall be used for a latex admixture used in bridge deck latex concrete overlays.

The sequence, method, and equipment for adding the admixtures shall be approved by the Engineer. Admixtures shall be added to the concrete separately. An accelerator shall always be added prior to a high range water-reducing admixture, if both are used.

Admixture use shall be according to the following.

(1) When the atmosphere or concrete temperature is 65 °F (18 °C) or higher, a retarding admixture shall be used in the Class BS concrete and concrete bridge deck overlays. The proportions of the ingredients of the concrete shall be the same as without the retarding admixture, except that the amount of mixing water shall be reduced, as may be necessary, in order to maintain the consistency of the concrete as required. In addition, a high range water-reducing admixture shall be used in bridge deck concrete. At the option of the Contractor, a water-reducing admixture may be used with the high range water-reducing admixture in Class BS concrete.

(2) At the Contractor's option, admixtures in addition to an air-entraining admixture may be used for Class PP-1 or RR concrete. When the air temperature is less than 55 °F (13 °C) and an accelerator is used, the non-chloride accelerator shall be calcium nitrite.

(3) When Class C fly ash or ground granulated blast-furnace slag is used in Class PP-1 or RR concrete, a water-reducing or high range water-reducing admixture shall be used.

(4) For Class PP-2 or PP-3 concrete, a non-chloride accelerator followed by a high range water-reducing admixture shall be used, in addition to the air-entraining admixture. The Contractor has the option to use a water-reducing admixture with the high range water-reducing admixture. For Class PP-3 concrete, the non-chloride accelerator shall be calcium nitrite. For Class PP-2 concrete, the non-chloride accelerator shall be calcium nitrite when the air temperature is less than 55 °F (13 °C).

(5) For Class PP-4 concrete, a high range water-reducing admixture shall be used in addition to the air-entraining admixture. The Contractor has the option to use a water-reducing admixture with the high range water-reducing admixture. An accelerator shall not be used. For stationary or truck-mixed concrete, a retarding admixture shall be used to allow for haul time. The Contractor has the option to use a mobile portland cement concrete plant, but a retarding admixture shall not be used unless approved by the Engineer.

For PP-5 concrete, a non-chloride accelerator, high range water-reducing admixture, and air-entraining admixture shall be used. The accelerator, high range water-reducing admixture, and air-entraining admixture shall be per the Contractor's recommendation and dosage. The approved list of concrete admixtures shall not apply. A mobile portland cement concrete plant shall be used to produce the patching mixture.

(6) When a calcium chloride accelerator is specified in the contract, the maximum chloride dosage shall be 1.0 quart (1.0 L) of solution per 100 lb (45 kg) of cement. The dosage may be increased to a maximum 2.0 quarts (2.0 L) per 100 lb (45 kg) of cement if approved by the Engineer. When a calcium chloride accelerator for Class PP-2 concrete is specified in the contract, the maximum chloride dosage shall be 1.3 quarts (1.3 L) of solution per 100 lb (45 kg) of cement. The dosage may be increased to a maximum 2.6 quarts (2.6 L) per 100 lb (45 kg) of cement if approved by the Engineer.

(7) For Class DS concrete a retarding admixture and a high range water-reducing admixture shall be used. For dry excavations that are 10 ft (3 m) or less, the high range water-reducing admixture may be replaced with a water-reducing admixture if the concrete is vibrated. The use of admixtures shall take into consideration the slump loss limits specified in Article 516.12 and the fluidity requirement in Article 1020.04 (Note 12).

(8) At the Contractor's option, when a water-reducing admixture or a high range water-reducing admixture is used for Class PV, PP-1, RR, SC, and SI concrete, the cement factor may be reduced a maximum 0.30 hundredweight/cu yd (18 kg/cu m).

However, a cement factor reduction will not be allowed for concrete placed underwater.

(9) When Type F or Type G high range water-reducing admixtures are used, the initial slump shall be a minimum of 1 1/2 in. (40 mm) prior to addition of the Type F or Type G admixture, except as approved by the Engineer.

(10) When specified, a corrosion inhibitor shall be added to the concrete mixture utilized in the manufacture of precast, prestressed concrete members and/or other applications. It shall be added, at the same rate, to all grout around post-tensioning steel when specified.

When calcium nitrite is used, it shall be added at the rate of 4 gal/cu yd (20 L/cu m), and shall be added to the mix immediately after all compatible admixtures have been introduced to the batch.

When Rheocrete 222+ is used, it shall be added at the rate of 1.0 gal/cu yd (5.0 L/cu m), and the batching sequence shall be according to the manufacturer's instructions.

(c) Finely Divided Minerals. Use of finely divided minerals shall be according to the following.

(1) Fly Ash. At the Contractor's option, fly ash from approved sources may partially replace portland cement in cement aggregate mixture II, Class PV, PP-1, PP-2, RR, BS, PC, PS, DS, SC, and SI concrete.

The use of fly ash shall be according to the following.

a. Measurements of fly ash and portland cement shall be rounded up to the nearest 5 lb (2.5 kg).

b. When Class F fly ash is used in cement aggregate mixture II, Class PV, BS, PC, PS, DS, SC, and SI concrete, the amount of portland cement replaced shall not exceed 25 percent by weight (mass).

c. When Class C fly ash is used in cement aggregate mixture II, Class PV, PP-1, PP-2, RR, BS, PC, PS, DS, SC, and SI concrete, the amount of portland cement replaced shall not exceed 30 percent by weight (mass).

d. Fly ash may be used in concrete mixtures when the air temperature is below 40 °F (4 °C), but the Engineer may request a trial batch of the concrete mixture to show the mix design strength requirement will be met.

(2) Ground Granulated Blast-Furnace (GGBF) Slag. At the Contractor's option, GGBF slag may partially replace portland cement in Class PV, PP-1, PP-2, RR, BS, PC, PS, DS, SC, and SI concrete. For Class PP-3 concrete, GGBF slag shall be used according to Article 1020.04.

The use of GGBF slag shall be according to the following.

a. Measurements of GGBF slag and portland cement shall be rounded up to the nearest 5 lb (2.5 kg).

b. When GGBF slag is used in Class PV, PP-1, PP-2, RR, BS, PC, PS, DS, SC and SI concrete, the amount of portland cement replaced shall not exceed 35 percent by weight (mass).

c. GGBF slag may be used in concrete mixtures when the air temperature is below 40 °F (4 °C), but the Engineer may request a trial batch of the concrete mixture to show the mix design strength requirement will be met.

(3) Microsilica. At the Contractor's option, microsilica may be added at a maximum of 5.0 percent by weight (mass) of the cement and finely divided minerals summed together.

Microsilica shall be used in Class PP-3 concrete according to Article 1020.04.

(4) High Reactivity Metakaolin (HRM). At the Contractor's option, HRM may be added at a maximum of 5.0 percent by weight (mass) of the cement and finely divided minerals summed together.

(5) Mixtures with Multiple Finely Divided Minerals. Except as specified for Class PP-3 concrete, the Contractor has the option to use more than one finely divided mineral in Class PV, PP-1, PP-2, RR, BS, PC, PS, DS, SC, and SI concrete as follows.

a. The mixture shall contain a maximum of two finely divided minerals. The finely divided mineral in portland-pozzolan cement or portland blast-furnace slag cement shall count toward the total number of finely divided minerals allowed. The finely divided minerals shall constitute a maximum of 35.0 percent of the total cement plus finely divided minerals. The fly ash portion shall not exceed 30.0 percent for Class C fly ash or 25.0 percent for Class F fly ash. The Class C

and F fly ash combination shall not exceed 30.0 percent. The ground granulated blast-furnace slag portion shall not exceed 35.0 percent. The microsilica or high-reactivity metakaolin portion used together or separately shall not exceed ten percent. The finely divided mineral in the portland-pozzolan cement or portland blast-furnace slag blended cement shall apply to the maximum 35.0 percent.

b. Central Mixed. For Class PV, SC, and SI concrete, the mixture shall contain a minimum of 565 lbs/cu yd (335 kg/cu m) of cement and finely divided minerals summed together. If a water-reducing or high-range water-reducing admixture is used, the Contractor has the option to use a minimum of 535 lbs/cu yd (320 kg/cu m).

c. Truck-Mixed or Shrink-Mixed. For Class PV, SC, and SI concrete, the mixture shall contain a minimum of 605 lbs/cu yd (360 kg/cu m) of cement and finely divided minerals summed together. If a water-reducing or high-range water-reducing admixture is used, the Contractor has the option to use a minimum of 575 lbs/cu yd (345 kg/cu m).

d. Central-Mixed, Truck-Mixed or Shrink-Mixed. For Class PP-1 and RR concrete, the mixture shall contain a minimum of 650 lbs/cu yd (385 kg/cu m) of cement and finely divided minerals summed together. For Class PP-1 and RR concrete using Type III portland cement, the mixture shall contain a minimum of 620 lbs/cu yd (365 kg/cu m).

   For Class PP-2 concrete, the mixture shall contain a minimum of 735 lbs/cu yd (435 kg/cu m) of cement and finely divided minerals summed together. For Class BS concrete, the mixture shall contain a minimum of 605 lbs/cu yd (360 kg/cu m). For Class DS concrete, the mixture shall contain a minimum of 665 lbs/cu yd (395 kg/cu m).

   If a water-reducing or high range water-reducing admixture is used in Class PP-1 and RR concrete, the Contractor has the option to use a minimum of 620 lbs/cu yd (365 kg/cu m) of cement and finely divided minerals summed together. If a water-reducing or high-range water-reducing admixture is used with Type III portland cement in Class PP-1 and RR concrete, the Contractor has the option to use a minimum of 590 lbs/cu yd (350 kg/cu m).

e. Central-Mixed or Truck-Mixed. For Class PC and PS concrete, the mixture shall contain a minimum of 565 lbs/cu yd (335 kg/cu m) of cement and finely divided minerals summed together.

f. The mixture shall contain a maximum of 705 lbs/cu yd (418 kg/cu m) of cement and finely divided mineral(s) summed together for Class PV, BS, PC, PS, DS, SC, and SI concrete. For Class PP-1 and RR concrete, the mixture shall contain a maximum of 750 lbs/cu yd (445 kg/cu m). For Class PP-1 and RR concrete using Type III portland cement, the mixture shall contain a maximum of 720 lbs/cu yd (425 kg/cu m). For Class PP-2 concrete, the mixture shall contain a maximum of 820 lbs/cu yd (485 kg/cu m).

g. For Class SC concrete and for any other class of concrete that is to be placed underwater, except Class DS concrete, the allowable cement and finely divided minerals summed together shall be increased by ten percent.

h. The combination of cement and finely divided minerals shall comply with Article 1020.05(d).

(d) Alkali-Silica Reaction. For cast-in-place (includes cement aggregate mixture II and latex mixtures), precast, and precast prestressed concrete, one of the mixture options provided in Article 1020.05(d)(2) shall be used to reduce the risk of a deleterious alkali-silica reaction in concrete exposed to humid or wet conditions. The mixture options are not intended or adequate for concrete exposed to potassium acetate, potassium formate, sodium acetate, or sodium formate. The mixture options will not be required for the dry environment (humidity less than 60 percent) found inside buildings for residential or commercial occupancy.

The mixture options shall not apply to concrete revetment mats, insertion lining of pipe culverts, portland cement mortar fairing course, controlled low-strength material, miscellaneous grouts that are not prepackaged, Class PP-3 concrete, Class PP-4 concrete, and Class PP-5 concrete.

(1) Aggregate Groups. Each combination of aggregates used in a mixture will be assigned to an aggregate group. The point at which the coarse aggregate and fine aggregate expansion values intersect in the following table will determine the group.

| Aggregate Groups | | | |
|---|---|---|---|
| Coarse Aggregate or Coarse Aggregate Blend | Fine Aggregate Or Fine Aggregate Blend | | |
| | ASTM C 1260 Expansion | | |
| ASTM C 1260 Expansion | ≤0.16% | >0.16% - 0.27% | >0.27% |

| | | | |
|---|---|---|---|
| ≤0.16% | Group I | Group II | Group III |
| >0.16% - 0.27% | Group II | Group II | Group III |
| >0.27% | Group III | Group III | Group IV |

(2) Mixture Options. Based upon the aggregate group, the following mixture options shall be used. However, the Department may prohibit a mixture option if field performance shows a deleterious alkali-silica reaction or Department testing indicates the mixture may experience a deleterious alkali-silica reaction.

| Reduction of Risk for Deleterious Alkali-Silica Reaction | | | | | |
|---|---|---|---|---|---|
| Aggregate Groups | Mixture Options | | | | |
| | Option 1 | Option 2 | Option 3 | Option 4 | Option 5 |
| Group I | Mixture options are not applicable. Use any cement or finely divided mineral. | | | | |
| Group II | X | X | X | X | X |
| Group III | X | Combine Option 2 with Option 3 | Combine Option 2 with Option 3 | X | X |
| Group IV | X | Combine Option 2 with Option 4 | Invalid Option | Combine Option 2 with Option 4 | X |

"X" denotes valid mixture option for aggregate group.

a. Mixture Option 1. The coarse or fine aggregates shall be blended to place the material in a group that will allow the selected cement or finely divided mineral to be used. Coarse aggregate may only be blended with another coarse aggregate. Fine aggregate may only be blended with another fine aggregate. Blending of coarse with fine aggregate to place the material in another group will not be permitted.

When a coarse or fine aggregate is blended, the weighted expansion value shall be calculated separately for the coarse and fine aggregate as follows:

Weighted Expansion Value = (a/100 x A) + (b/100 x B) + (c/100 x C) + ...

Where: a, b, c... = percentage of aggregate in the blend;

A, B, C... = expansion value for that aggregate.

b. Mixture Option 2. A finely divided mineral shall be used as described in 1), 2), 3), or 4) that follow. In addition, a blended cement with a finely divided mineral may be added to a separate finely divided mineral to meet the following requirements, provided the finely divided minerals are the same material. However, adding together two different finely divided minerals to obtain the specified minimum percentage of one material will not be permitted for 1), 2), 3), and 4). Refer to Mixture Option 5 to address this situation.

1. Class F Fly Ash. For cement aggregate mixture II, Class PV, BS, PC, PS, MS, DS, SC and SI concrete, the Class F fly ash shall be a minimum 25.0 percent by weight (mass) of the cement and finely divided minerals summed together.

   If the maximum total equivalent available alkali content ($Na_2O + 0.658K_2O$) exceeds 4.50 percent for the Class F fly ash, it may be used only if it complies with Mixture Option 5.

2. Class C Fly Ash. For cement aggregate mixture II, Class PV, PP-1, PP-2, RR, BS, PC, PS, DS, SC, and SI concrete, Class C fly ash shall be a minimum of 25.0 percent by weight (mass) of the cement and finely divided minerals summed together.

   If the maximum total equivalent available alkali content ($Na_2O + 0.658K_2O$) exceeds 4.50 percent or the calcium oxide exceeds 26.50 percent for the Class C fly ash, it may be used only per Mixture Option 5.

3. Ground Granulated Blast-Furnace Slag. For Class PV, PP-1, PP-2, RR, BS, PC, PS, DS, SC, and SI concrete, ground granulated blast-furnace slag shall be a minimum of 25.0 percent by weight (mass) of the cement and finely divided minerals summed together.

   If the maximum total equivalent available alkali content ($Na_2O + 0.658K_2O$) exceeds 1.00 percent for the ground granulated blast-furnace slag, it may be used only per Mixture Option 5.

4. Microsilica or High Reactivity Metakaolin, Microsilica solids or high reactivity metakaolin shall be a minimum 5.0 percent by weight (mass) of the cement and finely divided minerals summed together.

If the maximum total equivalent available alkali content ($Na_2O + 0.658K_2O$) exceeds 1.00 percent for the Microsilica or High Reactivity Metakaolin, it may be used only if it complies with Mixture Option 5.

c. Mixture Option 3. The cement used shall have a maximum total equivalent alkali content ($Na_2O + 0.658K_2O$) of 0.60 percent. When aggregate in Group II is involved and the Contractor desires to use a finely divided mineral, any finely divided mineral may be used with the cement unless the maximum total equivalent available alkali content ($Na_2O + 0.658K_2O$) exceeds 4.50 percent for the fly ash; or 1.00 percent for the ground granulated blast-furnace slag, microsilica or high reactivity metakaolin. If the alkali content is exceeded, the finely divided mineral may be used only per Mixture Option 5.

d. Mixture Option 4. The cement used shall have a maximum total equivalent alkali content ($Na_2O + 0.658K_2O$) of 0.45 percent. When aggregate in Group II or III is involved and the Contractor desires to use a finely divided mineral, any finely divided mineral may be used with the cement unless the maximum total equivalent available alkali content ($Na_2O + 0.658K_2O$) exceeds 4.50 percent for the fly ash; or 1.00 percent for the ground granulated blast-furnace slag, microsilica, or high reactivity metakaolin. If the alkali content is exceeded, the finely divided mineral may be used only per Mixture Option 5.

e. Mixture Option 5. The proposed cement or finely divided mineral may be used if the ASTM C 1567 expansion value is $\leq$ 0.16 percent when performed on the aggregate in the concrete mixture with the highest ASTM C 1260 test result. The laboratory performing the ASTM C 1567 test shall be approved by the Department according to the current Bureau of Materials and Physical Research Policy Memorandum "Minimum Laboratory Requirements for Alkali-Silica Reactivity (ASR) Testing". The ASTM C 1567 test will be valid for two years, unless the Engineer determines the materials have changed significantly.

   For latex concrete, the ASTM C 1567 test shall be performed without the latex.

   The 0.20 percent autoclave expansion limit in ASTM C 1567 shall not apply.

   If during the two year time period the Contractor needs to replace the cement, and the replacement cement has an equal or lower total equivalent alkali content ($Na_2O + 0.658K_2O$), a new ASTM C 1567 test will not be required.

   The Engineer reserved the right to verify a Contractor's ASTM C 1567 test result. When the Contractor performs the test, a split sample may be requested by the Engineer. The Engineer may also independently obtain a sample at any time.

The proposed cement or finely divided mineral will not be allowed for use if the Contractor or Engineer obtains an expansion value greater than 0.16 percent.

**1020.06 Water/Cement Ratio.** The water/cement ratio shall be determined on a weight (mass) basis. When a maximum water/cement ratio is specified, the water shall include mixing water, water in admixtures, free moisture on the aggregates, and water added at the jobsite. The quantity of water may be adjusted within the limit specified to meet slump requirements.

When fly ash, ground granulated blast-furnace slag, high-reactivity metakaolin, or microsilica (silica fume) are used in a concrete mix, the water/cement ratio will be based on the total cement and finely divided minerals contained in the mixture.

**1020.07 Slump.** The slump shall be determined according to Illinois Modified AASHTO T 119.

If the measured slump falls outside the limits specified, a check test will be made. In the event of a second failure, the Engineer may refuse to permit the use of the batch of concrete represented.

If the Contractor is unable to add water to prepare concrete of the specified slump without exceeding the maximum design water/cement ratio, a water-reducing admixture shall be added.

**1020.08 Air Content.** The air content shall be determined according to Illinois Modified AASHTO T 152 or Illinois Modified AASHTO T 196. The air-entrainment shall be obtained by the use of cement with an approved air-entraining admixture added during the mixing of the concrete or the use of air-entraining cement.

If the air-entraining cement furnished is found to produce concrete having air content outside the limits specified, its use shall be discontinued immediately and the Contractor shall provide other air-entraining cement which will produce air contents within the specified limits.

If the air content obtained is above the specified maximum limit at the jobsite, the Contractor may have the concrete further mixed, within the limits of time and revolutions specified, to reduce the air content. If the air content obtained is below the specified minimum limit, the Contractor may add to the concrete a sufficient quantity of an approved air-entraining admixture at the jobsite to bring the air content within the specified limits.

**1020.09 Strength Tests.** The specimens shall be molded and cured according to Illinois Modified AASHTO T 23. Specimens shall be field cured with the construction item as specified in Illinois Modified AASHTO T 23. The compressive strength shall be determined according to Illinois Modified AASHTO T 22. The flexural strength shall be determined according to Illinois Modified AASHTO T 177.

Except for Class PC and PS concrete, the Contractor shall transport the strength specimens from the site of the work to the field laboratory or other location as instructed by the Engineer. During transportation in a suitable light truck, the specimens shall be embedded in straw, burlap, or other acceptable material in a manner meeting with the approval of the Engineer to protect them from damage; care shall be taken to avoid impacts during hauling and handling. For strength specimens, the Contractor shall provide a field curing box for initial curing and a water storage tank for final curing. The field curing box will be required when an air temperature below 60 °F (16 °C) is expected during the initial curing period. The device shall maintain the initial curing temperature range specified in Illinois Modified AASHTO T 23, and may be insulated or power operated as appropriate.

**1020.10 Handling, Measuring, and Batching Materials.** Aggregates shall be handled in a manner to prevent mixing with soil and other foreign material.

Aggregates shall be handled in a manner which produces a uniform gradation, before placement in the plant bins. Aggregates delivered to the plant in a nonuniform gradation condition shall be stockpiled. The stockpiled aggregate shall be mixed uniformly before placement in the plant bins.

Aggregates shall have a uniform moisture content before placement in the plant bins. This may require aggregates to be stockpiled for 12 hours or more to allow drainage, or water added to the stockpile, or other methods approved by the Engineer. Moisture content requirements for crushed concrete, crushed slag or lightweight aggregate shall be according to Article 1004.01(e)(5).

Aggregates, cement, and finely divided minerals shall be measured by weight (mass). Water and admixtures shall be measured by volume or weight (mass).

The Engineer may permit aggregates, cement, and finely divided minerals to be measured by volume for small isolated structures and for miscellaneous items. Aggregates, cement, and finely divided minerals shall be measured individually. The volume shall be based upon dry, loose materials.

**1020.11 Mixing Portland Cement Concrete.** The mixing of concrete shall be according to the following.

(a) Ready-Mixed Concrete. Ready-mixed concrete is central-mixed, truck-mixed, or shrink-mixed concrete transported and delivered in a plastic state ready for placement in the work and shall be according to the following.

(1) Central-Mixed Concrete. Central-mixed concrete is concrete which has been completely mixed in a stationary mixer and delivered in a truck agitator, a truck mixer operating at agitating speed, or a nonagitator truck.

The stationary mixer shall operate at the drum speed for which it was designed. The batch shall be charged into the drum so that some of the water shall enter in advance of the cement, finely divided minerals, and aggregates. The flow of the water shall be uniform and all water shall be in the drum by the end of the first 15 seconds of the mixing period. Water shall begin to enter the drum from zero to two seconds in advance of solid material and shall stop flowing within two seconds of the beginning of mixing time.

Some coarse aggregate shall enter in advance of other solid materials. For the balance of the charging time for solid materials, the aggregates, finely divided minerals, and cement (to assure thorough blending) shall each flow at acceptably uniform rates, as determined by visual observation. Coarse aggregate shall enter two seconds in advance of other solid materials and a uniform rate of flow shall continue to within two seconds of the completion of charging time.

The entire contents of the drum, or of each single compartment of a multiple-drum mixer, shall be discharged before the succeeding batch is introduced.

The volume of concrete mixed per batch shall not exceed the mixer's rated capacity as shown on the standard rating plate on the mixer by more than ten percent.

The minimum mixing time shall be 75 seconds for a stationary mixer having a capacity greater than 2 cu yd (1.5 cu m). For a mixer with a capacity equal to or less than 2 cu yd (1.5 cu m) the mixing time shall be 60 seconds. Transfer time in multiple drum mixers is included in the mixing time. Mixing time shall begin when all materials are in the mixing compartment and shall end when the discharge of any part of the batch is started. The required mixing times will be established by the Engineer for all types of stationary mixers.

When central-mixed concrete is to be transported in a truck agitator or a truck mixer, the stationary-mixed batch shall be transferred to the agitating unit without delay and without loss of any portion of the batch. Agitating shall start immediately thereafter and shall continue without interruption until the batch is discharged from the agitator. The ingredients of the batch shall be completely discharged from the agitator before the succeeding batch is introduced. Drums and auxiliary parts of the equipment shall be kept free from accumulations of materials.

The vehicles used for transporting the mixed concrete shall be of such capacity, or the batches shall be so proportioned, that the entire contents of the mixer drum can be discharged into each vehicle load.

(2) Truck-Mixed Concrete. Truck-mixed concrete is completely mixed and delivered in a truck mixer. When the mixer is charged with fine and coarse aggregates simultaneously, not less than 60 nor more than 100 revolutions of the drum or blades at mixing speed shall be required, after all of the ingredients including water are in the drum. When fine and coarse aggregates are charged separately, not less than 70 revolutions will be required. For self-consolidating concrete, a minimum of 100 revolutions is required in all cases. Additional mixing beyond 100 revolutions shall be at agitating speed unless additions of water, admixtures, or other materials are made at the jobsite. The mixing operation shall begin immediately after the cement and water, or the cement and wet aggregates, come in contact. The ingredients of the batch shall be completely discharged from the drum before the succeeding batch is introduced. The drum and auxiliary parts of the equipment shall be kept free from accumulations of materials. If additional water or an admixture is added at the jobsite, the concrete batch shall be mixed a minimum of 40 additional revolutions after each addition.

(3) Shrink-Mixed Concrete. Shrink-mixed concrete is mixed partially in a stationary mixer and completed in a truck mixer for delivery. The mixing time of the stationary mixer may be reduced to a minimum of 30 seconds to intermingle the ingredients, before transferring to the truck mixer. All ingredients for the batch shall be in the stationary mixer and partially mixed before any of the mixture is discharged into the truck mixer. The partially mixed batch shall be transferred to the truck mixer without delay and without loss of any portion of the batch, and mixing in the truck mixer shall start immediately. The mixing time in the truck mixer shall be not less than 50 nor more than 100 revolutions of the drum or blades at mixing speed. For self-consolidating concrete, a minimum of 100 revolutions is required in the truck mixer. Additional mixing beyond 100 revolutions shall be at agitating speed, unless additions of water, admixtures, or other materials are made at the jobsite. Units designed as agitators shall not be used for shrink mixing. The ingredients of the batch shall be completely discharged from the drum before the succeeding batch is introduced. The drum and auxiliary parts of the equipment shall be kept free from accumulations of materials. If additional water or an admixture is added at the jobsite, the concrete batch shall be mixed a minimum of 40 additional revolutions after each addition.

(4) Mixing Water. Wash water shall be completely discharged from the drum or container before a batch is introduced. All mixing water shall be added at the plant and any adjustment of water at the jobsite by the Contractor shall not exceed the

specified maximum water/cement ratio or slump. If strength specimens have been made for a batch of concrete, and subsequently during discharge there is more water added, additional strength specimens shall be made for the batch of concrete. No additional water may be added at the jobsite to central-mixed concrete if the mix design has less than 565 lbs/cu yd (335 kg/cu m) of cement and finely divided minerals summed together.

(5) Mixing and Agitating Speeds. The mixing or agitating speeds used for truck mixers or truck agitators shall be per the manufacturer's rating plate.

(6) Capacities. The volume of plastic concrete in a given batch will be determined according to AASHTO T 121, based on the total weight (mass) of the batch, determined either from the weight (masses) of all materials, including water, entering the batch or directly from the net weight (mass) of the concrete in the batch as delivered.

The volume of mixed concrete in truck mixers or truck agitators shall in no case be greater than the rated capacity determined according to the Truck Mixer, Agitator, and Front Discharge Concrete Carrier Standards of the Truck Mixer Manufacturer's Bureau, as shown by the rating plate attached to the truck. If the truck mixer does not have a rating plate, the volume of mixed concrete shall not exceed 63 percent of the gross volume of the drum or container, disregarding the blades. For truck agitators, the value is 80 percent.

(7) Time of Haul. Haul time shall begin when the delivery ticket is stamped. The delivery ticket shall be stamped no later than five minutes after the addition of the mixing water to the cement, or after the addition of the cement to the aggregate when the combined aggregates contain free moisture in excess of two percent by weight (mass). If more than one batch is required for charging a truck using a stationary mixer, the time of haul shall start with mixing of the first batch. Haul time shall end when the truck is emptied for incorporation of the concrete into the work.

The time elapsing from when water is added to the mix until it is deposited in place at the site of the work shall not exceed 30 minutes when the concrete is transported in nonagitating trucks.

The maximum haul time for concrete transported in truck mixers or truck agitators shall be according to the following.

| Concrete Temperature at Point of Discharge °F (°C) | Haul Time | |
|---|---|---|
| | Hours | Minutes |

| | | |
|---|---|---|
| 50-64 (10-17.5) | 1 | 30 |
| >64 (>17.5) - without retarder | 1 | 0 |
| >64 (>17.5) - with retarder | 1 | 30 |

To encourage start-up testing for mix adjustments at the plant, the first two trucks will be allowed an additional 15 minutes haul time whenever such testing is performed.

For a mixture which is not mixed on the jobsite, a delivery ticket shall be required for each load. The following information shall be recorded on each delivery ticket: (1) ticket number; (2) name of producer and plant location; (3) contract number; (4) name of Contractor; (5) stamped date and time batched; (6) truck number; (7) quantity batched; (8) amount of admixture(s) in the batch; (9) amount of water in the batch; and (10) Department mix design number.

For concrete mixed in jobsite stationary mixers, the above delivery ticket may be waived, but a method of verifying the haul time shall be established to the satisfaction of the Engineer.

(8) Production and Delivery. The production of ready-mixed concrete shall be such that the operations of placing and finishing will be continuous insofar as the job operations require. The Contractor shall be responsible for producing concrete that will have the required workability, consistency, and plasticity when delivered to the work. Concrete which is unsuitable for placement as delivered will be rejected. The Contractor shall minimize the need to adjust the mixture at the jobsite, such as adding water and admixtures prior to discharging.

(9) Use of Multiple Plants in the Same Construction Item. The Contractor may simultaneously use central-mixed, truck-mixed, and shrink-mixed concrete from more than one plant, for the same construction item, on the same day, and in the same pour. However, the following criteria shall be met.

a. Each plant shall use the same cement, finely divided minerals, aggregates, admixtures, and fibers.

b. Each plant shall use the same mix design. However, material proportions may be altered slightly in the field to meet slump and air content criteria. Field water adjustments shall not result in a difference that exceeds 0.02 between plants for water/cement ratio. The required cement factor for central-mixed concrete shall be increased to match truck-mixed or shrink-mixed concrete, if the latter two types of mixed concrete are used in the same pour.

c. The maximum slump difference between deliveries of concrete shall be 3/4 in. (19 mm) when tested at the jobsite. If the difference is exceeded, but test results are within specification limits, the concrete may be used. The Contractor shall take immediate corrective action and shall test subsequent deliveries of concrete until the slump difference is corrected. For each day, the first three truck loads of delivered concrete from each plant shall be tested for slump by the Contractor. Thereafter, when a specified test frequency for slump is to be performed, it shall be conducted for each plant at the same time.

d. The maximum air content difference between deliveries of concrete shall be 1.5 percent when tested at the jobsite. If the difference is exceeded, but test results are within specification limits, the concrete may be used. The Contractor shall take immediate corrective action and shall test subsequent deliveries of concrete until the air content difference is corrected. For each day, the first three truck loads of delivered concrete from each plant shall be tested for air content by the Contractor. Thereafter, when a specified test frequency for air content is to be performed, it shall be conducted for each plant at the same time.

e. Strength tests shall be performed and taken at the jobsite for each plant. When a specified strength test is to be performed, it shall be conducted for each plant at the same time. The difference between plants for strength shall not exceed 900 psi (6200 kPa) compressive and 90 psi (620 kPa) flexural. If the strength difference requirements are exceeded, the Contractor shall take corrective action.

f. The maximum haul time difference between deliveries of concrete shall be 15 minutes. If the difference is exceeded, but haul time is within specification limits, the concrete may be used. The Contractor shall take immediate corrective action and check subsequent deliveries of concrete.

(b) Class PC Concrete. The concrete shall be central-mixed or truck-mixed. Variations in plastic concrete properties shall be minimized between batches.

(c) Class PV Concrete. The concrete shall be central-mixed, truck-mixed, or shrink-mixed.

The required mixing time for stationary mixers with a capacity greater than 2 cu yd (1.5 cu m) may be less than 75 seconds upon satisfactory completion of a mixer performance test. Mixer performance tests may be requested by the Contractor when the quantity of concrete to be placed exceeds 50,000 sq yd (42,000 sq m). The testing shall be conducted according to the current Bureau of Materials and Physical Research's Policy Memorandum, "Field Test Procedures for Mixer Performance and Concrete Uniformity Tests".

The Contractor will be allowed to test two mixing times within a range of 50 to 75 seconds. If satisfactory results are not obtained from the required tests, the mixing time shall continue to be 75 seconds for the remainder of the contract. If satisfactory results are obtained, the mixing time may be reduced. In no event will mixing time be less than 50 seconds.

The Contractor shall furnish the labor, equipment, and material required to perform the testing according to the current Bureau of Materials and Physical Research's Policy Memorandum, "Field Test Procedures for Mixer Performance and Concrete Uniformity Tests".

A contract which has 12 ft (3.6 m) wide pavement or base course, and a continuous length of 1/2 mile (0.8 km) or more, shall have the following additional requirements.

(1) The plant and truck delivery operation shall be able to provide a minimum of 50 cu yd (38 cu m) of concrete per hour.

(2) The plant shall have automatic or semi-automatic batching equipment.

(d) All Other Classes of Concrete. The concrete shall be central-mixed, truck-mixed, or shrink-mixed concrete.

**1020.12 Mobile Portland Cement Concrete Plants.** The use of a mobile portland cement concrete plant may be approved under the provisions of Article 1020.10 for volumetric proportioning in small isolated structures, thin overlays, and for miscellaneous and incidental concrete items.

The first 1 cu ft (0.03 cu m) of concrete produced may not contain sufficient mortar and shall not be incorporated in the work. The side plate on the cement feeder shall be removed periodically (normally the first time the mixer is used each day) to see if cement is building up on the feed drum.

Sufficient mixing capacity of mixers shall be provided to enable continuous placing and finishing insofar as the job operations and the specifications require.

Slump and air tests made immediately after discharge of the mix may be misleading, since the aggregates may absorb a significant amount of water for four or five minutes after mixing.

**1020.13 Curing and Protection.** The method of curing, curing period, and method of protection for each type of concrete construction is included in the following Index Table.

| INDEX TABLE OF CURING AND PROTECTION OF CONCRETE CONSTRUCTION | | | |
|---|---|---|---|
| TYPE OF CONSTRUCTION | CURING METHODS | CURING PERIOD DAYS | LOW AIR TEMPERATURE PROTECTION METHODS |
| Cast-in-Place Concrete [11/] | | | |
| Pavement<br>Shoulder | 1020.13(a)(1)(2)(3)(4)(5) [3/ 5/] | 3 | 1020.13(c) |
| Base Course<br>Base Course Widening | 1020.13(a)(1)(2)(3)(4)(5) [2/] | 3 | 1020.13(c) |
| Driveway<br>Median<br>Barrier<br>Curb<br>Gutter<br>Curb & Gutter<br>Sidewalk<br>Slope Wall<br>Paved Ditch | 1020.13(a)(1)(2)(3)(4)(5) [4/ 5/] | 3 | 1020.13(c) [16/] |
| Catch Basin<br>Manhole<br>Inlet<br>Valve Vault | 1020.13(a)(1)(2)(3)(4)(5) [4/] | 3 | 1020.13(c) |
| Pavement Patching | 1020.13(a)(1)(2)(3)(4)(5) [2/] | 3 [12/] | 1020.13(c) |
| Bridge Deck Patching | 1020.13(a)(3)(5) | 3 or 7 [12/] | 1020.13(c) |
| Railroad Crossing | 1020.13(a)(3)(5) | 1 | 1020.13(c) |
| Piles and Drilled Shafts | 1020.13(a)(3)(5) | 7 | 1020.13(d)(1)(2)(3) |
| Foundations & Footings<br>Seal Coat | 1020.13(a)(1)(2)(3)(4)(5) [4/ 6/] | 7 | 1020.13(d)(1)(2)(3) |
| Substructure | 1020.13(a)(1)(2)(3)(4)(5) [1/ 7/] | 7 | 1020.13(d)(1)(2)(3) |
| Superstructure (except deck) | 1020.13(a)(1)(2)(3)(5) [8/] | 7 | 1020.13(d)(1)(2) |
| Deck<br>Bridge Approach Slab | 1020.13(a)(5) | 7 | 1020.13(d)(1)(2) [17/] |
| Retaining Walls | 1020.13(a)(1)(2)(3)(4)(5) [1/ 7/] | 7 | 1020.13(d)(1)(2) |
| Pump Houses | 1020.13(a)(1)(2)(3)(4)(5) [1/] | 7 | 1020.13(d)(1)(2) |
| Culverts | 1020.13(a)(1)(2)(3)(4)(5) [4/ 6/] | 7 | 1020.13(d)(1)(2) [18/] |
| Other Incidental Concrete | 1020.13(a)(1)(2)(3)(5) | 3 | 1020.13(c) |
| Precast Concrete [11/] | | | |
| Bridge Slabs<br>Piles and Pile Caps<br>Other Structural Members | 1020.13(a)(3)(5) [9/ 10/] | As Required [13/] | 9/ |
| All Other Precast Items | 1020.13(a)(3)(4)(5) [2/ 9/ 10/] | As Required [14/] | 9/ |
| Precast, Prestressed Concrete [11/] | | | |
| All Items | 1020(a)(3)(5) [9/ 10/] | Until Strand Tensioning is Released [15/] | 9/ |

Notes-General:

1/ Type I, membrane curing only

2/ Type II, membrane curing only

3/ Type III, membrane curing only

4/ Type I, II and III membrane curing

5/ Membrane Curing will not be permitted between November 1 and April 15.

6/ The use of water to inundate foundations and footings, seal coats or the bottom slab of culverts is permissible when approved by the Engineer, provided the water temperature can be maintained at 45 °F (7 °C) or higher.

7/ Asphalt emulsion for waterproofing may be used in lieu of other curing methods when specified and permitted according to Article 503.18. The top surfaces of abutments and piers shall be cured according to Article 1020.13(a)(3) or (5).

8/ On non-traffic surfaces which receive protective coat according to Article 503.19, a linseed oil emulsion curing compound may be used as a substitute for protective coat and other curing methods. The linseed oil emulsion curing compound will be permitted between April 16 and October 31 of the same year, provided it is applied with a mechanical sprayer according to Article 1101.09(b).

9/ Steam, supplemental heat, or insulated blankets (with or without steam/supplemental heat) are acceptable and shall be according to the Bureau of Materials and Physical Research's Policy Memorandum "Quality Control/Quality Assurance Program for Precast Concrete Products" and the "Manual for Fabrication of Precast, Prestressed Concrete Products".

10/ A moist room according to AASHTO M 201 is acceptable for curing.

11/ If curing is required and interrupted because of form removal for cast-in-place concrete items, precast concrete products, or precast prestressed concrete products, the curing shall be resumed within two hours from the start of the form removal.

12/ Curing maintained only until opening strength is attained for pavement patching, with a maximum curing period of three days. For bridge deck patching the curing period shall be three days if Class PP concrete is used and 7 days if Class BS concrete is used.

13/ The curing period shall end when the concrete has attained the mix design strength. The producer has the option to discontinue curing when the concrete has attained

80 percent of the mix design strength or after seven days. All strength test specimens shall remain with the units and shall be subjected to the same curing method and environmental condition as the units, until the time of testing.

14/ The producer shall determine the curing period or may elect to not cure the product. All strength test specimens shall remain with the units and shall be subjected to the same curing method and environmental condition as the units, until the time of testing.

15/ The producer has the option to continue curing after strand release.

16/ When structural steel or structural concrete is in place above slope wall, Article 1020.13(c) shall not apply. The protection method shall be according to Article 1020.13(d)(1).

17/ When Article 1020.13(d)(2) is used to protect the deck, the housing may enclose only the bottom and sides. The top surface shall be protected according to Article 1020.13(d)(1).

18/ For culverts having a waterway opening of 10 sq ft (1 sq m) or less, the culverts may be protected according to Article 1020.13(d)(3).

(a) Methods of Curing. Except as provided for in the Index Table of Curing and Protection of Concrete Construction, curing shall be accomplished by one of the following described methods. When water is required to wet the surface, it shall be applied as a fine spray so that it will not mar or pond on the surface. Except where otherwise specified, the curing period shall be at least 72 hours.

(1) Waterproof Paper Method. The surface of the concrete shall be covered with waterproof paper as soon as the concrete has hardened sufficiently to prevent marring the surface. The surface of the concrete shall be wetted immediately before the paper is placed. The blankets shall be lapped at least 12 in. (300 mm) end to end, and these laps shall be securely weighted with a windrow of earth, or other approved method, to form a closed joint. The same requirements shall apply to the longitudinal laps where separate strips are used for curing edges, except the lap shall be at least 9 in. (225 mm). The edges of the blanket shall be weighted securely with a continuous windrow of earth or any other means satisfactory to the Engineer to provide an air-tight cover. Any torn places or holes in the paper shall be repaired immediately by patches cemented over the openings, using a bituminous cement having a melting point of not less than 180 °F (82 °C). The blankets may be reused, provided they are air-tight and kept serviceable by proper repairs.

A longitudinal pleat shall be provided in the blanket to permit shrinkage where the width of the blanket is sufficient to cover the entire surface. The pleat will not be required where separate strips are used for the edges. Joints in the blanket shall be sewn or cemented together in such a manner that they will not separate during use.

(2) Polyethylene Sheeting Method. The surface of the concrete shall be covered with white polyethylene sheeting as soon as the concrete has hardened sufficiently to prevent marring the surface. The surface of the concrete shall be wetted immediately before the sheeting is placed. The edges of the sheeting shall be weighted securely with a continuous windrow of earth or any other means satisfactory to the Engineer to provide an air-tight cover. Adjoining sheets shall overlap not less than 12 in. (300 mm) and the laps shall be securely weighted with earth, or any other means satisfactory to the Engineer, to provide an air tight cover. For surface and base course concrete, the polyethylene sheets shall be not less than 100 ft (30 m) in length nor longer than can be conveniently handled, and shall be of such width that, when in place, they will cover the full width of the surface, including the edges, except that separate strips may be used to cover the edges. Any tears or holes in the sheeting shall be repaired. When sheets are no longer serviceable as a single unit, the Contractor may select from such sheets and reuse those which will serve for further applications, provided two sheets are used as a single unit; however, the double sheet units will be rejected when the Engineer deems that they no longer provide an air tight cover.

(3) Wetted Burlap Method. The surface of the concrete shall be covered with wetted burlap blankets as soon as the concrete has hardened sufficiently to prevent marring the surface. The blankets shall overlap 6 in. (150 mm). At least two layers of wetted burlap shall be placed on the finished surface. The burlap shall be kept saturated by means of a mechanically operated sprinkling system. In place of the sprinkling system, at the Contractor's option, two layers of burlap covered with impermeable covering shall be used. The burlap shall be kept saturated with water. Plastic coated burlap may be substituted for one layer of burlap and impermeable covering.

The blankets shall be placed so that they are in contact with the edges of the concrete, and that portion of the material in contact with the edges shall be kept saturated with water.

(4) Membrane Curing Method. Membrane curing will not be permitted where a protective coat, concrete sealer, or waterproofing is to be applied, or at areas where rubbing or a normal finish is required, or at construction joints other than those necessary in pavement or base course. Concrete at these locations shall be cured by another method specified in Article 1020.13(a).

After all finishing work to the concrete surface has been completed, it shall be sealed with membrane curing compound of the type specified within ten minutes. The seal shall be maintained for the specified curing period. The edges of the concrete shall, likewise, be sealed within ten minutes after the forms are removed. Two separate applications, applied at least one minute apart, each at the rate of not less than 1 gal/250 sq ft (0.16 L/sq m) will be required upon the surfaces and edges of the concrete. These applications shall be made with the mechanical equipment specified. Type III compound shall be agitated immediately before and during the application.

At locations where the coating is discontinuous or where pin holes show or where the coating is damaged due to any cause and on areas adjacent to sawed joints, immediately after sawing is completed, an additional coating of membrane curing compound shall be applied at the above specified rate. The equipment used may be of the same type as that used for coating variable widths of pavement. Before the additional coating is applied adjacent to sawed joints, the cut faces of the joint shall be protected by inserting a suitable flexible material in the joint, or placing an adhesive width of impermeable material over the joint, or by placing the permanent sealing compound in the joint. Material, other than the permanent sealing compound, used to protect cut faces of the joint, shall remain in place for the duration of the curing period. In lieu of applying the additional coating, the area of the sawed joint may be cured according to any other method permitted.

When rain occurs before an application of membrane curing compound has dried, and the coating is damaged, the Engineer may require another application be made in the same manner and at the same rate as the original coat. The Engineer may order curing by another method specified, if unsatisfactory results are obtained with membrane curing compound.

(5) Wetted Cotton Mat Method. After the surface of concrete has been textured or finished, it shall be covered immediately with dry or damp cotton mats. The cotton mats shall be placed in a manner which will not mar the concrete surface. A texture resulting from the cotton mat material is acceptable. The cotton mats shall then be wetted immediately and thoroughly soaked with a gentle spray of water. For bridge decks, a foot bridge shall be used to place and wet the cotton mats.

The cotton mats shall be maintained in a wetted condition until the concrete has hardened sufficiently to place soaker hoses without marring the concrete surface. The soaker hoses shall be placed on top of the cotton mats at a maximum 4 ft (1.2 m) spacing. The cotton mats shall be kept wet with a continuous supply of water for the remainder of the curing period. Other continuous wetting systems may be used if approved by the Engineer.

After placement of the soaker hoses, the cotton mats shall be covered with white polyethylene sheeting or burlap-polyethylene blankets.

For construction items other than bridge decks, soaker hoses or a continuous wetting system will not be required if the alternative method keeps the cotton mats wet. Periodic wetting of the cotton mats is acceptable.

For areas inaccessible to the cotton mats on bridge decks, curing shall be according to Article 1020.13(a)(3).

(b) Removing and Replacing Curing Covering. When curing methods specified above in Article 1020.13(a), (1), (2), or (3) are used for concrete pavement, the curing covering for each day's paving shall be removed to permit testing of the pavement surface with a profilograph or straightedge, as directed by the Engineer.

Immediately after testing, the surface of the pavement shall be wetted thoroughly and the curing coverings replaced. The top surface and the edges of the concrete shall not be left unprotected for a period of more than 1/2 hour.

(c) Protection of Concrete, Other Than Structures, From Low Air Temperatures. When the official National Weather Service forecast for the construction area predicts a low of 32 °F (0 °C), or lower, or if the actual temperature drops to 32 °F (0 °C), or lower, concrete less than 72 hours old shall be provided at least the following protection.

| Minimum Temperature | Protection |
|---|---|
| 25 – 32 °F (-4 – 0 °C) | Two layers of polyethylene sheeting, one layer of polyethylene and one layer of burlap, or two layers of waterproof paper. |
| Below 25 °F (-4 °C) | 6 in. (150 mm) of straw covered with one layer of polyethylene sheeting or waterproof paper. |

These protective covers shall remain in place until the concrete is at least 96 hours old. When straw is required on pavement cured with membrane curing compound, the compound shall be covered with a layer of burlap, polyethylene sheeting or waterproof paper before the straw is applied.

After September 15, there shall be available to the work within four hours, sufficient clean, dry straw to cover at least two days production. Additional straw shall be provided

as needed to afford the protection required. Regardless of the precautions taken, the Contractor shall be responsible for protection of the concrete placed and any concrete damaged by cold temperatures shall be removed and replaced.

(d) Protection of Concrete Structures From Low Air Temperatures. When the official National Weather Service forecast for the construction area predicts a low below 45 °F (7 °C), or if the actual temperature drops below 45 °F (7 °C), concrete less than 72 hours old shall be provided protection. Concrete shall also be provided protection when placed during the winter period of December 1 through March 15. Concrete shall not be placed until the materials, facilities, and equipment for protection are approved by the Engineer.

When directed by the Engineer, the Contractor may be required to place concrete during the winter period. When winter construction is specified, the Contractor shall proceed with the construction, including excavation, pile driving, concrete, steel erection, and all appurtenant work required for the complete construction of the item, except at times when weather conditions make such operations impracticable.

Regardless of the precautions taken, the Contractor shall be responsible for protection of the concrete placed and any concrete damaged by cold temperatures shall be removed and replaced.

(1) Protection Method I. The concrete shall be completely covered with insulating material such as fiberglass, rock wool, or other approved commercial insulating material having the minimum thermal resistance R, as defined in ASTM C 168, for the corresponding minimum dimension of the concrete unit being protected as shown in the following table.

| Minimum Pour Dimension | | Thermal Resistance R |
|---|---|---|
| in. | (mm) | |
| 6 or less | (150 or less) | R=16 |
| > 6 to 12 | (> 150 to 300) | R=10 |
| > 12 to 18 | (> 300 to 450) | R=6 |
| > 18 | (> 450) | R=4 |

The insulating material manufacturer shall clearly mark the insulating material with the thermal resistance R value.

The insulating material shall be completely enclosed on sides and edges with an approved waterproof liner and shall be maintained in a serviceable condition. Any tears in the liner shall be repaired in a manner approved by the Engineer. The

Contractor shall provide means for checking the temperature of the surface of the concrete during the protection period.

On formed surfaces, the insulating material shall be attached to the outside of the forms with wood cleats or other suitable means to prevent any circulation of air under the insulation and shall be in place before the concrete is placed. The blanket insulation shall be applied tightly against the forms. The edges and ends shall be attached so as to exclude air and moisture. If the blankets are provided with nailing flanges, the flanges shall be attached to the studs with cleats. Where tie rods or reinforcement bars protrude, the areas adjacent to the rods or bars shall be adequately protected in a manner satisfactory to the Engineer. Where practicable, the insulation shall overlap any previously placed concrete by at least 1 ft (300 mm). Insulation on the underside of floors on steel members shall cover the top flanges of supporting members. On horizontal surfaces, the insulating material shall be placed as soon as the concrete has set, so that the surface will not be marred and shall be covered with canvas or other waterproof covering. The insulating material shall remain in place for a period of seven days after the concrete is placed.

The Contractor may remove the forms, providing the temperature is 35 °F (2 °C) and rising and the Contractor is able to wrap the particular section within two hours from the time of the start of the form removal. The insulation shall remain in place for the remainder of the seven days curing period.

(2) Protection Method II. The concrete shall be enclosed in adequate housing and the air surrounding the concrete kept at a temperature of not less than 50 °F (10 °C) nor more than 80 °F (27 °C) for a period of seven days after the concrete is placed. The Contractor shall provide means for checking the temperature of the surface of the concrete or air temperature within the housing during the protection period. All exposed surfaces within the housing shall be cured according to the Index Table.

The Contractor shall provide adequate fire protection where heating is in progress and such protection shall be accessible at all times. The Contractor shall maintain labor to keep the heating equipment in continuous operation.

At the close of the heating period, the temperature shall be decreased to the approximate temperature of the outside air at a rate not to exceed 15 °F (8 °C) per 12 hour period, after which the housing maybe removed. The surface of the concrete shall be permitted to dry during the cooling period.

(3) Protection Method III. As soon as the surface is sufficiently set to prevent marring, the concrete shall be covered with 12 in. (300 mm) of loose, dry straw followed by a layer of impermeable covering. The edges of the covering shall be sealed to prevent

circulation of air and prevent the cover from flapping or blowing. The protection shall remain in place until the concrete is seven days old. If construction operations require removal, the protection removed shall be replaced immediately after completion or suspension of such operations.

**1020.14 Temperature Control for Placement.** Temperature control for concrete placement shall be according to the following.

(a) Concrete other than Structures. Concrete may be placed when the air temperature is above 35 °F (2 °C) and rising, and concrete placement shall stop when the falling temperature reaches 40 °F (4 °C) or below, unless otherwise approved by the Engineer.

The temperature of concrete immediately before placement shall be a minimum of 50 °F (10 °C) and a maximum of 90 °F (32 °C). If concrete is pumped, the temperature of the concrete at point of placement shall be a minimum of 50 °F (10 °C) and a maximum of 90 °F (32 °C). A maximum concrete temperature shall not apply to Class PP concrete.

(b) Concrete in Structures. Concrete may be placed when the air temperature is above 40 °F (4 °C) and rising, and concrete placement shall stop when the falling temperature reaches 45 °F (7 °C) or below, unless otherwise approved by the Engineer.

The temperature of the concrete immediately before placement shall be a minimum of 50 °F (10 °C) and a maximum of 90 °F (32 °C). If concrete is pumped, the temperature of the concrete at point of placement shall be a minimum of 50 °F (10 °C) and a maximum of 90 °F (32 °C).

When insulated forms are used according to Article 1020.13(d)(1), the maximum temperature of the concrete mixture immediately before placement shall be 80 °F (25 °C).

When concrete is placed in contact with previously placed concrete, the temperature of the freshly mixed concrete may be increased to 80 °F (25 °C) by the Contractor to offset anticipated heat loss.

(c) All Classes of Concrete. Aggregates and water shall be heated or cooled uniformly and as necessary to produce concrete within the specified temperature limits. No frozen aggregates shall be used in the concrete.

(d) Temperature. The concrete temperature shall be determined according to Illinois Modified AASHTO T 309.

For Class DS concrete, CA 11 may be used. If CA 11 is used, the Contractor shall have the option to develop a mixture with a minimum cement and finely divided minerals of 605 lbs/cu yd (360 kg/cu m) summed together. If CA 11 is used and either Class DS concrete is placed underwater or a self-consolidating concrete mixture is desired, the Contractor shall have the option to develop a mixture with a minimum cement and finely divided minerals of 635 lbs/cu yd (378 kg/cu m) summed together.

c. The minimum portland cement content in the mixture shall be 375 lbs/cu yd (222 kg/cu m). When the total of organic processing additions, inorganic processing additions, and limestone addition exceed 5.0 percent in the cement, the minimum portland cement content in the mixture shall be 400 lbs/cu yd (237 kg/cu m). For a drilled shaft, foundation, footing, or substructure, the minimum portland cement may be reduced to as low as 330 lbs/cu yd (196 kg/cu m) if the concrete has adequate freeze/thaw durability. The Contractor shall provide freeze/thaw test results according to AASHTO T 161 Procedure A or B, and the relative dynamic modulus of elasticity of the mix design shall be a minimum of 80 percent. Freeze/thaw testing will not be required for concrete that will not be exposed to freezing and thawing conditions as determined by the Engineer.

d. The maximum cement replacement with fly ash shall be 40.0 percent. The maximum cement replacement with ground granulated blast-furnace slag shall be 65.0 percent. When cement replacement with ground granulated blast-furnace slag exceeds 35.0 percent, only Grade 100 shall be used.

e. The mixture may contain a maximum of two finely divided minerals. The finely divided mineral in portland-pozzolan cement or portland blast-furnace slag cement shall count toward the total number of finely divided minerals allowed. The finely divided minerals shall constitute a maximum of 65.0 percent of the total cement plus finely divided minerals. The fly ash portion shall not exceed 40.0 percent. The ground granulated blast-furnace slag portion shall not exceed 65.0 percent. The microsilica or high-reactivity metakaolin portion used together or separately shall not exceed 5.0 percent.

f. The time to obtain the specified strength may be increased to a maximum 56 days, provided the curing period specified in Article 1020.13 is increased to a minimum of 14 days.

The minimum grout strength for filling embedded pipe shall be as specified for the concrete, and testing shall be according to AASHTO T 106.

circulation of air and prevent the cover from flapping or blowing. The protection shall remain in place until the concrete is seven days old. If construction operations require removal, the protection removed shall be replaced immediately after completion or suspension of such operations.

**1020.14 Temperature Control for Placement.** Temperature control for concrete placement shall be according to the following.

(a) Concrete other than Structures. Concrete may be placed when the air temperature is above 35 °F (2 °C) and rising, and concrete placement shall stop when the falling temperature reaches 40 °F (4 °C) or below, unless otherwise approved by the Engineer.

The temperature of concrete immediately before placement shall be a minimum of 50 °F (10 °C) and a maximum of 90 °F (32 °C). If concrete is pumped, the temperature of the concrete at point of placement shall be a minimum of 50 °F (10 °C) and a maximum of 90 °F (32 °C). A maximum concrete temperature shall not apply to Class PP concrete.

(b) Concrete in Structures. Concrete may be placed when the air temperature is above 40 °F (4 °C) and rising, and concrete placement shall stop when the falling temperature reaches 45 °F (7 °C) or below, unless otherwise approved by the Engineer.

The temperature of the concrete immediately before placement shall be a minimum of 50 °F (10 °C) and a maximum of 90 °F (32 °C). If concrete is pumped, the temperature of the concrete at point of placement shall be a minimum of 50 °F (10 °C) and a maximum of 90 °F (32 °C).

When insulated forms are used according to Article 1020.13(d)(1), the maximum temperature of the concrete mixture immediately before placement shall be 80 °F (25 °C).

When concrete is placed in contact with previously placed concrete, the temperature of the freshly mixed concrete may be increased to 80 °F (25 °C) by the Contractor to offset anticipated heat loss.

(c) All Classes of Concrete. Aggregates and water shall be heated or cooled uniformly and as necessary to produce concrete within the specified temperature limits. No frozen aggregates shall be used in the concrete.

(d) Temperature. The concrete temperature shall be determined according to Illinois Modified AASHTO T 309.

**1020.15 Heat of Hydration Control for Concrete Structures.** The Contractor shall control the heat of hydration for concrete structures when the least dimension for a drilled shaft, foundation, footing, substructure, or superstructure concrete pour exceeds 5.0 ft (1.5 m). The work shall be according to the following.

(a) Temperature Restrictions. The maximum temperature of the concrete after placement shall not exceed 150 °F (66 °C). The maximum temperature differential between the internal concrete core and concrete 2 to 3 in. (50 to 75 mm) from the exposed surface shall not exceed 35 °F (19 °C). The Contractor shall perform temperature monitoring to ensure compliance with the temperature restrictions.

(b) Thermal Control Plan. The Contractor shall provide a thermal control plan a minimum of 28 calendar days prior to concrete placement for review by the Engineer. Acceptance of the thermal control plan by the Engineer shall not preclude the Contractor from specification compliance, and from preventing cracks in the concrete. At a minimum, the thermal control plan shall provide detailed information on the following requested items and shall comply with the specific specifications indicated for each item.

(1) Concrete mix design(s) to be used. Grout mix design if post-cooling with embedded pipe.

The mix design requirements in Articles 1020.04 and 1020.05 shall be revised to include the following additional requirements to control the heat of hydration.

a. The concrete mixture should be uniformly graded and preference for larger size aggregate should be used in the mix design. Article 1004.02(d)(2) shall apply and information in the "Portland Cement Concrete Level III Technician Course – Manual of Instructions for Design of Concrete Mixtures" may be used to develop the uniformly graded mixture.

b. The following shall apply to all concrete except Class DS concrete or when self-consolidating concrete is desired. For central-mixed concrete, the Contractor shall have the option to develop a mixture with a minimum of 520 lbs/cu yd (309 kg/cu m) of cement and finely divided minerals summed together. For truck-mixed or shrink-mixed concrete, the Contractor shall have the option to develop a mixture with a minimum of 550 lbs/cu yd (326 kg/cu m) of cement and finely divided minerals summed together. A water-reducing or high range water-reducing admixture shall be used in the central mixed, truck-mixed or shrink-mixed concrete mixture. For any mixture to be placed underwater, the minimum cement and finely divided minerals shall be 550 lbs/cu yd (326 kg/cu m) for central-mixed concrete, and 580 lbs/cu yd (344 kg/cu m) for truck-mixed or shrink-mixed concrete.

For Class DS concrete, CA 11 may be used. If CA 11 is used, the Contractor shall have the option to develop a mixture with a minimum cement and finely divided minerals of 605 lbs/cu yd (360 kg/cu m) summed together. If CA 11 is used and either Class DS concrete is placed underwater or a self-consolidating concrete mixture is desired, the Contractor shall have the option to develop a mixture with a minimum cement and finely divided minerals of 635 lbs/cu yd (378 kg/cu m) summed together.

c. The minimum portland cement content in the mixture shall be 375 lbs/cu yd (222 kg/cu m). When the total of organic processing additions, inorganic processing additions, and limestone addition exceed 5.0 percent in the cement, the minimum portland cement content in the mixture shall be 400 lbs/cu yd (237 kg/cu m). For a drilled shaft, foundation, footing, or substructure, the minimum portland cement may be reduced to as low as 330 lbs/cu yd (196 kg/cu m) if the concrete has adequate freeze/thaw durability. The Contractor shall provide freeze/thaw test results according to AASHTO T 161 Procedure A or B, and the relative dynamic modulus of elasticity of the mix design shall be a minimum of 80 percent. Freeze/thaw testing will not be required for concrete that will not be exposed to freezing and thawing conditions as determined by the Engineer.

d. The maximum cement replacement with fly ash shall be 40.0 percent. The maximum cement replacement with ground granulated blast-furnace slag shall be 65.0 percent. When cement replacement with ground granulated blast-furnace slag exceeds 35.0 percent, only Grade 100 shall be used.

e. The mixture may contain a maximum of two finely divided minerals. The finely divided mineral in portland-pozzolan cement or portland blast-furnace slag cement shall count toward the total number of finely divided minerals allowed. The finely divided minerals shall constitute a maximum of 65.0 percent of the total cement plus finely divided minerals. The fly ash portion shall not exceed 40.0 percent. The ground granulated blast-furnace slag portion shall not exceed 65.0 percent. The microsilica or high-reactivity metakaolin portion used together or separately shall not exceed 5.0 percent.

f. The time to obtain the specified strength may be increased to a maximum 56 days, provided the curing period specified in Article 1020.13 is increased to a minimum of 14 days.

The minimum grout strength for filling embedded pipe shall be as specified for the concrete, and testing shall be according to AASHTO T 106.

(2) The selected mathematical method for evaluating heat of hydration thermal effects, which shall include the calculated adiabatic temperature rise, calculated maximum concrete temperature, and calculated maximum temperature differential between the internal concrete core and concrete 2 to 3 in. (50 to 75 mm) from the exposed surface. The time when the maximum concrete temperature and maximum temperature differential will occur is required.

Acceptable mathematical methods include ACI 207.2R "Report on Thermal and Volume Change Effects on Cracking of Mass Concrete" as well as other proprietary methods. The Contractor shall perform heat of hydration testing on the cement and finely divided minerals to be used in the concrete mixture. The test shall be according to ASTM C 186 or other applicable test methods, and the result for heat shall be used in the equation to calculate adiabatic temperature rise. Other required test parameters for the mathematical model may be assumed if appropriate.

The Contractor has the option to propose a higher maximum temperature differential between the internal concrete core and concrete 2 to 3 in. (50 to 75 mm) from the exposed surface, but the proposed value shall not exceed 50 °F (28 °C). In addition, based on strength gain of the concrete, multiple maximum temperature differentials at different times may be proposed. The proposed value shall be justified through a mathematical method.

(3) Proposed maximum concrete temperature or temperature range prior to placement.

Article 1020.14 shall apply except a minimum 40 °F (4 °C) concrete temperature will be permitted.

(4) Pre-cooling, post-cooling, and surface insulation methods that will be used to ensure the concrete will comply with the specified maximum temperature and specified or proposed temperature differential. For reinforcement that extends beyond the limits of the pour, the Contractor shall indicate if the reinforcement is required to be covered with insulation.

Refer to ACI 207.4R "Cooling and Insulating Systems for Mass Concrete" for acceptable methods that will be permitted. If embedded pipe is used for post-cooling, the material shall be polyvinyl chloride or polyethylene. The embedded pipe system shall be properly supported, and the Contractor shall subsequently inspect glued joints to ensure they are able to withstand free falling concrete. The embedded pipe system shall be leak tested after inspection of the glued joints, and prior to the concrete placement. The leak test shall be performed at maximum service pressure or higher for a minimum of 15 minutes. All leaks shall be repaired.

The embedded pipe cooling water may be from natural sources such as streams and rivers, but shall be filtered to prevent system stoppages. When the embedded pipe is no longer needed, the surface connections to the pipe shall be removed to a depth of 4 in. (100 mm) below the surface of the concrete. The remaining pipe shall be completely filled with grout. The 4 in. (100 mm) deep concrete hole shall be filled with nonshrink grout. Form and insulation removal shall be done in a manner to prevent cracking and ensure the maximum temperature differential is maintained. Insulation shall be in good condition as determined by the Engineer and properly attached.

(5) Dimensions of each concrete pour, location of construction joints, placement operations, pour pattern, lift heights, and time delays between lifts.

Refer to ACI 207.1R "Guide to Mass Concrete" for acceptable placement operations that will be permitted.

(6) Type of temperature monitoring system, the number of temperature sensors, and location of sensors.

A minimum of two independent temperature monitoring systems and corresponding sensors shall be used.

The temperature monitoring system shall have a minimum temperature range of 32 °F (0 °C) to 212 °F (100 °C), an accuracy of ± 2 °F (± 1 °C), and be able to automatically record temperatures without external power. Temperature monitoring shall begin once the sensor is encased in concrete, and with a maximum interval of one hour. Temperature monitoring may be discontinued after the maximum concrete temperature has been reached, post-cooling is no longer required, and the maximum temperature differential between the internal concrete core and the ambient air temperature does not exceed 35 °F (19 °C). The Contractor has the option to select a higher maximum temperature differential, but the proposed value shall not exceed 50 °F (28 °C). The proposed value shall be justified through a mathematical method.

At a minimum, a temperature sensor shall be located at the theoretical hottest portion of the concrete, normally the geometric center, and at the exterior face that will provide the maximum temperature differential. At the exterior face, the sensor shall be located 2 to 3 in. (50 to 75 mm) from the surface of the concrete. Sensors shall also be located a minimum of 1 in. (25 mm) away from reinforcement, and equidistant between cooling pipes if either applies. A sensor will also be required to measure ambient air temperature. The entrant/exit cooling water temperature for embedded pipe shall also be monitored.

Temperature monitoring results shall be provided to the Engineer a minimum of once each day and whenever requested by the Engineer. The report may be electronic or hard copy. The report shall indicate the location of each sensor, the temperature recorded, and the time recorded. The report shall be for all sensors and shall include ambient air temperature and entrant/exit cooling water temperatures. The temperature data in the report may be provided in tabular or graphical format, and the report shall indicate any corrective actions during the monitoring period. At the completion of the monitoring period, the Contractor shall provide the Engineer a final report that includes all temperature data and corrective actions.

(7) Indicate contingency operations to be used if the maximum temperature or temperature differential of the concrete is reached after placement.

(c) Temperature Restriction Violations. If the maximum temperature of the concrete after placement exceeds 150 °F (66 °C), but is equal to or less than 158 °F (70 °C), the concrete will be accepted if no cracking or other unacceptable defects are identified. If cracking or unacceptable defects are identified, Article 105.03 shall apply. If the concrete temperature exceeds 158 °F (70 °C), Article 105.03 shall apply.

If a temperature differential between the internal concrete core and concrete 2 to 3 in. (50 to 75 mm) from the exposed surface exceeds the specified or proposed maximum value allowed, the concrete will be accepted if no cracking or other unacceptable defects are identified. If unacceptable defects are identified, Article 105.03 shall apply.

When the maximum 150 °F (66 °C) concrete temperature or the maximum allowed temperature differential is violated, the Contractor shall implement corrective action prior to the next pour. In addition, the Engineer reserves the right to request a new thermal control plan for acceptance before the Contractor is allowed to pour again.

(d) Inspection and Repair of Cracks. The Engineer will inspect the concrete for cracks after the temperature monitoring is discontinued, and the Contractor shall provide access for the Engineer to do the inspection. A crack may require repair by the Contractor as determined by the Engineer. The Contractor shall be responsible for the repair of all cracks. Protective coat or a concrete sealer shall be applied to a crack less than 0.007 in. (0.18 mm) in width. A crack that is 0.007 in. (0.18 mm) or greater shall be pressure injected with epoxy according to Section 590.

Designer Note: Insert in all HMA contracts.

**WARM MIX ASPHALT (BDE)**

Effective: January 1, 2012
Revised: November 1, 2013

Description. This work shall consist of designing, producing and constructing Warm Mix Asphalt (WMA) in lieu of Hot Mix Asphalt (HMA) at the Contractor's option. Work shall be according to Sections 406, 407, 408, 1030, and 1102 of the Standard Specifications, except as modified herein. In addition, any references to HMA in the Standard Specifications, or the special provisions shall be construed to include WMA.

WMA is an asphalt mixture which can be produced at temperatures lower than allowed for HMA utilizing approved WMA technologies. WMA technologies are defined as the use of additives or processes which allow a reduction in the temperatures at which HMA mixes are produced and placed. WMA is produced by the use of additives, a water foaming process, or combination of both. Additives include minerals, chemicals or organics incorporated into the asphalt binder stream in a dedicated delivery system. The process of foaming injects water into the asphalt binder stream, just prior to incorporation of the asphalt binder with the aggregate.

Approved WMA technologies may also be used in HMA provided all the requirements specified herein, with the exception of temperature, are met. However, asphalt mixtures produced at temperatures in excess of 275 °F (135 °C) will not be considered WMA when determining the grade reduction of the virgin asphalt binder grade.

Materials.

Add the following to Article 1030.02 of the Standard Specifications.

"(h) Warm Mix Asphalt (WMA) Technologies (Note 3)"

Add the following note to Article 1030.02 of the Standard Specifications.

"Note 3. Warm mix additives or foaming processes shall be selected from the current Bureau of Materials and Physical Research Approved List, "Warm-Mix Asphalt Technologies"."

Equipment.

Revise the first paragraph of Article 1102.01 of the Standard Specifications to read:

"**1102.01 Hot-Mix Asphalt Plant.** The hot-mix asphalt (HMA) plant shall be the batch-type, continuous-type, or dryer drum plant. The plants shall be evaluated for prequalification rating and approval to produce HMA according to the current Bureau of Materials and Physical Research Policy Memorandum, "Approval of Hot-Mix Asphalt Plants and Equipment". Once approved, the Contractor shall notify the Bureau of Materials and Physical Research to obtain approval of all plant modifications. The plants shall not be used to produce mixtures concurrently for more than one project or for private work unless permission is granted in writing by the Engineer. The plant units shall be so designed, coordinated and operated that they will function properly and produce HMA having uniform temperatures and compositions within the tolerances specified. The plant units shall meet the following requirements."

Add the following to Article 1102.01(a) of the Standard Specifications.

"(13) Equipment for Warm Mix Technologies.

a. Foaming. Metering equipment for foamed asphalt shall have an accuracy of ± 2 percent of the actual water metered. The foaming control system shall be electronically interfaced with the asphalt binder meter.

b. Additives. Additives shall be introduced into the plant according to the supplier's recommendations and shall be approved by the Engineer. The system for introducing the WMA additive shall be interlocked with the aggregate feed or weigh system to maintain correct proportions for all rates of production and batch sizes."

Mix Design Verification.

Add the following to Article 1030.04 of the Standard Specifications.

"(e) Warm Mix Technologies.

(1) Foaming. WMA mix design verification will not be required when foaming technology is used alone (without WMA additives). However, the foaming technology shall only be used on HMA designs previously approved by the Department.

(2) Additives. WMA mix designs utilizing additives shall be submitted to the Engineer for mix design verification.

Production.

Revise the second paragraph of Article 1030.06(a) of the Standard Specifications to read:

"At the start of mix production for HMA, WMA, and HMA using WMA technologies, QC/QA mixture start-up will be required for the following situations; at the beginning of production of a new mixture design, at the beginning of each production season, and at every plant utilized to produce mixtures, regardless of the mix."

Quality Control/Quality Assurance Testing.

Revise the table in Article 1030.05(d)(2)a. of the Standard Specifications to read:

| Parameter | Frequency of Tests<br><br>High ESAL Mixture<br>Low ESAL Mixture | Frequency of Tests<br><br>All Other Mixtures | Test Method<br>See Manual of Test Procedures for Materials |
|---|---|---|---|
| Aggregate Gradation<br><br>% passing sieves:<br>1/2 in. (12.5 mm),<br>No. 4 (4.75 mm),<br>No. 8 (2.36 mm),<br>No. 30 (600 μm)<br>No. 200 (75 μm)<br><br>Note 1. | 1 washed ignition oven test on the mix per half day of production<br><br>Note 4. | 1 washed ignition oven test on the mix per day of production<br><br>Note 4. | Illinois Procedure |
| Asphalt Binder Content by Ignition Oven | 1 per half day of production | 1 per day | Illinois-Modified AASHTO T 308 |

| Parameter | Frequency of Tests<br><br>High ESAL Mixture<br>Low ESAL Mixture | Frequency of Tests<br><br>All Other Mixtures | Test Method<br>See Manual of Test Procedures for Materials |
|---|---|---|---|
| Note 2. | | | |
| VMA<br><br>Note 3. | Day's production ≥ 1200 tons:<br><br>1 per half day of production | N/A | Illinois-Modified AASHTO R 35 |
| | Day's production < 1200 tons:<br><br>1 per half day of production for first 2 days and 1 per day thereafter (first sample of the day) | | |
| Air Voids<br><br>Bulk Specific Gravity of Gyratory Sample<br><br>Note 5. | Day's production ≥ 1200 tons:<br><br>1 per half day of production | 1 per day | Illinois-Modified AASHTO T 312 |
| | Day's production < 1200 tons:<br><br>1 per half day of production for first 2 days and 1 per day thereafter (first sample of the day) | | |
| Maximum Specific Gravity of Mixture | Day's production ≥ 1200 tons:<br><br>1 per half day of production | 1 per day | Illinois-Modified AASHTO T 209 |
| | Day's production < 1200 tons:<br><br>1 per half day of production for first 2 days and 1 per day thereafter (first sample of the day) | | |

Note 1. The No. 8 (2.36 mm) and No. 30 (600 µm) sieves are not required for All Other Mixtures.

Note 2. The Engineer may waive the ignition oven requirement for asphalt binder content if the aggregates to be used are known to have ignition asphalt binder content calibration factors which exceed 1.5 percent. If the ignition oven requirement is waived, other Department approved methods shall be used to determine the asphalt binder content.

Note 3. The $G_{sb}$ used in the voids in the mineral aggregate (VMA) calculation shall be the same average $G_{sb}$ value listed in the mix design.

Note 4. The Engineer reserves the right to require additional hot bin gradations for batch

Note 5. The WMA compaction temperature for mixture volumetric testing shall be 270 ± 5 °F (132 ± 3 °C) for quality control testing. The WMA compaction temperature for quality assurance testing will be 270 ± 5 °F (132 ± 3 °C) if the mixture is not allowed to cool to room temperature. If the mixture is allowed to

cool to room temperature it shall be reheated to standard HMA compaction temperatures."

Construction Requirements.

Revise the second paragraph of Article 406.06(b)(1) of the Standard Specifications to read:

"The HMA shall be delivered at a temperature of 250 to 350 °F (120 to 175 °C). WMA shall be delivered at a minimum temperature of 215 °F (102 °C)."

Basis of Payment.

This work will be paid at the contract unit price bid for the HMA pay items involved. Anti-strip will not be paid for separately, but shall be considered as included in the cost of the work.

Designer Note: Insert in all contracts with HMA items.

**HOT-MIX ASPHALT – MIXTURE DESIGN VERIFICATION AND PRODUCTION (BDE)**

Effective: November 1, 2013

Description. This special provision provides the requirements for Hamburg Wheel and tensile strength testing for High ESAL, IL-4.75, and Stone Matrix Asphalt (SMA) hot-mix asphalt (HMA) mixes during mix design verification and production. This special provision also provides the plant requirements for hydrated lime addition systems used in the production of High ESAL, IL-4.75, and SMA mixes.

Mix Design Testing. Add the following to Article 1030.04 of the Standard Specifications:

"(d) Verification Testing. High ESAL, IL-4.75, and SMA mix designs submitted for verification will be tested to ensure that the resulting mix designs will pass the required criteria for the Hamburg Wheel Test (Illinois Modified AASHTO T 324) and the Tensile Strength Test (Illinois Modified AASHTO T 283). The Department will perform a verification test on gyratory specimens compacted by the Contractor. If the mix fails the Department's verification test, the Contractor shall make necessary changes to the mix and provide passing Hamburg Wheel and tensile strength test results from a private lab. The Department will verify the passing results.

All new and renewal mix designs shall meet the following requirements for verification testing.

(1) Hamburg Wheel Test Criteria. The maximum allowable rut depth shall be 0.5 in. (12.5 mm). The minimum number of wheel passes at the 0.5 in. (12.5 mm) rut depth criteria shall be based on the high temperature binder grade of the mix as specified in the mix requirements table of the plans.

Illinois Modified AASHTO T 324 Requirements [1/]

| PG Grade | Number of Passes |
|---|---|
| PG 58-xx (or lower) | 5,000 |
| PG 64-xx | 7,500 |
| PG 70-xx | 15,000 |
| PG 76-xx (or higher) | 20,000 |

1/ When produced at temperatures of 275 ± 5 °F (135 ± 3 °C) or less, loose Warm Mix Asphalt shall be oven aged at 270 ± 5 °F (132 ± 3 °C) for two hours prior to gyratory compaction of Hamburg Wheel specimens.

(2) Tensile Strength Criteria. The minimum allowable conditioned tensile strength shall be 415 kPa (60 psi) for non-polymer modified performance graded (PG) asphalt binder and 550 kPa (80 psi) for polymer modified PG asphalt binder. The maximum allowable unconditioned tensile strength shall be 1380 kPa (200 psi)."

Production Testing. Revise Article 1030.06(a) of the Standard Specifications to read:

"(a) High ESAL, IL-4.75 and SMA Mixtures. For each contract, a 300 ton (275 metric tons) test strip will be required at the beginning of HMA production for each mixture with a

quantity of 3000 tons (2750 metric tons) or more according to the Manual of Test Procedures for Materials "Hot Mix Asphalt Test Strip Procedures".

Before start-up, target values shall be determined by applying gradation correction factors to the JMF when applicable. These correction factors shall be determined from previous experience. The target values, when approved by the Engineer, shall be used to control HMA production. Plant settings and control charts shall be set according to target values.

Before constructing the test strip, target values shall be determined by applying gradation correction factors to the JMF when applicable. After any JMF adjustment, the JMF shall become the Adjusted Job Mix Formula (AJMF). Upon completion of the first acceptable test strip, the JMF shall become the AJMF regardless of whether or not the JMF has been adjusted. If an adjustment/plant change is made, the Engineer may require a new test strip to be constructed. If the HMA placed during the initial test strip is determined to be unacceptable to remain in place by the Engineer, it shall be removed and replaced.

The limitations between the JMF and AJMF are as follows.

| Parameter | Adjustment |
|---|---|
| 1/2 in. (12.5 mm) | ± 5.0 % |
| No. 4 (4.75 mm) | ± 4.0 % |
| No. 8 (2.36 mm) | ± 3.0 % |
| No. 30 (600 μm) | * |
| No. 200 (75 μm) | * |
| Asphalt Binder Content | ± 0.3 % |

* In no case shall the target for the amount passing be greater than the JMF.

Any adjustments outside the above limitations will require a new mix design.

Mixture sampled to represent the test strip shall include additional material sufficient for the Department to conduct Hamburg Wheel testing according to Illinois Modified AASHTO T324 (approximately 60 lb (27 kg) total).

The Contractor shall immediately cease production upon notification by the Engineer of failing Hamburg Wheel test. All prior produced material may be paved out provided all other mixture criteria is being met. No additional mixture shall be produced until the Engineer receives passing Hamburg Wheel tests.

The Department may conduct additional Hamburg Wheel tests on production material as determined by the Engineer."

Revise the title of Article 1030.06(b) of the Standard Specifications to read:

"(b) Low ESAL and All Other Mixtures."

System for Hydrated Lime Addition. Revise the fourth sentence of the third paragraph of Article 1030.04(c) of the Standard Specifications to read:

"The method of application shall be according to Article 1102.01(a)(10)."

Replace the first three sentences of the second paragraph of Article 1102.01(a)(10) of the Standard Specifications to read:

"When hydrated lime is used as the anti-strip additive, a separate bin or tank and feeder system shall be provided to store and accurately proportion the lime onto the aggregate either as a slurry, as dry lime applied to damp aggregates, or as dry lime injected onto the hot aggregates prior to adding the liquid asphalt cement. If the hydrated lime is added either as a slurry or as dry lime on damp aggregates, the lime and aggregates shall be mixed by a power driven pugmill to provide a uniform coating of the lime prior to entering the dryer. If dry hydrated lime is added to the hot dry aggregates in a dryer-drum plant, the lime shall be added in such a manner that the lime will not become entrained into the air stream of the dryer-drum and that thorough dry mixing shall occur prior to the injection point of the liquid asphalt. When a batch plant is used, the hydrated lime shall be added to the mixture in the weigh hopper or as approved by the Engineer."

Basis of Payment. Replace the seventh paragraph of Article 406.14 of the Standard Specifications with the following:

"For mixes designed and verified under the Hamburg Wheel criteria, the cost of furnishing and introducing anti-stripping additives in the HMA will not be paid for separately, but shall be considered as included in the contract unit price of the HMA item involved.

If an anti-stripping additive is required for any other HMA mix, the cost of the additive will be paid for according to Article 109.04. The cost incurred in introducing the additive into the HMA will not be paid for separately, but shall be considered as included in the contract unit price of the HMA item involved.

No additional compensation will be awarded to the Contractor because of reduced production rates associated with the addition of the anti-stripping additive."

Designer Note: Insert into all contracts with HMA items.

**HOT-MIX ASPHALT – MIXTURE DESIGN COMPOSITION AND VOLUMETRIC REQUIREMENTS (BDE)**

Effective: November 1, 2013

Revise Article 406.14(b) of the Standard Specifications to read.

"(b) If the HMA placed during the initial test strip (1) is determined to be unacceptable to remain in place by the Engineer, and (2) was not produced within 2.0 to 6.0 percent air voids or within the individual control limits of the JMF, the mixture and test strip will not be paid for and the mixture shall be removed at the Contractor's expense. An additional test strip and mixture will be paid for in full, if produced within 2.0 to 6.0 percent air voids and within the individual control limits of the JMF."

Revise Article 406.14(c) of the Standard Specifications to read.

"(c) If the HMA placed during the initial test strip (1) is determined to be unacceptable to remain in place by the Engineer, and (2) was produced within 2.0 to 6.0 percent air voids and within the individual control limits of the JMF, the mixture shall be removed. Removal will be paid in accordance to Article 109.04. This initial mixture and test strip will be paid for at the contract unit prices. The additional mixture will be paid for at the contract unit price, and any additional test strips will be paid for at one half the unit price of each test strip."

Revise Article 1030.04(a)(1) of the Standard Specifications to read.

"(1) High ESAL Mixtures. The Job Mix Formula (JMF) shall fall within the following limits.

| High ESAL, MIXTURE COMPOSITION (% PASSING) 1/ | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Sieve Size | IL-25.0 mm | | IL-19.0 mm | | IL-12.5 mm | | IL-9.5 mm | | IL-4.75 mm | |
| | min | max | min | max | min | max | min | max | min | max |
| 1 1/2 in (37.5 mm) | | 100 | | | | | | | | |
| 1 in. (25 mm) | 90 | 100 | | 100 | | | | | | |
| 3/4 in. (19 mm) | | 90 | 82 | 100 | | 100 | | | | |
| 1/2 in. (12.5 mm) | 45 | 75 | 50 | 85 | 90 | 100 | | 100 | | 100 |
| 3/8 in. (9.5 mm) | | | | | | 89 | 90 | 100 | | 100 |
| #4 (4.75 mm) | 24 | 42 2/ | 24 | 50 2/ | 28 | 65 | 32 | 69 | 90 | 100 |
| #8 (2.36 mm) | 16 | 31 | 20 | 36 | 28 | 48 3/ | 32 | 52 3/ | 70 | 90 |
| #16 (1.18 mm) | 10 | 22 | 10 | 25 | 10 | 32 | 10 | 32 | 50 | 65 |
| #50 (300 µm) | 4 | 12 | 4 | 12 | 4 | 15 | 4 | 15 | 15 | 30 |
| #100 (150 µm) | 3 | 9 | 3 | 9 | 3 | 10 | 3 | 10 | 10 | 18 |
| #200 (75 µm) | 3 | 6 | 3 | 6 | 4 | 6 | 4 | 6 | 7 | 9 |
| Ratio Dust/Asphalt Binder | | 1.0 | | 1.0 | | 1.0 | | 1.0 | | 1.0 4/ |

1/ Based on percent of total aggregate weight.

2/ The mixture composition shall not exceed 40 percent passing the #4 (4.75 mm) sieve for binder courses with Ndesign ≥ 90.

3/ The mixture composition shall not exceed 44 percent passing the #8 (2.36 mm) sieve for surface courses with Ndesign ≥ 90.

4/ Additional minus No. 200 (0.075 mm) material required by the mix design shall be mineral filler, unless otherwise approved by the Engineer."

Delete Article 1030.04(a)(4) of the Standard Specifications.

Revise Article 1030.04(b)(1) of the Standard Specifications to read.

"(1) High ESAL Mixtures. The target value for the air voids of the HMA shall be 4.0 percent at the design number of gyrations. The VMA and VFA of the HMA design shall be based on the nominal maximum size of the aggregate in the mix, and shall conform to the following requirements.

| VOLUMETRIC REQUIREMENTS<br>High ESAL | | | | | | |
|---|---|---|---|---|---|---|
| | Voids in the Mineral Aggregate (VMA), % minimum | | | | | Voids Filled with Asphalt Binder (VFA), % |
| Ndesign | IL-25.0 | IL-19.0 | IL-12.5 | IL-9.5 | IL-4.75[1/] | |
| 50 | 12.0 | 13.0 | 14.0 | 15.0 | 18.5 | 65 – 78 [2/] |
| 70 | | | | | | 65 - 75 |
| 90 | | | | | | |
| 105 | | | | | | |

1/ Maximum Draindown for IL-4.75 shall be 0.3 percent

2/ VFA for IL-4.75 shall be 76-83 percent"

Delete Article 1030.04(b)(4) of the Standard Specifications.

Revise the Control Limits Table in Article 1030.05(d)(4) of the Standard Specifications to read.

| "CONTROL LIMITS | | | | | |
|---|---|---|---|---|---|
| Parameter | High ESAL Low ESAL<br>Individual Test | High ESAL Low ESAL<br>Moving Avg. of 4 | All Other<br>Individual Test | IL-4.75<br>Individual Test | IL-4.75<br>Moving Avg. of 4 |
| % Passing: [1/] | | | | | |
| 1/2 in. (12.5 mm) | ± 6 % | ± 4 % | ± 15 % | | |
| No. 4 (4.75 mm) | ± 5 % | ± 4 % | ± 10 % | | |
| No. 8 (2.36 mm) | ± 5 % | ± 3 % | | | |
| No. 16 (1.18 mm) | | | | ± 4 % | ± 3 % |
| No. 30 (600 µm) | ± 4 % | ± 2.5 % | | | |
| Total Dust Content No. 200 (75 µm) | ± 1.5 % | ± 1.0 % | ± 2.5 % | ± 1.5 % | ± 1.0 % |

| | | | | | |
|---|---|---|---|---|---|
| Asphalt Binder Content | ± 0.3 % | ± 0.2 % | ± 0.5 % | ± 0.3 % | ± 0.2 % |
| Voids | ± 1.2 % | ± 1.0 % | ± 1.2 % | ± 1.2 % | ± 1.0 % |
| VMA | -0.7 % 2/ | -0.5 % 2/ | | -0.7 % 2/ | -0.5 % 2/ |

1/ Based on washed ignition oven

2/ Allowable limit below minimum design VMA requirement"

Designer Note: Insert into all contracts using cast-in-place concrete, precast concrete, or precast pre-stressed concrete.

**REINFORCEMENT BARS (BDE)**

Effective: November 1, 2013

Revise the first and second paragraphs of Article 508.05 of the Standard Specifications to read:

"**508.05 Placing and Securing.** All reinforcement bars shall be placed and tied securely at the locations and in the configuration shown on the plans prior to the placement of concrete. Manual welding of reinforcement may only be permitted or precast concrete products as indicated in the current Bureau of Materials and Physical Research Policy Memorandum "Quality Control / Quality Assurance Program for Precast Concrete Products", and for precast prestressed concrete products as indicated in the Department's current "Manual for Fabrication of Precast Prestressed Concrete Products". Reinforcement bars shall not be placed by sticking or floating into place or immediately after placement of the concrete.

Bars shall be tied at all intersections, except where the center to center dimension is less than 1 ft (300 mm) in each direction, in which case alternate intersections shall be tied. Molded plastic clips may be used in lieu of wire to secure bar intersections, but shall not be permitted in horizontal bar mats subject to construction foot traffic or to secure longitudinal bar laps. Plastic clips shall adequately secure the reinforcement bars, and shall permit the concrete to flow through and fully encase the reinforcement. Plastic clips may be recycled plastic, and shall meet the approval of the Engineer. The number of ties as specified shall be doubled for lap splices at the stage construction line of concrete bridge decks when traffic is allowed on the first completed stage during the pouring of the second stage."

Revise the fifth paragraph of Article 508.05 of the Standard Specifications to read:

"Supports for reinforcement in bridge decks shall be metal. For all other concrete construction the supports shall be metal or plastic. Metal bar supports shall be made of cold-drawn wire, or other approved material and shall be either epoxy coated, galvanized or plastic tipped. When the reinforcement bars are epoxy coated, the metal supports shall be epoxy coated. Plastic supports may be recycled plastic. Supports shall be provided in sufficient number and spaced to provide the required clearances. Supports shall adequately support the reinforcement bars, and shall permit the concrete to flow through and fully encase the reinforcement. The legs of supports shall be spaced to allow an opening that is a minimum 1.33 times the nominal maximum aggregate size used in the concrete. Nominal maximum aggregate size is defined as the largest sieve which retains any of the aggregate sample particles. All supports shall meet the approval of the Engineer."

Revise the first sentence of the eighth paragraph of Article 508.05 of the Standard Specifications to read:

"Epoxy coated reinforcement bars shall be tied with plastic coated wire, epoxy coated wire, or molded plastic clips where allowed."

Add the following sentence to the end of the first paragraph of Article 508.06(c) of the Standard Specifications:

"In addition, the total slip of the bars within the splice sleeve of the connector after loading in tension to 30 ksi (207 MPa) and relaxing to 3 ksi (20.7 MPa) shall not exceed 0.01 in. (254 microns)."

Revise Article 1042.03(d) of the Standard Specifications to read:

"(d) Reinforcement and Accessories: The concrete cover over all reinforcement shall be within ±1/4 in. (±6 mm) of the specified cover.

Welded wire fabric shall be accurately bent and tied in place.

Miscellaneous accessories to be cast into the concrete or for forming holes and recesses shall be carefully located and rigidly held in place by bolts, clamps, or other effective means. If paper tubes are used for vertical dowel holes, or other vertical holes which require grouting, they shall be removed before transportation to the construction site."

Designer Note: Insert into all contracts with proposed pipe culverts.

**LRFD PIPE CULVERT BURIAL TABLES (BDE)**

Effective: November 1, 2013

Revise Article 542.02 of the Standard Specifications to read as follows:

"

| Item | Article/Section |
|---|---|
| (a) Corrugated Steel Pipe | 1006.01 |
| (b) Corrugated Steel Pipe Arch | 1006.01 |
| (c) Bituminous Coated Corrugated Steel Pipe | 1006.01 |
| (d) Bituminous Coated Corrugated Steel Pipe Arch | 1006.01 |
| (e) Zinc and Aramid Fiber Composite Coated Corrugated Steel Pipe | 1006.01 |
| (f) Aluminized Steel Type 2 Corrugated Pipe | 1006.01 |
| (g) Aluminized Steel Type 2 Corrugated Pipe Arch | 1006.01 |
| (h) Precoated Galvanized Corrugated Steel Pipe | 1006.01 |
| (i) Precoated Galvanized Corrugated Steel Pipe Arch | 1006.01 |
| (j) Corrugated Aluminum Alloy Pipe | 1006.03 |
| (k) Corrugated Aluminum Alloy Pipe Arch | 1006.03 |
| (l) Extra Strength Clay Pipe | 1040.02 |
| (m) Concrete Sewer, Storm Drain, and Culvert Pipe | 1042 |
| (n) Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe | 1042 |
| (o) Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe | 1042 |
| (p) Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe | 1042 |
| (q) Polyvinyl Chloride (PVC) Pipe | 1040.03 |
| (r) Corrugated Polyvinyl Chloride (PVC) Pipe with a Smooth Interior | 1040.03 |
| (s) Corrugated Polypropylene (CPP) pipe with smooth Interior | 1040.07 |
| (t) Corrugated Polyethylene (PE) Pipe with a Smooth Interior | 1040.04 |
| (u) Polyethylene (PE) Pipe with a Smooth Interior | 1040.04 |
| (v) Rubber Gaskets and Preformed Flexible Joint Sealants for Concrete Pipe | 1056 |
| (w) Mastic Joint Sealer for Pipe | 1055 |
| (x) External Sealing Band | 1057 |
| (y) Fine Aggregate (Note 1) | 1003.04 |
| (z) Coarse Aggregate (Note 2) | 1004.05 |
| (aa) Packaged Rapid Hardening Mortar or Concrete | 1018 |
| (bb) Nonshrink Grout | 1024.02 |
| (cc) Reinforcement Bars and Welded Wire Fabric | 1006.10 |
| (dd) Handling Hole Plugs | 1042.16 |

Note 1. The fine aggregate shall be moist.

Note 2. The coarse aggregate shall be wet."

Revise the table for permitted materials in Article 542.03 of the Standard Specifications as follows:

| "Class | Materials |
|---|---|
| A | Rigid Pipes:<br>Extra Strength Clay Pipe<br>Concrete Sewer Storm Drain and Culvert Pipe, Class 3<br>Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe<br>Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe<br>Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe |
| C | Rigid Pipes:<br>Extra Strength Clay Pipe<br>Concrete Sewer Storm Drain and Culvert Pipe, Class 3<br>Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe<br>Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe<br>Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe<br>Flexible Pipes:<br>Aluminized Steel Type 2 Corrugated Pipe<br>Aluminized Steel Type 2 Corrugated Pipe Arch<br>Precoated Galvanized Corrugated Steel Pipe<br>Precoated Galvanized Corrugated Steel Pipe Arch<br>Corrugated Aluminum Alloy Pipe<br>Corrugated Aluminum Alloy Pipe Arch<br>Polyvinyl Chloride (PVC) Pipe<br>Corrugated Polyvinyl Chloride (PVC) Pipe with a Smooth Interior<br>Polyethylene (PE) Pipe with a Smooth Interior<br>Corrugated Polypropylene (CPP) Pipe with Smooth Interior |
| D | Rigid Pipes:<br>Extra Strength Clay Pipe<br>Concrete Sewer Storm Drain and Culvert Pipe, Class 3<br>Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe<br>Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe<br>Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe<br>Flexible Pipes:<br>Corrugated Steel Pipe<br>Corrugated Steel Pipe Arch<br>Bituminous Coated Corrugated Steel Pipe<br>Bituminous Coated Corrugated Steel Pipe Arch<br>Zinc and Aramid Fiber Composite Coated Corrugated Steel Pipe<br>Aluminized Steel Type 2 Corrugated Pipe<br>Aluminized Steel Type 2 Corrugated Pipe Arch<br>Precoated Galvanized Corrugated Steel Pipe<br>Precoated Galvanized Corrugated Steel Pipe Arch<br>Corrugated Aluminum Alloy Pipe<br>Corrugated Aluminum Alloy Pipe Arch<br>Polyvinyl Chloride (PVC) Pipe<br>Corrugated Polyvinyl Chloride (PVC) Pipe with a Smooth Interior<br>Corrugated Polyethylene (PE) Pipe with a Smooth Interior<br>Polyethylene (PE) Pipe with a Smooth Interior"<br>Corrugated Polypropylene (CPP) Pipe with Smooth Interior |

Revise Articles 542.03(b) and (c) of the Standard Specifications to read:

"(b) Extra strength clay pipe will only be permitted for pipe culverts Type 1, for 10 in., 12 in., 42 in. and 48 in. (250 mm, 300 mm, 1050 mm and 1200 mm), Types 2, up to and including 48 in. (1200 mm), Type 3, up to and including 18 in. (450 mm), Type 4 up to and including 10 in. (250 mm), for all pipe classes.

(c) Concrete sewer, storm drain, and culvert pipe Class 3 will only be permitted for pipe culverts Type 1, up to and including 10 in (250 mm), Type 2, up to and including 30 in. (750 mm), Type 3, up to and including 15 in. (375 mm); Type 4, up to and including 10 in. (250 mm), for all pipe classes."

Replace the pipe tables in Article 542.03 of the Standard Specifications with the following:

"Table IA: Classes of Reinforced Concrete Pipe
for the Respective Diameters of Pipe and Fill Heights over the Top of the Pipe

| Nominal Diameter in. | Type 1<br>Fill Height:<br>3' and less<br>1' min cover | Type 2<br>Fill Height:<br>Greater than 3'<br>not exceeding<br>10' | Type 3<br>Fill Height:<br>Greater than 10'<br>not exceeding<br>15' | Type 4<br>Fill Height:<br>Greater than 15'<br>not exceeding<br>20' | Type 5<br>Fill Height:<br>Greater than 20'<br>not exceeding<br>25' | Type 6<br>Fill Height:<br>Greater than 25'<br>not exceeding 30' | Type 7<br>Fill Height:<br>Greater than 30'<br>not exceeding 35' |
|---|---|---|---|---|---|---|---|
| 12 | IV | II | III | IV | IV | V | V |
| 15 | IV | II | III | IV | IV | V | V |
| 18 | IV | II | III | IV | IV | V | V |
| 21 | III | II | III | IV | IV | V | V |
| 24 | III | II | III | IV | IV | V | V |
| 30 | IV | II | III | IV | IV | V | V |
| 36 | III | II | III | IV | IV | V | V |
| 42 | II | II | III | IV | IV | V | V |
| 48 | II | II | III | IV | IV | V | V |
| 54 | II | II | III | IV | IV | V | V |
| 60 | II | II | III | IV | IV | V | V |
| 66 | II | II | III | IV | IV | V | V |
| 72 | II | II | III | IV | V | V | V |
| 78 | II | II | III | IV | 2020 | 2370 | 2730 |
| 84 | II | II | III | IV | 2020 | 2380 | 2740 |
| 90 | II | III | III | 1680 | 2030 | 2390 | 2750 |
| 96 | II | III | III | 1690 | 2040 | 2400 | 2750 |
| 102 | II | III | IV | 1700 | 2050 | 2410 | 2760 |
| 108 | II | III | 1360 | 1710 | 2060 | 2410 | 2770 |

Notes:
A number indicates the D-Load for the diameter and depth of fill and that a special design is required.
Design assumptions; Water filled pipe, Type 2 bedding and Class C Walls

Table IA: Classes of Reinforced Concrete Pipe
for the Respective Diameters of Pipe and Fill Heights over the Top of the Pipe
(Metric)

| Nominal Diameter mm | Type 1<br>Fill Height:<br>1 m and less 0.3 m min cover | Type 2<br>Fill Height:<br>Greater than 1 m not exceeding 3 m | Type 3<br>Fill Height:<br>Greater than 3 m not exceeding 4.5 m | Type 4<br>Fill Height:<br>Greater than 4.5 m not exceeding 6 m | Type 5<br>Fill Height:<br>Greater than 6 m not exceeding 7.5 m | Type 6<br>Fill Height:<br>Greater than 7.5 m not exceeding 9 m | Type 7<br>Fill Height:<br>Greater than 9 m not exceeding 10.5 m |
|---|---|---|---|---|---|---|---|
| 300 | IV | II | III | IV | IV | V | V |
| 375 | IV | II | III | IV | IV | V | V |
| 450 | IV | II | III | IV | IV | V | V |
| 525 | III | II | III | IV | IV | V | V |
| 600 | III | II | III | IV | IV | V | V |
| 750 | IV | II | III | IV | IV | V | V |
| 900 | III | II | III | IV | IV | V | V |
| 1050 | II | II | III | IV | IV | V | V |
| 1200 | II | II | III | IV | IV | V | V |
| 1350 | II | II | III | IV | IV | V | V |
| 1500 | II | II | III | IV | IV | V | V |
| 1650 | II | II | III | IV | IV | V | V |
| 1800 | II | II | III | IV | V | V | V |
| 1950 | II | II | III | IV | 100 | 110 | 130 |
| 2100 | II | II | III | IV | 100 | 110 | 130 |
| 2250 | II | III | III | 80 | 100 | 110 | 130 |
| 2400 | II | III | III | 80 | 100 | 110 | 130 |
| 2550 | II | III | IV | 80 | 100 | 120 | 130 |
| 2700 | II | III | 70 | 80 | 100 | 120 | 130 |

Notes:
A number indicates the D-Load for the diameter and depth of fill and that a special design is required.
Design assumptions; Water filled pipe, Type 2 bedding and Class C Walls

TABLE IB: THICKNESS OF CORRUGATED STEEL PIPE
FOR THE RESPECTIVE DIAMETER OF PIPE AND FILL HEIGHTS OVER THE TOP OF THE PIPE FOR 2 2/3"x1/2", 3"x1" AND 5"x1" CORRUGATIONS

| Nominal Diameter in. | Type 1 | | | Type 2 | | | Type 3 | | | Type 4 | | | Type 5 | | | Type 6 | | | Type 7 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Fill Height: 3' and less 1' min. cover | | | Fill Height: Greater than 3' not exceeding 10' | | | Fill Height: Greater than 10' not exceeding 15' | | | Fill Height: Greater than 15' not exceeding 20' | | | Fill Height: Greater than 20' not exceeding 25' | | | Fill Height: Greater than 25' not exceeding 30' | | | Fill Height: Greater than 30' not exceeding 35' | | |
| | 2 2/3" x 1/2" | 3"x1" | 5"x1" | 2 2/3" x 1/2" | 3"x1" | 5"x1" | 2 2/3" x 1/2" | 3"x1" | 5"x1" | 2 2/3" x 1/2" | 3"x1" | 5"x1" | 2 2/3" x 1/2" | 3"x1" | 5"x1" | 2 2/3" x 1/2" | 3"x1" | 5"x1" | 2 2/3" x 1/2" | 3"x1" | 5"x1" |
| 12* | 0.109 | | | 0.079 | | | 0.079 | | | 0.079 | | | 0.079 | | | 0.079 | | | 0.079 | | |
| 15 | 0.109 | | | 0.079 | | | 0.079 | | | 0.079 | | | 0.079 | | | 0.109 | | | 0.109 | | |
| 18 | 0.109 | | | 0.079 | | | 0.079 | | | 0.079 | | | 0.109 | | | 0.109 | | | 0.109 | | |
| 21 | 0.109 | | | 0.079 | | | 0.079 | | | 0.079 | | | 0.109 | | | 0.109 | | | 0.109 | | |
| 24 | 0.109 | | | 0.079 | | | 0.079 | | | 0.109 | | | 0.109 | | | 0.109 | | | 0.109 | | |
| 30 | 0.109 | | | 0.079 | | | 0.109 | | | 0.109 | | | 0.109 | | | 0.109 | | | 0.109 | | |
| 36 | 0.109E | | | 0.079 | | | 0.109 | | | 0.109 | | | 0.109 | | | 0.109 | | | 0.138E | | |
| 42 | 0.109 | 0.109 | 0.109 | 0.079 | 0.079 | 0.079 | 0.109 | 0.079 | 0.109 | 0.109 | 0.079 | 0.109 | 0.109 | 0.109 | 0.109 | 0.109E | 0.109 | 0.109 | 0.138E | 0.109 | 0.109 |
| 48 | 0.109 | 0.109 | 0.109 | 0.109 | 0.079 | 0.079 | 0.109 | 0.079 | 0.109 | 0.109 | 0.109 | 0.109 | 0.109 | 0.109 | 0.109 | 0.138E | 0.109 | 0.109 | 0.138E | 0.109 | 0.109 |
| 54 | 0.109 | 0.109 | 0.109 | 0.109 | 0.079 | 0.109 | 0.109 | 0.079 | 0.109 | 0.109 | 0.109 | 0.109 | 0.109 | 0.109 | 0.109 | 0.138E | 0.109 | 0.109 | 0.168E | 0.138 | 0.138 |
| 60 | 0.109 | 0.109 | 0.109 | 0.109 | 0.079 | 0.109 | 0.109 | 0.079 | 0.109 | 0.109 | 0.109 | 0.109 | 0.138 | 0.109 | 0.109 | 0.138E | 0.109 | 0.138 | 0.168E | 0.138E | 0.138E |
| 66 | 0.138 | 0.109 | 0.109 | 0.138 | 0.079 | 0.109 | 0.138 | 0.109 | 0.109 | 0.138 | 0.109 | 0.109 | 0.138 | 0.109 | 0.109 | 0.138E | 0.138 | 0.138 | 0.168E | 0.138E | 0.168E |
| 72 | 0.138 | 0.109 | 0.109 | 0.138 | 0.079 | 0.109 | 0.138 | 0.109 | 0.109 | 0.138 | 0.109 | 0.109 | 0.138 | 0.109 | 0.138 | 0.168E | 0.138E | 0.138E | 0.168E | 0.138E | 0.168E |
| 78 | 0.168 | 0.109 | 0.109 | 0.168 | 0.079 | 0.109 | 0.168 | 0.109 | 0.109 | 0.168 | 0.109 | 0.109 | 0.168 | 0.138 | 0.138 | 0.168E | 0.138E | 0.138E | 0.168E | 0.168E | 0.168E |
| 84 | 0.168 | 0.109 | 0.138 | 0.168 | 0.079 | 0.109 | 0.168 | 0.109 | 0.109 | 0.168 | 0.109 | 0.109 | 0.168 | 0.138 | 0.138 | 0.168E | 0.138E | 0.168E | 0.168E | 0.168E | 0.168E |
| 90 | | 0.138 | 0.138 | | 0.079 | 0.109 | | 0.109 | 0.109 | | 0.109 | 0.138 | | 0.138 | 0.138 | | 0.168E | 0.168E | | 0.168E | 0.168E |
| 96 | | 0.138 | 0.138 | | 0.109 | 0.109 | | 0.109 | 0.109 | | 0.138 | 0.138 | | 0.138 | 0.168 | | 0.168E | 0.168E | | 0.168E | 0.168E |
| 102 | | 0.138Z | 0.138Z | | 0.109 | 0.109 | | 0.109 | 0.109 | | 0.138 | 0.138 | | 0.138 | 0.168 | | 0.168E | 0.168E | | | |
| 108 | | 0.138Z | 0.168Z | | 0.109 | 0.109 | | 0.109 | 0.109 | | 0.138 | 0.138 | | 0.168 | 0.168 | | 0.168E | 0.168E | | | |
| 114 | | 0.138Z | 0.168Z | | 0.109 | 0.109 | | 0.109 | 0.109 | | 0.138 | 0.168 | | 0.168 | 0.168 | | 0.168E | 0.168E | | | |
| 120 | | 0.138Z | 0.168Z | | 0.109 | 0.109 | | 0.109 | 0.138 | | 0.138 | 0.168 | | 0.168 | 0.168 | | | | | | |
| 126 | | 0.168Z | 0.168Z | | 0.138 | 0.138 | | 0.138 | 0.138 | | 0.138 | 0.168 | | 0.168 | 0.168 | | | | | | |
| 132 | | 0.168Z | 0.168Z | | 0.138 | 0.138 | | 0.138 | 0.138 | | 0.168 | 0.168 | | 0.168 | 0.168 | | | | | | |
| 138 | | 0.168Z | 0.168Z | | 0.138 | 0.138 | | 0.138 | 0.138 | | 0.168 | 0.168 | | 0.168 | 0.168 | | | | | | |
| 144 | | 0.168Z | 0.168Z | | 0.168 | 0.168 | | 0.168 | 0.168 | | 0.168 | 0.168 | | | | | | | | | |

Notes:
* 1 1/2" x 1/4" corrugations shall be use for 6", 8", and 10" diameters.
E Elongation according to Article 542.04(e), the elongation requirement for Type 1 fill heights may be eliminated for fills above 1'-6"
Z 1'-6" Minimum fill
Longitudinal seams assumed.

TABLE IB: THICKNESS OF CORRUGATED STEEL PIPE
FOR THE RESPECTIVE DIAMETER OF PIPE AND FILL HEIGHTS OVER THE TOP OF THE PIPE FOR 68 mm x 13 mm, 75 mm x 25 mm AND 125 mm x 25 mm CORRUGATIONS
(Metric)

| Nominal Diameter mm | Type 1 Fill Height: 1 m and less 0.3 m min. cover | | | Type 2 Fill Height: Greater than 1 m not exceeding 3 m | | | Type 3 Fill Height: Greater than 3 m not exceeding 4.5 m | | | Type 4 Fill Height: Greater than 4.5 m not exceeding 6 m | | | Type 5 Fill Height: Greater than 6 m not exceeding 7.5 m | | | Type 6 Fill Height: Greater than 7.5 m not exceeding 9 m | | | Type 7 Fill Height: Greater than 9 m not exceeding 10.5 m | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 68 x 13 mm | 75 x 25 mm | 125 x 25 mm | 68 x 13 mm | 75 x 25 mm | 125 x 25 mm | 68 x 13 mm | 75 x 25 mm | 125 x 25 mm | 68 x 13 mm | 75 x 25 mm | 125 x 25 mm | 68 x 13 mm | 75 x 25 mm | 125 x 25 mm | 68 x 13 mm | 75 x 25 mm | 125 x 25 mm | 68 x 13 mm | 75 x 25 mm | 125 x 25 mm |
| 300* | 2.77 | | | 2.01 | | | 2.01 | | | 2.01 | | | 2.01 | | | 2.01 | | | 2.01 | | |
| 375 | 2.77 | | | 2.01 | | | 2.01 | | | 2.01 | | | 2.01 | | | 2.77 | | | 2.77 | | |
| 450 | 2.77 | | | 2.01 | | | 2.01 | | | 2.01 | | | 2.77 | | | 2.77 | | | 2.77 | | |
| 525 | 2.77 | | | 2.01 | | | 2.01 | | | 2.01 | | | 2.77 | | | 2.77 | | | 2.77 | | |
| 600 | 2.77 | | | 2.01 | | | 2.01 | | | 2.77 | | | 2.77 | | | 2.77 | | | 2.77 | | |
| 750 | 2.77 | | | 2.01 | | | 2.77 | | | 2.77 | | | 2.77 | | | 2.77 | | | 2.77 | | |
| 900 | 2.77E | | | 2.01 | | | 2.77 | | | 2.77 | | | 2.77 | | | 2.77 | | | 3.51E | | |
| 1050 | 2.77 | 2.77 | 2.77 | 2.01 | 2.01 | 2.01 | 2.77 | 2.01 | 2.77 | 2.77 | 2.01 | 2.77 | 2.77 | 2.77 | 2.77 | 2.77E | 2.77 | 2.77 | 3.51E | 2.77 | 2.77 |
| 1200 | 2.77 | 2.77 | 2.77 | 2.77 | 2.01 | 2.01 | 2.77 | 2.01 | 2.77 | 2.77 | 2.77 | 2.77 | 2.77 | 2.77 | 2.77 | 3.51E | 2.77 | 2.77 | 3.51E | 2.77 | 2.77 |
| 1350 | 2.77 | 2.77 | 2.77 | 2.77 | 2.01 | 2.77 | 2.77 | 2.01 | 2.77 | 2.77 | 2.77 | 2.77 | 2.77 | 2.77 | 2.77 | 3.51E | 2.77 | 2.77 | 4.27E | 3.51 | 3.51 |
| 1500 | 2.77 | 2.77 | 2.77 | 2.77 | 2.01 | 2.77 | 2.77 | 2.01 | 2.77 | 2.77 | 2.77 | 2.77 | 3.51 | 2.77 | 2.77 | 3.51E | 2.77 | 3.51 | 4.27E | 3.51E | 3.51E |
| 1650 | 3.51 | 2.77 | 2.77 | 3.51 | 2.01 | 2.77 | 3.51 | 2.77 | 2.77 | 3.51 | 2.77 | 2.77 | 3.51 | 2.77 | 2.77 | 3.51E | 3.51 | 3.51 | 4.27E | 3.51E | 4.27E |
| 1800 | 3.51 | 2.77 | 2.77 | 3.51 | 2.01 | 2.77 | 3.51 | 2.77 | 2.77 | 3.51 | 2.77 | 2.77 | 3.51 | 2.77 | 3.51 | 4.27E | 3.51E | 3.51E | 4.27E | 3.51E | 4.27E |
| 1950 | 4.27 | 2.77 | 2.77 | 4.27 | 2.01 | 2.77 | 4.27 | 2.77 | 2.77 | 4.27 | 2.77 | 2.77 | 4.27 | 3.51 | 3.51 | 4.27E | 3.51E | 3.51E | 4.27E | 4.27E | 4.27E |
| 2100 | 4.27 | 2.77 | 3.51 | 4.27 | 2.01 | 2.77 | 4.27 | 2.77 | 2.77 | 4.27 | 2.77 | 2.77 | 4.27 | 3.51 | 3.51 | 4.27E | 3.51E | 4.27E | 4.27E | 4.27E | 4.27E |
| 2250 | | 3.51 | 3.51 | | 2.01 | 2.77 | | 2.77 | 2.77 | | 2.77 | 3.51 | | 3.51 | 3.51 | | 4.27E | 4.27E | | 4.27E | 4.27E |
| 2400 | | 3.51 | 3.51 | | 2.77 | 2.77 | | 2.77 | 2.77 | | 3.51 | 3.51 | | 3.51 | 4.27 | | 4.27E | 4.27E | | 4.27E | 4.27E |
| 2550 | | 3.51Z | 3.51Z | | 2.77 | 2.77 | | 2.77 | 2.77 | | 3.51 | 3.51 | | 3.51 | 4.27 | | 4.27E | 4.27E | | | |
| 2700 | | 3.51Z | 4.27Z | | 2.77 | 2.77 | | 2.77 | 2.77 | | 3.51 | 3.51 | | 4.27 | 4.27 | | 4.27E | 4.27E | | | |
| 2850 | | 3.51Z | 4.27Z | | 2.77 | 2.77 | | 2.77 | 2.77 | | 3.51 | 4.27 | | 4.27 | 4.27 | | 4.27E | 4.27E | | | |
| 3000 | | 3.51Z | 4.27Z | | 2.77 | 2.77 | | 2.77 | 3.51 | | 3.51 | 4.27 | | 4.27 | 4.27 | | | | | | |
| 3150 | | 4.27Z | 4.27Z | | 3.51 | 3.51 | | 3.51 | 3.51 | | 3.51 | 4.27 | | 4.27 | 4.27 | | | | | | |
| 3300 | | 4.27Z | 4.27Z | | 3.51 | 3.51 | | 3.51 | 3.51 | | 4.27 | 4.27 | | 4.27 | 4.27 | | | | | | |
| 3450 | | 4.27Z | 4.27Z | | 3.51 | 3.51 | | 3.51 | 3.51 | | 4.27 | 4.27 | | 4.27 | 4.27 | | | | | | |
| 3600 | | 4.27Z | 4.27Z | | 4.27 | 4.27 | | 4.27 | 4.27 | | 4.27 | 4.27 | | | | | | | | | |

Notes:

* 38 mm x 6.5 mm corrugations shall be use for 150 mm, 200 mm, and 250 mm diameters.

E Elongation according to Article 542.04(e), the elongation requirement for Type 1 fill heights may be eliminated for fills above 450 mm

Z 450 mm Minimum Fill

Longitudinal seams assumed.

TABLE IC: THICKNESS OF CORRUGATED ALUMINUM ALLOY PIPE
FOR THE RESPECTIVE DIAMETER OF PIPE AND FILL HEIGHTS OVER THE TOP OF THE PIPE FOR 2 2/3"x1/2" AND 3"x1" CORRUGATIONS

| Nominal Diameter in. | Type 1 Fill Height: 3' and less 1' min. cover | | Type 2 Fill Height: Greater than 3' not exceeding 10' | | Type 3 Fill Height: Greater than 10' not exceeding 15' | | Type 4 Fill Height: Greater than 15' not exceeding 20' | | Type 5 Fill Height: Greater than 20' not exceeding 25' | | Type 6 Fill Height: Greater than 25' not exceeding 30' | | Type 7 Fill Height: Greater than 30' not exceeding 35' | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2 2/3"x1/2" | 3"x1" | 2 2/3"x1/2" | 3"x1" | 2 2/3"x1/2" | 3"x1" | 2 2/3"x1/2" | 3"x1" | 2 2/3"x1/2" | 3"x1" | 2 2/3"x1/2" | 3"x1" | 2 2/3"x1/2" | 3"x1" |
| 12 | 0.06 | | 0.06 | | 0.06 | | 0.06 | | 0.06 | | 0.06 | | 0.06 | |
| 15 | 0.06 | | 0.06 | | 0.06 | | 0.06 | | 0.06 | | 0.06 | | 0.06 | |
| 18 | 0.06 | | 0.06 | | 0.06 | | 0.06 | | 0.06 | | 0.06 | | 0.075 | |
| 21 | 0.075E | | 0.06 | | 0.06 | | 0.06 | | 0.06 | | 0.075 | | 0.075E | |
| 24 | 0.075E | | 0.06 | | 0.06 | | 0.06 | | 0.06 | | 0.075 | | 0.075E | |
| 30 | 0.105E | | 0.075 | | 0.075 | | 0.075 | | 0.075 | | 0.105E | | 0.105E | |
| 36 | 0.105E | | 0.075 | | 0.075 | | 0.075 | | 0.105 | | 0.105E | | 0.105E | |
| 42 | 0.105E | 0.06 | 0.105 | 0.06 | 0.105 | 0.06 | 0.105 | 0.06 | 0.105 | 0.06 | 0.105E | 0.105 | 0.105E | 0.105E |
| 48 | 0.105E | 0.105 | 0.105 | 0.06 | 0.105 | 0.06 | 0.105 | 0.06 | 0.105 | 0.105 | 0.105E | 0.105E | 0.135E | 0.135E |
| 54 | 0.105E | 0.105 | 0.105 | 0.06 | 0.105 | 0.06 | 0.105 | 0.105 | 0.105 | 0.105 | 0.105E | 0.135E | 0.135E | 0.135E |
| 60 | 0.135E | 0.105 | 0.135 | 0.06 | 0.135 | 0.06 | 0.135 | 0.105 | 0.135 | 0.105 | 0.135E | 0.135E | 0.164E | 0.135E |
| 66 | 0.164E | 0.105 | 0.164 | 0.06 | 0.164 | 0.06 | 0.164 | 0.105 | 0.164 | 0.135 | 0.164E | 0.135E | | 0.135E |
| 72 | 0.164E | 0.135 | 0.164 | 0.06 | 0.164 | 0.105 | 0.164 | 0.105 | 0.164 | 0.135 | | 0.135E | | 0.164E |
| 78 | | 0.135 | | 0.075 | | 0.105 | | 0.135 | | 0.135 | | 0.135E | | 0.164E |
| 84 | | 0.135 | | 0.105 | | 0.105 | | 0.135 | | 0.135 | | 0.164E | | 0.164E |
| 90 | | 0.135 | | 0.105 | | 0.105 | | 0.135 | | 0.135 | | 0.164E | | 0.164E |
| 96 | | 0.135 | | 0.105 | | 0.105 | | 0.135 | | 0.164 | | 0.164E | | |
| 102 | | 0.135Z | | 0.135 | | 0.135 | | 0.135 | | 0.164 | | 0.164E | | |
| 108 | | 0.135Z | | 0.135 | | 0.135 | | 0.135 | | 0.164 | | | | |
| 114 | | 0.164Z | | 0.164 | | 0.164 | | 0.164 | | 0.164 | | | | |
| 120 | | 0.164Z | | 0.164 | | 0.164 | | 0.164 | | 0.164 | | | | |

Notes:
E Elongation according to Article 542.04(e), the elongation requirement for Type 1 fill heights may be eliminated for fills above 1'-6"

TABLE IC: THICKNESS OF CORRUGATED ALUMINUM ALLOY PIPE
FOR THE RESPECTIVE DIAMETER OF PIPE AND FILL HEIGHTS OVER THE TOP OF THE PIPE FOR 2 2/3"x1/2" AND 3"x1" CORRUGATIONS
(Metric)

| Nominal Diameter in. | Type 1 Fill Height: 1 m and less 0.3 m min. cover | | Type 2 Fill Height: Greater than 1 m not exceeding 3 m | | Type 3 Fill Height: Greater than 3 m not exceeding 4.5 m | | Type 4 Fill Height: Greater than 4.5 m not exceeding 6 m | | Type 5 Fill Height: Greater than 6 m not exceeding 7.5 m | | Type 6 Fill Height: Greater than 7.5 m not exceeding 9 m | | Type 7 Fill Height: Greater than 9 m not exceeding 10.5 m | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 68 x 13 mm | 75 x 25 mm | 68 x 13 mm | 75 x 25 mm | 68 x 13 mm | 75 x 25 mm | 68 x 13 mm | 75 x 25 mm | 68 x 13 mm | 75 x 25 mm | 68 x 13 mm | 75 x 25 mm | 68 x 13 mm | 75 x 25 mm |
| 300 | 1.52 | | 1.52 | | 1.52 | | 1.52 | | 1.52 | | 1.52 | | 1.52 | |
| 375 | 1.52 | | 1.52 | | 1.52 | | 1.52 | | 1.52 | | 1.52 | | 1.52 | |
| 450 | 1.52 | | 1.52 | | 1.52 | | 1.52 | | 1.52 | | 1.52 | | 1.91 | |
| 525 | 1.91E | | 1.52 | | 1.52 | | 1.52 | | 1.52 | | 1.91 | | 1.91E | |
| 600 | 1.91E | | 1.52 | | 1.52 | | 1.52 | | 1.52 | | 1.91 | | 1.91E | |
| 750 | 2.67E | | 1.91 | | 1.91 | | 1.91 | | 1.91 | | 2.67E | | 2.67E | |
| 900 | 2.67E | | 1.91 | | 1.91 | | 1.91 | | 2.67 | | 2.67E | | 2.67E | |
| 1050 | 2.67E | 1.52 | 2.67 | 1.52 | 2.67 | 1.52 | 2.67 | 1.52 | 2.67 | 1.52 | 2.67E | 2.67 | 2.67E | 2.67E |
| 1200 | 2.67E | 2.67 | 2.67 | 1.52 | 2.67 | 1.52 | 2.67 | 1.52 | 2.67 | 2.67 | 2.67E | 2.67E | 3.43E | 3.43E |
| 1350 | 2.67E | 2.67 | 2.67 | 1.52 | 2.67 | 1.52 | 2.67 | 2.67 | 2.67 | 2.67 | 2.67E | 3.43E | 3.43E | 3.43E |
| 1500 | 3.43E | 2.67 | 3.43 | 1.52 | 3.43 | 1.52 | 3.43 | 2.67 | 3.43 | 2.67 | 3.43E | 3.43E | 4.17E | 3.43E |
| 1650 | 4.17E | 2.67 | 4.17 | 1.52 | 4.17 | 1.52 | 4.17 | 2.67 | 4.17 | 3.43 | 4.17E | 3.43E | | 3.43E |
| 1800 | 4.17E | 3.43 | 4.17 | 1.52 | 4.17 | 2.67 | 4.17 | 2.67 | 4.17 | 3.43 | | 3.43E | | 4.17E |
| 1950 | | 3.43 | | 1.91 | | 2.67 | | 3.43 | | 3.43 | | 3.43E | | 4.17E |
| 2100 | | 3.43 | | 2.67 | | 2.67 | | 3.43 | | 3.43 | | 4.17E | | 4.17E |
| 2250 | | 3.43 | | 2.67 | | 2.67 | | 3.43 | | 3.43 | | 4.17E | | 4.17E |
| 2400 | | 3.43 | | 2.67 | | 2.67 | | 3.43 | | 4.17 | | 4.17E | | |
| 2550 | | 3.43Z | | 3.43 | | 3.43 | | 3.43 | | 4.17 | | 4.17E | | |
| 2700 | | 3.43Z | | 3.43 | | 3.43 | | 3.43 | | 4.17 | | | | |
| 2850 | | 4.17Z | | 4.17 | | 4.17 | | 4.17 | | 4.17 | | | | |
| 3000 | | 4.17Z | | 4.17 | | 4.17 | | 4.17 | | 4.17 | | | | |

Notes:

E Elongation according to Article 542.04(e), the elongation requirement for Type 1 fill heights may be eliminated for fills above 450 mm.

Table IIA: THICKNESS FOR CORRUGATED STEEL PIPE ARCHES AND CORRUGATED ALUMINUM ALLOY PIPE ARCHES FOR THE RESPECTIVE EQUIVALENT ROUND SIZE OF PIPE AND FILL HEIGHTS OVER THE TOP OF PIPE

| Equivalent Round Size in. | Corrugated Steel & Aluminum Pipe Arch 2 2/3" x 1/2" | | Corrugated Steel & Aluminum Pipe Arch 3" x 1" | | Corrugated Steel Pipe Arch 5" x 1" | | Min. Cover | Type 1 | | | | | Type 2 | | | | | Type 3 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Fill Height: 3' and less | | | | | Fill Height: Greater than 3' not exceeding 10' | | | | | Fill Height: Greater than 10' not exceeding 15' | | | | |
| | Span (in.) | Rise (in.) | Span (in.) | Rise (in.) | Span (in.) | Rise (in.) | Steel & Aluminum | Steel | | | Aluminum | | Steel | | | Aluminum | | Steel | | | Aluminum | |
| | | | | | | | | 2 2/3" x 1/2" | 3"x1" | 5" x 1" | 2 2/3" x 1/2" | 3"x1" | 2 2/3" x 1/2" | 3"x1" | 5" x 1" | 2 2/3" x 1/2" | 3"x1" | 2 2/3" x 1/2" | 3"x1" | 5" x 1" | 2 2/3" x 1/2" | 3"x1" |
| 15 | 17 | 13 | | | | | 1'-6" | 0.079 | | | 0.060 | | 0.079 | | | 0.060 | | 0.079 | | | 0.060 | |
| 18 | 21 | 15 | | | | | 1'-6" | 0.109 | | | 0.060 | | 0.079 | | | 0.060 | | 0.079 | | | 0.060 | |
| 21 | 24 | 18 | | | | | 1'-6" | 0.109 | | | 0.060 | | 0.079 | | | 0.060 | | 0.079 | | | 0.060 | |
| 24 | 28 | 20 | | | | | 1'-6" | 0.109 | | | 0.075 | | 0.079 | | | 0.075 | | 0.079 | | | 0.075 | |
| 30 | 35 | 24 | | | | | 1'-6" | 0.109 | | | 0.075 | | 0.079 | | | 0.075 | | 0.109 | | | 0.075 | |
| 36 | 42 | 29 | | | | | 1'-6" | 0.109 | | | 0.105 | | 0.079 | | | 0.105 | | 0.109 | | | 0.105 | |
| 42 | 49 | 33 | | | | | 1'-6" | 0.109 | | | 0.105 | | 0.109 | | | 0.105 | | 0.109 | | | 0.105 | |
| 48 | 57 | 38 | 53 | 41 | 53 | 41 | 1'-6" | 0.109 | 0.079 | 0.109 | 0.135 | 0.060 | 0.109 | 0.079 | 0.109 | 0.135 | 0.060 | 0.109 | 0.079 | 0.109 | 0.135 | 0.060 |
| 54 | 64 | 43 | 60 | 46 | 60 | 46 | 1'-6" | 0.109 | 0.109 | 0.109 | 0.135 | 0.060 | 0.109 | 0.079 | 0.109 | 0.135 | 0.060 | 0.109 | 0.079 | 0.109 | 0.135 | 0.060 |
| 60 | 71 | 47 | 66 | 51 | 66 | 51 | 1'-6" | 0.138 | 0.109 | 0.109 | 0.164 | 0.060 | 0.138 | 0.079 | 0.109 | 0.164 | 0.060 | 0.138 | 0.109 | 0.109 | 0.164 | 0.060 |
| 66 | 77 | 52 | 73 | 55 | 73 | 55 | 1'-6" | 0.168 | 0.109 | 0.109 | | 0.105 | 0.168 | 0.079 | 0.109 | | 0.075 | 0.168 | 0.109 | 0.109 | | 0.105 |
| 72 | 83 | 57 | 81 | 59 | 81 | 59 | 1'-6" | 0.168 | 0.109 | 0.109 | | 0.105 | 0.168 | 0.079 | 0.109 | | 0.105 | 0.168 | 0.109 | 0.109 | | 0.105 |
| 78 | | | 87 | 63 | 87 | 63 | 1'-6" | | 0.109 | 0.109 | | 0.105 | | 0.079 | 0.109 | | 0.105 | | 0.109 | 0.109 | | 0.105 |
| 84 | | | 95 | 67 | 95 | 67 | 1'-6" | | 0.109 | 0.109 | | 0.105 | | 0.109 | 0.109 | | 0.105 | | 0.109 | 0.109 | | 0.105 |
| 90 | | | 103 | 71 | 103 | 71 | 1'-6" | | 0.109 | 0.109 | | 0.135 | | 0.109 | 0.109 | | 0.135 | | 0.109 | 0.109 | | 0.135 |
| 96 | | | 112 | 75 | 112 | 75 | 1'-6" | | 0.109 | 0.109 | | 0.164 | | 0.109 | 0.109 | | 0.164 | | 0.109 | 0.109 | | 0.164 |
| 102 | | | 117 | 79 | 117 | 79 | 1'-6" | | 0.109 | 0.109 | | 0.164 | | 0.109 | 0.109 | | 0.164 | | 0.109 | 0.109 | | 0.164 |
| 108 | | | 128 | 83 | 128 | 83 | 1'-6" | | 0.138 | 0.138 | | | | 0.138 | 0.138 | | | | 0.138 | 0.138 | | |
| 114 | | | 137 | 87 | 137 | 87 | 1'-6" | | 0.138 | 0.138 | | | | 0.138 | 0.138 | | | | 0.138 | 0.138 | | |
| 120 | | | 142 | 91 | 142 | 91 | 1'-6" | | 0.168 | 0.168 | | | | 0.168 | 0.168 | | | | 0.168 | 0.168 | | |

Notes:
The Type 1 corrugated steel or aluminum pipe arches shall be placed on soil having a minimum bearing capacity of 3 tons per square foot.
The Type 2 and 3 corrugated steel or aluminum pipe arches shall be placed on soil having a minimum bearing capacity of 2 tons per square foot.
This minimum bearing capacity will be determined by the Engineer in the field.

Table IIA: THICKNESS FOR CORRUGATED STEEL PIPE ARCHES AND CORRUGATED ALUMINUM ALLOY PIPE ARCHES FOR THE RESPECTIVE EQUIVALENT ROUND SIZE OF PIPE AND FILL HEIGHTS OVER THE TOP OF PIPE (Metric)

| Equivalent Round Size (mm) | Corrugated Steel & Aluminum Pipe Arch 68 x 13 mm | | Corrugated Steel & Aluminum Pipe Arch 75 x 25 mm | | Corrugated Steel Pipe Arch 125 x 25 mm | | Min. Cover | Type 1 Fill Height: 1 m and less | | | | | Type 2 Fill Height: Greater than 1 m not exceeding 3 m | | | | | Type 3 Fill Height: Greater than 3 m not exceeding 4.5 m | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Span (mm) | Rise (mm) | Span (mm) | Rise (mm) | Span (mm) | Rise (mm) | Steel & Aluminum | Steel | | | Aluminum | | Steel | | | Aluminum | | Steel | | | Aluminum | |
| | | | | | | | | 68 x 13 mm | 75 x 25 mm | 125 x 25 mm | 68 x 13 mm | 75 x 25 mm | 68 x 13 mm | 75 x 25 mm | 125 x 25 mm | 68 x 13 mm | 75 x 25 mm | 68 x 13 mm | 75 x 25 mm | 125 x 25 mm | 68 x 13 mm | 75 x 25 mm |
| 375 | 430 | 330 | | | | | 0.5 m | 2.01 | | | 1.52 | | 2.01 | | | 1.52 | | 2.01 | | | 1.52 | |
| 450 | 530 | 380 | | | | | 0.5 m | 2.77 | | | 1.52 | | 2.01 | | | 1.52 | | 2.01 | | | 1.52 | |
| 525 | 610 | 460 | | | | | 0.5 m | 2.77 | | | 1.52 | | 2.01 | | | 1.52 | | 2.01 | | | 1.52 | |
| 600 | 710 | 510 | | | | | 0.5 m | 2.77 | | | 1.91 | | 2.01 | | | 1.91 | | 2.01 | | | 1.91 | |
| 750 | 870 | 630 | | | | | 0.5 m | 2.77 | | | 1.91 | | 2.01 | | | 1.91 | | 2.77 | | | 1.91 | |
| 900 | 1060 | 740 | | | | | 0.5 m | 2.77 | | | 2.67 | | 2.01 | | | 2.67 | | 2.77 | | | 2.67 | |
| 1050 | 1240 | 840 | | | | | 0.5 m | 2.77 | | | 2.67 | | 2.77 | | | 2.67 | | 2.77 | | | 2.67 | |
| 1200 | 1440 | 970 | 1340 | 1050 | 1340 | 1050 | 0.5 m | 2.77 | 2.01 | 2.77 | 3.43 | 1.52 | 2.77 | 2.01 | 2.77 | 3.43 | 1.52 | 2.77 | 2.01 | 2.77 | 3.43 | 1.52 |
| 1350 | 1620 | 1100 | 1520 | 1170 | 1520 | 1170 | 0.5 m | 2.77 | 2.77 | 2.77 | 3.43 | 1.52 | 2.77 | 2.01 | 2.77 | 3.43 | 1.52 | 2.77 | 2.01 | 2.77 | 3.43 | 1.52 |
| 1500 | 1800 | 1200 | 1670 | 1300 | 1670 | 1300 | 0.5 m | 3.51 | 2.77 | 2.77 | 4.17 | 1.52 | 3.51 | 2.01 | 2.77 | 4.17 | 1.52 | 3.51 | 2.77 | 2.77 | 4.17 | 1.52 |
| 1650 | 1950 | 1320 | 1850 | 1400 | 1850 | 1400 | 0.5 m | 4.27 | 2.77 | 2.77 | | 2.67 | 4.27 | 2.01 | 2.77 | | 1.91 | 4.27 | 2.77 | 2.77 | | 2.67 |
| 1800 | 2100 | 1450 | 2050 | 1500 | 2050 | 1500 | 0.5 m | 4.27 | 2.77 | 2.77 | | 2.67 | 4.27 | 2.01 | 2.77 | | 2.67 | 4.27 | 2.77 | 2.77 | | 2.67 |
| 1950 | | | 2200 | 1620 | 2200 | 1620 | 0.5 m | | 2.77 | 2.77 | | 2.67 | | 2.01 | 2.77 | | 2.67 | | 2.77 | 2.77 | | 2.67 |
| 2100 | | | 2400 | 1720 | 2400 | 1720 | 0.5 m | | 2.77 | 2.77 | | 2.67 | | 2.77 | 2.77 | | 2.67 | | 2.77 | 2.77 | | 2.67 |
| 2250 | | | 2600 | 1820 | 2600 | 1820 | 0.5 m | | 2.77 | 2.77 | | 3.43 | | 2.77 | 2.77 | | 3.43 | | 2.77 | 2.77 | | 3.43 |
| 2400 | | | 2840 | 1920 | 2840 | 1920 | 0.5 m | | 2.77 | 2.77 | | 4.17 | | 2.77 | 2.77 | | 4.17 | | 2.77 | 2.77 | | 4.17 |
| 2550 | | | 2970 | 2020 | 2970 | 2020 | 0.5 m | | 2.77 | 2.77 | | 4.17 | | 2.77 | 2.77 | | 4.17 | | 2.77 | 2.77 | | 4.17 |
| 2700 | | | 3240 | 2120 | 3240 | 2120 | 0.5 m | | 3.51 | 3.51 | | | | 3.51 | 3.51 | | | | 3.51 | 3.51 | | |
| 2850 | | | 3470 | 2220 | 3470 | 2220 | 0.5 m | | 3.51 | 3.51 | | | | 3.51 | 3.51 | | | | 3.51 | 3.51 | | |
| 3000 | | | 3600 | 2320 | 3600 | 2320 | 0.5 m | | 4.27 | 4.27 | | | | 4.27 | 4.27 | | | | 4.27 | 4.27 | | |

Notes:
The Type 1 corrugated steel or aluminum pipe arches shall be placed on soil having a minimum bearing capacity of 290 kN per square meter.
The Type 2 and 3 corrugated steel or aluminum pipe arches shall be placed on soil having a minimum bearing capacity of 192 kN per square meter.
This minimum bearing capacity will be determined by the Engineer in the field.

Table IIB: CLASSES OF REINFORCED CONCRETE ELLIPTICALL AND REINFORCED CONCRETE ARCH PIPE FOR THE RESPECTIVE EQUIVALENT ROUND SIZE OF PIPE AND FILL HEIGHTS OVER THE TOP OF PIPE

| Equivalent Round Size (in.) | Reinforced Concrete Elliptical pipe (in.) | | Reinforced Concrete Arch pipe (in.) | | Minimum Cover | Type 1 Fill Height: 3' and less | | Type 2 Fill Height: Greater than 3' not exceeding 10' | | Type 3 Fill Height: Greater than 10' not exceeding 15' | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Span | Rise | Span | Rise | RCCP HE & A | HE | Arch | HE | Arch | HE | Arch |
| 15 | 23 | 14 | 18 | 11 | 1' -0" | HE-III | A-III | HE-III | A-III | HE-IV | A-IV |
| 18 | 23 | 14 | 22 | 13 1/2 | 1' -0" | HE-III | A-III | HE-III | A-III | HE-IV | A-IV |
| 21 | 30 | 19 | 26 | 15 1/2 | 1' -0" | HE-III | A-III | HE-III | A-III | HE-IV | A-IV |
| 24 | 30 | 19 | 28 1/2 | 18 | 1' -0" | HE-III | A-III | HE-III | A-III | HE-IV | A-IV |
| 27 | 34 | 22 | 36 1/4 | 22 1/2 | 1' -0" | HE-III | A-III | HE-III | A-III | HE-IV | A-IV |
| 30 | 38 | 24 | 36 1/4 | 22 1/2 | 1' -0" | HE-III | A-III | HE-III | A-III | HE-IV | A-IV |
| 36 | 45 | 29 | 43 3/4 | 26 5/8 | 1' -0" | HE-II | A-II | HE-III | A-III | HE-IV | A-IV |
| 42 | 53 | 34 | 51 1/8 | 31 5/16 | 1' -0" | HE-I | A-II | HE-III | A-III | HE-IV | A-IV |
| 48 | 60 | 38 | 58 1/2 | 36 | 1' -0" | HE-I | A-II | HE-III | A-III | 1460 | 1450 |
| 54 | 68 | 43 | 65 | 40 | 1' -0" | HE-I | A-II | HE-III | A-III | 1460 | 1460 |
| 60 | 76 | 48 | 73 | 45 | 1' -0" | HE-I | A-II | HE-III | A-III | 1460 | 1470 |
| 66 | 83 | 53 | 88 | 54 | 1' -0" | HE-I | A-II | HE-III | A-III | 1470 | 1480 |
| 72 | 91 | 58 | 88 | 54 | 1' -0" | HE-I | A-II | HE-III | A-III | 1470 | 1480 |

Notes:
A number indicates the D-Load for the diameter and depth of fill and that a special design is required.
Design assumptions; Water filled pipe, AASHTO Type 2 installation per AASHTO LRFD Table 12.10.2.1-1

Table IIB: CLASSES OF REINFORCED CONCRETE ELLIPTICALL AND REINFORCED CONCRETE ARCH PIPE FOR THE RESPECTIVE EQUIVALENT ROUND SIZE OF PIPE AND FILL HEIGHTS OVER THE TOP OF PIPE
(Metric)

| Equivalent Round Size (mm) | Reinforced Concrete Elliptical pipe (mm) | | Reinforced Concrete Arch pipe (mm) | | Minimum Cover | Type 1 | | Type 2 | | Type 3 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Fill Height: 1 m and less | | Fill Height: Greater than 1 m not exceeding 3 m | | Fill Height: Greater than 3 m not exceeding 4.5 m | |
| | Span | Rise | Span | Rise | RCCP HE & A | HE | Arch | HE | Arch | HE | Arch |
| 375 | 584 | 356 | 457 | 279 | 0.3 m | HE-III | A-III | HE-III | A-III | HE-IV | A-IV |
| 450 | 584 | 356 | 559 | 343 | 0.3 m | HE-III | A-III | HE-III | A-III | HE-IV | A-IV |
| 525 | 762 | 483 | 660 | 394 | 0.3 m | HE-III | A-III | HE-III | A-III | HE-IV | A-IV |
| 600 | 762 | 483 | 724 | 457 | 0.3 m | HE-III | A-III | HE-III | A-III | HE-IV | A-IV |
| 686 | 864 | 559 | 921 | 572 | 0.3 m | HE-III | A-III | HE-III | A-III | HE-IV | A-IV |
| 750 | 965 | 610 | 921 | 572 | 0.3 m | HE-III | A-III | HE-III | A-III | HE-IV | A-IV |
| 900 | 1143 | 737 | 1111 | 676 | 0.3 m | HE-II | A-II | HE-III | A-III | HE-IV | A-IV |
| 1050 | 1346 | 864 | 1299 | 795 | 0.3 m | HE-I | A-II | HE-III | A-III | HE-IV | A-IV |
| 1200 | 1524 | 965 | 1486 | 914 | 0.3 m | HE-I | A-II | HE-III | A-III | 70 | 70 |
| 1350 | 1727 | 1092 | 1651 | 1016 | 0.3 m | HE-I | A-II | HE-III | A-III | 70 | 70 |
| 1500 | 1930 | 1219 | 1854 | 1143 | 0.3 m | HE-I | A-II | HE-III | A-III | 70 | 70 |
| 1676 | 2108 | 1346 | 2235 | 1372 | 0.3 m | HE-I | A-II | HE-III | A-III | 70 | 70 |
| 1800 | 2311 | 1473 | 2235 | 1372 | 0.3 m | HE-I | A-II | HE-III | A-III | 70 | 70 |

Notes:
A number indicates the D-Load for the diameter and depth of fill and that a special design is required.
Design assumptions; Water filled pipe, AASHTO Type 2 installation per AASHTO LRFD Table 12.10.2.1-1

TABLE IIIA: PLASTIC PIPE PERMITTED
FOR A GIVEN PIPE DIAMETER AND FILL HEIGHT OVER THE TOP OF THE PIPE

| Nominal Diameter (in.) | Type 1 Fill Height: 3' and less, with 1' min | | | | | Type 2 Fill Height: Greater than 3', not exceeding 10' | | | | | Type 3 Fill Height: Greater than 10', not exceeding 15' | | | | | Type 4 Fill Height: Greater than 15', not exceeding 20' | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PVC | CPVC | PE | CPE | CPP | PVC | CPVC | PE | CPE | CPP | PVC | CPVC | PE | CPE | CPP | PVC | CPVC | PE | CPP |
| 10 | X | X | X | X | NA | X | X | X | X | NA | X | X | X | X | NA | X | X | X | NA |
| 12 | X | X | X | X | X | X | X | X | X | X | X | X | X | NA | X | X | X | X | NA |
| 15 | X | X | NA | X | X | X | X | NA | X | X | X | X | NA | NA | X | X | X | NA | X |
| 18 | X | X | X | X | X | X | X | X | X | X | X | X | X | NA | X | X | X | X | NA |
| 21 | X | X | NA | NA | NA | X | X | NA | NA | NA | X | X | NA | NA | NA | X | X | NA | NA |
| 24 | X | X | X | X | X | X | X | X | X | X | X | X | NA | NA | NA | X | X | X | NA |
| 30 | X | X | X | X | X | X | X | X | X | X | X | X | X | NA | X | X | X | X | NA |
| 36 | X | X | X | X | X | X | X | X | NA | X | X | X | X | NA | NA | X | X | X | NA |
| 42 | X | NA | X | X | NA | X | NA | X | NA | NA | X | NA | X | NA | NA | X | NA | X | NA |
| 48 | X | NA | X | X | X | X | NA | X | NA | NA | X | NA | X | NA | NA | X | NA | X | NA |

Notes:

PVC Polyvinyl Chloride (PVC) pipe with a smooth interior
CPVC Corrugated Polyvinyl Chloride (CPVC) pipe with a smooth interior
PE Polyethylene (PE) pipe with a smooth interior
CPE Corrugated Polyethylene (PE) pipe with a smooth interior
CPP Corrugated Polypropylene (CPP) pipe with a smooth interior
X This material may be used for the given pipe diameter and fill height
NA Not Available

TABLE IIIA: PLASTIC PIPE PERMITTED
FOR A GIVEN PIPE DIAMETER AND FILL HEIGHT OVER THE TOP OF THE PIPE
(Metric)

| Nominal Diameter (mm) | Type 1 | | | | | Type 2 | | | | | Type 3 | | | | | Type 4 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Fill Height: 1 m and less, with 0.3 m min. cover | | | | | Fill Height: Greater than 1 m, not exceeding 3 m | | | | | Fill Height: Greater than 3 m, not exceeding 4.5 m | | | | | Fill Height: Greater than 4.5 m, not exceeding 6 m | | | |
| | PVC | CPVC | PE | CPE | CPP | PVC | CPVC | PE | CPE | CPP | PVC | CPVC | PE | CPE | CPP | PVC | CPVC | PE | CPP |
| 250 | X | X | X | X | NA | X | X | X | X | NA | X | X | X | X | NA | X | X | X | NA |
| 300 | X | X | X | X | X | X | X | X | X | X | X | X | X | NA | X | X | X | X | NA |
| 375 | X | X | NA | X | X | X | X | NA | X | X | X | X | NA | NA | X | X | X | NA | X |
| 450 | X | X | X | X | X | X | X | X | X | X | X | X | X | NA | X | X | X | X | NA |
| 525 | X | X | NA | NA | NA | X | X | NA | NA | NA | X | X | NA | NA | NA | X | X | NA | NA |
| 600 | X | X | X | X | X | X | X | X | X | X | X | X | NA | NA | NA | X | X | X | NA |
| 750 | X | X | X | X | X | X | X | X | X | X | X | X | X | NA | X | X | X | X | NA |
| 900 | X | X | X | X | X | X | X | X | NA | X | X | X | X | NA | NA | X | X | X | NA |
| 1000 | X | NA | X | X | NA | X | NA | X | NA | NA | X | NA | X | NA | NA | X | NA | X | NA |
| 1200 | X | NA | X | X | X | X | NA | X | NA | NA | X | NA | X | NA | NA | X | NA | X | NA |

Notes:

PVC Polyvinyl Chloride (PVC) pipe with a smooth interior
CPVC Corrugated Polyvinyl Chloride (CPVC) pipe with a smooth interior
PE Polyethylene (PE) pipe with a smooth interior
CPE Corrugated Polyethylene (PE) pipe with a smooth interior
CPP Corrugated Polypropylene (CPP) pipe with a smooth interior
X This material may be used for the given pipe diameter and fill height
NA Not Available

| TABLE IIIB: PLASTIC PIPE PERMITTED<br>FOR A GIVEN PIPE DIAMETER AND FILL HEIGHT OVER THE TOP OF THE PIPE | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Nominal Diameter (in.) | Type 5<br>Fill Height: Greater than 20', not exceeding 25' | | | Type 6<br>Fill Height: Greater than 25', not exceeding 30' | | | Type 7<br>Fill Height: Greater than 30', not exceeding 35' | |
| | PVC | CPVC | | PVC | CPVC | | CPVC | |
| 10 | X | X | | X | X | | X | |
| 12 | X | X | | X | X | | X | |
| 15 | X | X | | X | X | | X | |
| 18 | X | X | | X | X | | X | |
| 21 | X | X | | X | X | | X | |
| 24 | X | X | | X | X | | X | |
| 30 | X | X | | X | X | | X | |
| 36 | X | X | | X | X | | X | |
| 42 | X | NA | | X | NA | | NA | |
| 48 | X | NA | | X | NA | | NA | |

Notes:

PVC Polyvinyl Chloride (PVC) pipe with a smooth interior

CPVC Corrugated Polyvinyl Chloride (CPVC) pipe with a smooth interior

X This material may be used for the given pipe diameter and fill height

NA Not Available

TABLE IIIB: PLASTIC PIPE PERMITTED
FOR A GIVEN PIPE DIAMETER AND FILL HEIGHT OVER THE TOP OF THE PIPE
(metric)

| Nominal Diameter (mm) | Type 5 | | | Type 6 | | | Type 7 | |
|---|---|---|---|---|---|---|---|---|
| | Fill Height: Greater than 6 m, not exceeding 7.5 m | | | Fill Height: Greater than 7.5 m, not exceeding 9 m | | | Fill Height: Greater than 9 m, not exceeding 10.5 m | |
| | PVC | CPVC | | PVC | CPVC | | CPVC | |
| 250 | X | X | | X | X | | X | |
| 300 | X | X | | X | X | | X | |
| 375 | X | X | | X | X | | X | |
| 450 | X | X | | X | X | | X | |
| 525 | X | X | | X | X | | X | |
| 600 | X | X | | X | X | | X | |
| 750 | X | X | | X | X | | X | |
| 900 | X | X | | X | X | | X | |
| 1000 | X | NA | | X | NA | | NA | |
| 1200 | X | NA | | X | NA | | NA | |

Notes:

| | |
|---|---|
| PVC | Polyvinyl Chloride (PVC) pipe with a smooth interior |
| CPVC | Corrugated Polyvinyl Chloride (CPVC) pipe with a smooth interior |
| PE | Polyethylene (PE) pipe with a smooth interior |
| X | This material may be used for the given pipe diameter and fill height |
| NA | Not Available" |

Revise the first sentence of the first paragraph of Article 542.04(c) of the Standard Specifications to read:

"Compacted aggregate, at least 4 in. (100 mm) in depth below the pipe culvert, shall be placed the entire width of the trench and for the length of the pipe culvert, except compacted impervious material shall be used for the outer 3 ft (1 m) at each end of the pipe culvert."

Revise the seventh paragraph of Article 542.04(d) of the Standard Specifications to read:

"PVC, PE and CPP pipes shall be joined according to the manufacturer's specifications."

Replace the third sentence of the first paragraph of Article 542.04(h) of the Standard Specifications with the following:

"The total cover required for various construction loadings shall be as recommended by the manufacturer of the pipe to be loaded. The manufacturer's recommendations shall be provided in writing."

Delete "Table IV : Wheel Loads and Total Cover" in Article 542.04(h) of the Standard Specifications.

Revise the first and second paragraphs of Article 542.04(i) of the Standard Specifications to read:

"(i) Deflection Testing for Pipe Culverts. All PE, PVC and CPP pipe culverts shall be tested for deflection not less than 30 days after the pipe is installed and the backfill compacted. The testing shall be performed in the presence of the Engineer.

For PVC, PE, and CPP pipe culverts with diameters 24 in. (600 mm) or smaller, a mandrel drag shall be used for deflection testing. For PVC, PE, and CPP pipe culverts with diameters over 24 in. (600 mm), deflection measurements other than by a mandrel shall be used."

Revise Articles 542.04(i)(1) and (2) of the Standard Specifications to read:

"(1) For all PVC pipe: as defined using ASTM D 3034 methodology.

(2) For all PE and CPP pipe: the average inside diameter based on the minimum and maximum tolerances specified in the corresponding ASTM or AASHTO material specifications."

Revise the second sentence of the second paragraph of Article 542.07 of the Standard Specifications to read:

"When a prefabricated end section is used, it shall be of the same material as the pipe culvert, except for polyethylene (PE), polyvinylchloride (PVC), and polypropylene (PP) pipes which shall have metal end sections."

Revise the first paragraph of Article 1040.03 of the Standard Specifications to read:

"**1040.03 Polyvinyl Chloride (PVC) Pipe.** Acceptance testing of PVC pipe and fittings shall be accomplished during the same construction season in which they are installed. The section properties shall be according to the manufacturer pre-submitted geometric properties on file with

the Department. The manufacturer shall submit written certification that the material meets those properties. The pipe shall meet the following additional requirements."

Delete Articles 1040.03(e) and (f) of the Standard Specifications.

Revise Articles 1040.04(c) and (d) of the Standard Specifications to read:

"(c) PE Profile Wall Pipe for Insertion Lining. The pipe shall be according to ASTM F 894. When used for insertion lining of pipe culverts, the pipe liner shall have a minimum pipe stiffness of 46 psi (317 kPa) at five percent deflection for nominal inside diameters of 42 in. (1050 mm) or less. For nominal inside diameters of greater than 42 in. (1050 mm), the pipe liner shall have a minimum pipe stiffness of 32.5 psi (225 kPa) at five percent deflection. All sizes shall have wall construction that presents essentially smooth internal and external surfaces.

(d) PE Pipe with a Smooth Interior. The pipe shall be according to ASTM F 714 (DR 32.5) with a minimum cell classification of PE 335434 as defined in ASTM D 3350. The section properties shall be according to the manufacturer pre-submitted geometric properties on file with the Department. The manufacturer shall submit written certification that the material meets those properties and the resin used to manufacture the pipe meets or exceeds the minimum cell classification requirements."

Add the following to Section 1040 of the Standard Specifications:

"**1040.08 Polypropylene (PP) Pipe.** Storage and handling shall be according to the manufacturer's recommendations, except in no case shall the pipe be exposed to direct sunlight for more than six months. Acceptance testing of the pipe shall be accomplished during the same construction season in which it is installed. The section properties shall be according to the manufacturer pre-submitted geometric properties on file with the Department. The manufacturer shall submit written certification that the material meets those properties. The pipe shall meet the following additional requirements.

(a) Corrugated PP Pipe with a Smooth Interior. The pipe shall be according to AAHSTO M 330 (nominal size – 12 to 60 in. (300 to 1500 mm)). The pipe shall be Type S or D.

(b) Perforated Corrugated PP Pipe with A Smooth Interior. The pipe shall be according to AASHTO M 330 (nominal size – 12 to 60 in. (300 to 1500 mm)). The pipe shall be Type SP. In addition, the top centerline of the pipe shall be marked so that it is readily visible from the top of the trench before backfilling, and the upper ends of the slot perforations shall be a minimum of ten degrees below the horizontal."

Designer Note: Insert into all contracts requiring insertion lining of culverts.

## INSERTION LINING OF CULVERTS (BDE)

Effective: January 1, 2013
Revised: November 1, 2013

### "SECTION 543. INSERTION LINING OF CULVERTS

**543.01 Description.** This work shall consist of insertion lining of existing pipe culverts and grouting of the annular space between the existing culvert and the liner.

**543.02 Materials.** Materials shall be according to the following.

| Item | Article/Section |
|---|---|
| (a) Polyethylene (PE) Solid Wall Pipe with a Smooth Interior (Note 1) | 1040.04 |
| (b) Polyethylene (PE) Profile Wall Pipe (Note 1) | 1040.04 |
| (c) Reinforced Plastic Mortar (RPM) Pipe (Note 1) | 1040.05 |
| (d) Corrugated PVC with a Smooth Interior (Note 1) | 1040.03 |
| (e) Corrugated Steel Pipe (Note 1)(Note 3) | 1006.01 |
| (f) Steel Casing (Note 1)(Note 4) | 1006.05(d) |
| (g) Grout Mixture (Note 2) | 1024.01 |
| (h) Portland Cement Concrete | 1020 |
| (i) Controlled Low-Strength Material | 1019 |
| (j) Cellular Concrete | 1029 |

Note 1. Insertion linings are specified according to the existing pipe's inside diameter to be lined. Unless the Contractor can demonstrate by calculation that a small cross sectional area is hydraulically equivalent or better, the insertion lining shall provide a minimum of 72 percent of the cross sectional opening of the existing culvert for diameters under 5 ft (1.5 m), 82 percent for culverts between 5 and 10 ft (1.5 and 3 m) in diameter, and 90 percent for culverts greater than 10 ft (3 m) in diameter.

Any of the listed liner materials are permitted if the cross sectional area requirement is met and the liner is structurally adequate to handle the dead and live loads per current AASHTO LRFD Design Standards without the existing culvert taken into consideration.

Note 2. The grout mixture shall be 6.50 hundredweight/cu yd (385 kg/cu m) of portland cement plus fine aggregate and water. Fly ash may replace a maximum of 5.25 hundredweight/cu yd (310 kg/cu m) of the portland cement. The water/cement ratio, according to Article 1020.06, shall not exceed 0.60. An air-entraining admixture shall be used to produce an air content, according to Article 1020.08, of not less than 6.0 percent nor more than 9.0 percent of the volume of the grout. The Contractor shall have the option to use a water-reducing or high range water-reducing admixture.

Note 3. Corrugated metal pipe shall be spiral ribbed or double walled with a smooth interior and shall be polymer coated or Aluminized Steel Type 2.

Note 4. For pipe diameter 24 in. (600 mm) and less, use 3/8 in. (9.5 mm) minimum wall thickness, and for pipe 36 in. (900 mm) and above use 1/2 in. (13 mm) minimum wall thickness.

## CONSTRUCTION REQUIREMENTS

**543.03 General.** The Contractor shall submit a work plan at least 15 days prior to the start of work, detailing the methods for cleaning and preparing the existing culvert, the method(s) for joining the liner segments, the method for advancing the liner into the existing culvert, the process to fill the annular space and the proposed grout or cellular concrete mix design, and a list of potential corrective actions to address common installation issues that may arise. When applicable the method(s) for reconnecting or perpetuating existing lateral connections shall also be submitted. The Contractor shall verify that the specified liner can be installed and enough room remains to adequately fill the annular space remaining prior to ordering any materials. If a problem is discovered it shall be brought to the attention of the Engineer for resolution before ordering any materials.

Individual liner section lengths shall be planned to have no more than three joints per 50 ft (15 m) of pipe length unless approved by the Engineer.

Existing deformed culvert structures that require ovalled liners shall be lined with initial round solid wall PE pipe modified to an oval shape or elongated corrugated metal pipe.

All obvious cavities outside the existing culvert shall be filled with controlled low-strength material prior to the liner installation or with material placed in conjunction with filling the annular space between the liner and existing culvert.

Prior to commencing the liner installation, all jagged existing culvert edges or other deformities shall be repaired. All foreign material shall be removed from the existing culvert.

Joints shall be watertight and meet a 10.8 psi (74 kPa) laboratory test per ASTM D 3212. A mechanical coupler or male and female joint design shall use a gasket meeting ASTM F 477.

Joints shall have sufficient longitudinal or axial compression strength to withstand a maximum compressive force of 100 lbs/in. (17.5 N/mm) of outside diameter circumference in compression while maintaining joint integrity when tested.

Joints shall have sufficient pull-apart strength to withstand maximum tensile force of 100 lbs/in. (17.5 N/mm) of outside diameter circumference in tension without joint disassembly when tested.

Joints shall provide sufficient longitudinal or axial strength to preserve liner alignment, prevent separation at the joints, and maintain integrity while pushing or pulling pipe lengths into existing culverts. Joints shall be mechanical, fusion welded, or male and female joint connections. Mechanical or male and female joint connections shall be an integral part of the liner. Alternatively, the mechanical joint, male and female joints, or pipe ends may be heat fused provided that the fusion process meets the requirements of ASTM F 2620 and that the fused connection is water tight, and shall not reduce the inside diameter or enlarge the outside diameter of the liner being joined by 1/4 in. (6 mm).

If a liner is fusion welded, it shall be welded with a continuous weld for the circumference of the liner both inside and outside. The ends of liners that are to be welded or fused shall be at the same ambient temperature ± 5 °F (2.8 °C) and alignment bands shall be utilized. Welding, fusing, or joining shall be performed at all times by an installer trained and certified by either the liner's manufacturer or the welding, fusing, or joining equipment manufacturer. A copy of the welder's, fuser's, or joiner's certificate shall be provided to the Engineer prior to the start of work.

RPM liners or corrugated PVC liners with a smooth interior shall be joined according to the manufacturer's recommendations using joint lubricant. The joining may be accomplished in a jacking pit or other convenient location where the assembled liner can be brought into alignment with the existing culvert bore without damage. The Engineer will approve each joint before each section of liner is inserted.

The insertion may be made by pushing or pulling the assembled liner from either end of the culvert or if the size permits assembling inside the existing culvert. The Engineer may require the liner to have a temporary nose cone or plug to guide the liner past minor obstructions. The insertion operation shall not cause joints to separate nor damage the liner.

After the liner has been completely inserted and has been inspected in place by the Engineer, it shall be cut off 8 in. (200 mm) past the ends of the existing culvert or as otherwise directed by the Engineer. The liner shall be allowed to cool to the temperature of the existing culvert before it is cut off. The entire length of the annular space between the existing culvert and the liner shall be filled with a grout or cellular concrete.

Prior to filling the annular space, the upstream and downstream ends of the annular space shall have concrete bulkheads constructed to contain the grout mixture. The bulkheads shall be constructed with Class SI concrete. Alternative materials for the bulkhead as recommend by the pipe lining manufacturer may be used if approved by the Engineer. The bulkheads shall extend inward a minimum depth of 18 in. (450 mm) from the ends of the culvert. A method of venting through the bulkheads or grouting ports at the crown shall be utilized to allow air to escape when pumping material and to allow verification that the annular space has been filled.

When the grout or cellular concrete is pumped into the annular space, the Contractor shall prevent the floating of the liner. This shall be accomplished by any of the following methods.

(a) Intermittent Pumping Method. Small amounts of material shall be pumped into the annular space and allowed to harden. This shall continue until the bond between the liner and material is sufficient to resist floating. The remainder of the annular space shall then be filled.

(b) Bracing Method. Braces shall be installed in the annular space to prevent floating of the liner. Only braces which do not damage the liner shall be used. Bracing shall run parallel to the culvert.

(c) Water Fill Method. The liner shall be temporarily filled with water before filling the annular space with grout.

The pumping operation shall completely fill the annular space along the entire length, but shall be performed in a manner that does not distort the liner. The pressure developed in the annular space shall not exceed the liner manufacturer's recommended value. The air temperature at time of placement and for 24 hours thereafter shall be a minimum of 35 °F (2 °C). The temperature of the cellular concrete at point of discharge shall be a minimum of 45 °F (7 °C) and a maximum of 95 °F (35 °C).

The grout or cellular concrete mixture shall have a minimum 28 day compressive strength of 150 psi (1035 kPa). The Engineer will sample the grout or cellular concrete a minimum of once each day for compression strength during production. Mold the grout specimens according to ASTM C 1107, and the cellular concrete according to ASTM C 495. For each test, three 2 in. x 2 in. (50 mm x 50 mm) specimens will be molded for the grout and four 3 in. x 6 in. (75 mm x 150 mm) specimens will be molded for the cellular concrete. The specimens shall be stored in a temperature range of 60 to 80 °F (16 to 27 °C) for the first 24-72 hours, and the Contractor shall provide a field curing box. After this time, the Engineer will transport the specimens to the

laboratory for curing and testing. The grout will be tested for compressive strength according to ASTM C 109, and the cellular concrete will be tested for compressive strength according to ASTM C 495.

Upon completion of the pumping operation, all remaining unfilled vent holes including those at both the upstream and downstream ends shall be filled with a nonshrink grout. Only enough water to make a stiff but workable nonshrink grout shall be used. The air temperature at time of placement and for 24 hours thereafter shall be a minimum of 35 °F (2 °C).

**543.04 Method of Measurement.** This work will be measured for payment in place in feet (meters).

Excavation in rock will be measured for payment according to Article 502.12.

**543.05 Basis of Payment.** This work will be paid for at the contract unit price per foot (meter) for INSERTION CULVERT LINER for the existing size specified.

Excavation in rock will be paid for according to Article 502.13."

Revise Section 1040.04(d) of the Standard Specifications to read as follows.

"(d) PE Solid Wall Pipe with a Smooth Interior. The pipe shall be according to ASTM F 714 (DR 32.5) or ASTM F 2720 (SIDR 35), with a minimum cell classification of PE 335434 as defined in ASTM D 3350.

(1) Pipe Culverts. The section properties shall be according to AASHTO's Section 17. The manufacturer shall submit written certification that the material meets AASHTO's Section 17 properties and the resin used to manufacture the pipe meets or exceeds the minimum cell classification requirements.

(2) Insertion Lining. When used for insertion lining of culverts, the pipe liner for pipe diameters up to 63 in. (1600 mm) shall be according to AASHTO M 326.

(3) Oval shaped pipe liners. Standard round size pipe may be ovalled by compression so as to allow liner installation in deformed existing structures to maximize hydraulic capacity. Compression ovalling shall be performed by the pipe supplier at their facility. Compression ovalling will not be permitted in the field or on the construction site. An ovalled liner may not be compressed to a rise/span ratio less than 0.7 unless approved by the Engineer. Ovalled liners shall be strutted in both the horizontal and vertical axis so as to maintain the oval shape when the compressive source is removed. Struts and bracing shall result in a uniform shaped culvert. Struts shall not be removed until the liner has been completely installed and the grout or cellular concrete has fully cured to its minimum compressive strength."

Add the following Section to the Standard Specifications.

## "SECTION 1029. CELLULAR CONCRETE

**1029.01 Description.** This item shall consist of the materials and equipment to manufacture cellular concrete.

**1029.02 Materials.** Materials shall be according to the following.

| Item | Article/Section |
|---|---|

(a) Portland Cement ..... 1001
(b) Fly Ash ..... 1010
(c) Water ..... 1002
(d) Fine Aggregate ..... 1003
(e) Concrete Admixtures ..... 1021
(f) Foaming Agent (Note 1)

Note 1. The foaming agent shall be according to ASTM C 869 and be listed on the Department's Approved List of Foaming Agents for Cellular Concrete. The manufacturer shall provide an infrared spectrophotometer trace no more than five years old. When the infrared spectrophotometer trace is more than seven years old, a new one shall be provided.

**1029.03 Equipment.** Equipment shall be according to the following.

| Item | Article/Section |
|---|---|
| (a) Concrete Mixers and Trucks | 1103.01 |
| (b) Batching and Weighing Equipment | 1103.02 |
| (c) Automatic and Semi-Automatic Batching Equipment | 1103.03 |
| (d) Water Supply Equipment | 1103.11 |
| (e) Mobile Portland Cement Concrete Plants | 1103.04 |
| (f) Foam Generator (Note 1) | |
| (g) Mobile Site Batch Plants (Note 2) | |

Note 1. Foam generating equipment shall be calibrated daily to produce an accurate volume of foam.

Note 2. Mobile site batch plants shall be capable of mixing and pumping cellular concrete, and shall have a minimum 1 cu yd (0.76 cu m) capacity. Mobile site plants shall be calibrated before the start of a project and during the project as necessary."

Designer Note: Insert into all contracts with proposed storm sewers.

**LRFD STORM SEWER BURIAL TABLES (BDE)**

Effective: November 1, 2013

Revise Article 550.02 of the Standard Specifications to read as follows:

| "Item | Article Section |
|---|---|
| (a) Clay Sewer Pipe | 1040.02 |
| (b) Extra Strength Clay Pipe | 1040.02 |
| (c) Concrete Sewer, Storm Drain, and Culvert Pipe | 1042 |
| (d) Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe | 1042 |
| (e) Reinforced Concrete Elliptical Culvert, Storm Drain,and Sewer Pipe (Note 1) ..... | 1042 |
| (f) Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe (Note 1) | 1042 |
| (g) Polyvinyl Chloride (PVC) Pipe | 1040.03 |
| (h) Corrugated Polyvinyl Chloride (PVC) Pipe with a Smooth Interior | 1040.03 |
| (i) Corrugated Polypropylene (CPP) Pipe with Smooth Interior | 1040.07 |
| (j) Rubber Gaskets and Preformed Flexible Joint Sealants for Concrete Pipe ..... | 1056 |
| (k) Mastic Joint Sealer for Pipe | 1055 |
| (l) External Sealing Band | 1057 |
| (m) Fine Aggregate (Note 2) | 1003.04 |
| (n) Coarse Aggregate (Note 3) | 1004.05 |
| (o) Reinforcement Bars and Welded Wire Fabric | 1006.10 |
| (p) Handling Hole Plugs | 1042.16 |
| (q) Polyethylene (PE) Pipe with a Smooth Interior | 1040.04 |
| (r) Corrugated Polyethylene (PE) Pipe with a Smooth Interior | 1040.04 |

Note 1. The class of elliptical and arch pipe used for various storm sewer sizes and heights of fill shall conform to the requirements for circular pipe.

Note 2. The fine aggregate shall be moist.

Note 3. The coarse aggregate shall be wet."

Revise the table for permitted materials in Article 550.03 of the Standard Specifications as follows:

| "Class | **Materials** |
|---|---|
| A | Rigid Pipes:<br>Clay Sewer Pipe<br>Extra Strength Clay Pipe<br>Concrete Sewer, Storm Drain, and Culvert Pipe<br>Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe<br>Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe<br>Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe |
| B | Rigid Pipes:<br>Clay Sewer Pipe<br>Extra Strength Clay Pipe<br>Concrete Sewer, Storm Drain, and Culvert Pipe<br>Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe<br>Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe<br>Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe<br>Flexible Pipes:<br>Polyvinyl Chloride (PVC) Pipe<br>Corrugated Polyvinyl Chloride Pipe (PVC) with a Smooth Interior<br>Polyethylene (PE) Pipe with a Smooth Interior<br>Corrugated Polyethylene (PE) Pipe with a Smooth Interior<br>Corrugated Polypropylene (CPP) Pipe with a Smooth Interior" |

Replace the storm sewers tables in Article 550.03 of the Standard Specifications with the following:

STORM SEWERS
KIND OF MATERIAL PERMITTED AND STRENGTH REQUIRED
FOR A GIVEN PIPE DIAMETERS AND FILL HEIGHTS OVER THE TOP OF THE PIPE

| Nominal Diameter in. | Type 1 | | | | | | | | Type 2 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Fill Height: 3' and less With 1' minimum cover | | | | | | | | Fill Height: Greater than 3' not exceeding 10' | | | | | | | |
| | RCCP | CSP | ESCP | PVC | CPVC | PE | CPE | CPP | RCCP | CSP | ESCP | PVC | CPVC | PE | CPE | CPP |
| 10 | NA | 3 | X | X | X | X | X | NA | NA | 1 | *X | X | X | X | X | NA |
| 12 | IV | NA | X | X | X | X | X | X | II | 1 | *X | X | X | X | X | X |
| 15 | IV | NA | NA | X | X | NA | X | X | II | 1 | *X | X | X | NA | X | X |
| 18 | IV | NA | NA | X | X | X | X | X | II | 2 | X | X | X | X | X | X |
| 21 | III | NA | NA | X | X | NA | NA | NA | II | 2 | X | X | X | NA | NA | NA |
| 24 | III | NA | NA | X | X | X | X | X | II | 2 | X | X | X | X | X | X |
| 27 | III | NA | NA | NA | NA | NA | NA | NA | II | 3 | X | NA | NA | NA | NA | NA |
| 30 | IV | NA | NA | X | X | X | X | X | II | 3 | X | X | X | X | X | X |
| 33 | III | NA | NA | NA | NA | NA | NA | NA | II | NA | X | NA | NA | NA | NA | NA |
| 36 | III | NA | NA | X | X | X | X | X | II | NA | X | X | X | X | NA | X |
| 42 | II | NA | X | X | NA | X | X | NA | II | NA | X | X | NA | X | NA | NA |
| 48 | II | NA | X | X | NA | X | X | X | II | NA | X | X | NA | X | NA | NA |
| 54 | II | NA | NA | NA | NA | NA | NA | NA | II | NA | NA | NA | NA | NA | NA | NA |
| 60 | II | NA | NA | NA | NA | NA | NA | X | II | NA | NA | NA | NA | NA | NA | X |
| 66 | II | NA | NA | NA | NA | NA | NA | NA | II | NA | NA | NA | NA | NA | NA | NA |
| 72 | II | NA | NA | NA | NA | NA | NA | NA | II | NA | NA | NA | NA | NA | NA | NA |
| 78 | II | NA | NA | NA | NA | NA | NA | NA | II | NA | NA | NA | NA | NA | NA | NA |
| 84 | II | NA | NA | NA | NA | NA | NA | NA | II | NA | NA | NA | NA | NA | NA | NA |
| 90 | II | NA | NA | NA | NA | NA | NA | NA | III | NA | NA | NA | NA | NA | NA | NA |
| 96 | II | NA | NA | NA | NA | NA | NA | NA | III | NA | NA | NA | NA | NA | NA | NA |
| 102 | II | NA | NA | NA | NA | NA | NA | NA | III | NA | NA | NA | NA | NA | NA | NA |
| 108 | II | NA | NA | NA | NA | NA | NA | NA | III | NA | NA | NA | NA | NA | NA | NA |

RCCP Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
CSP Concrete Sewer, Storm drain, and Culvert Pipe
PVC Polyvinyl Chloride Pipe
CPVC Corrugated Polyvinyl Chloride Pipe
ESCP Extra Strength Clay Pipe
PE Polyethylene Pipe with a Smooth Interior
CPE Corrugated Polyethylene Pipe with a Smooth Interior
CPP Corrugated Polypropylene pipe with a Smooth Interior

X This material may be used for the given pipe diameter and fill height.
NA This material is Not Acceptable for the given pipe diameter and fill height.
* May also use Standard Strength Clay Pipe

STORM SEWERS (Metric)
KIND OF MATERIAL PERMITTED AND STRENGTH REQUIRED
FOR A GIVEN PIPE DIAMETERS AND FILL HEIGHTS OVER THE TOP OF THE PIPE

| Nominal Diameter in. | Type 1 | | | | | | | | Type 2 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Fill Height: 1 m' and less With 300 mm minimum cover | | | | | | | | Fill Height: Greater than 1 m not exceeding 3 m | | | | | | | |
| | RCCP | CSP | ESCP | PVC | CPVC | PE | CPE | CPP | RCCP | CSP | ESCP | PVC | CPVC | PE | CPE | CPP |
| 250 | NA | 3 | X | X | X | X | X | NA | NA | 1 | *X | X | X | X | X | NA |
| 300 | IV | NA | X | X | X | X | X | X | II | 1 | *X | X | X | X | X | X |
| 375 | IV | NA | NA | X | X | NA | X | X | II | 1 | *X | X | X | NA | X | X |
| 450 | IV | NA | NA | X | X | X | X | X | II | 2 | X | X | X | X | X | X |
| 525 | III | NA | NA | X | X | NA | NA | NA | II | 2 | X | X | X | NA | NA | NA |
| 600 | III | NA | NA | X | X | X | X | X | II | 2 | X | X | X | X | X | X |
| 675 | III | NA | NA | NA | NA | NA | NA | NA | II | 3 | X | NA | NA | NA | NA | NA |
| 750 | IV | NA | NA | X | X | X | X | X | II | 3 | X | X | X | X | X | X |
| 825 | III | NA | NA | NA | NA | NA | NA | NA | II | NA | X | NA | NA | NA | NA | NA |
| 900 | III | NA | NA | X | X | X | X | X | II | NA | X | X | X | X | NA | X |
| 1050 | II | NA | X | X | NA | X | X | NA | II | NA | X | X | NA | X | NA | NA |
| 1200 | II | NA | X | X | NA | X | X | X | II | NA | X | X | NA | X | NA | NA |
| 1350 | II | NA | NA | NA | NA | NA | NA | NA | II | NA | NA | NA | NA | NA | NA | NA |
| 1500 | II | NA | NA | NA | NA | NA | NA | X | II | NA | NA | NA | NA | NA | NA | X |
| 1650 | II | NA | NA | NA | NA | NA | NA | NA | II | NA | NA | NA | NA | NA | NA | NA |
| 1800 | II | NA | NA | NA | NA | NA | NA | NA | II | NA | NA | NA | NA | NA | NA | NA |
| 1950 | II | NA | NA | NA | NA | NA | NA | NA | II | NA | NA | NA | NA | NA | NA | NA |
| 2100 | II | NA | NA | NA | NA | NA | NA | NA | II | NA | NA | NA | NA | NA | NA | NA |
| 2250 | II | NA | NA | NA | NA | NA | NA | NA | III | NA | NA | NA | NA | NA | NA | NA |
| 2400 | II | NA | NA | NA | NA | NA | NA | NA | III | NA | NA | NA | NA | NA | NA | NA |
| 2550 | II | NA | NA | NA | NA | NA | NA | NA | III | NA | NA | NA | NA | NA | NA | NA |
| 2700 | II | NA | NA | NA | NA | NA | NA | NA | III | NA | NA | NA | NA | NA | NA | NA |

RCCP Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
CSP Concrete Sewer, Storm drain, and Culvert Pipe
PVC Polyvinyl Chloride Pipe
CPVC Corrugated Polyvinyl Chloride Pipe
ESCP Extra Strength Clay Pipe
PE Polyethylene Pipe with a Smooth Interior
CPE Corrugated Polyethylene Pipe with a Smooth Interior
CPP Corrugated Polypropylene pipe with a Smooth Interior
X This material may be used for the given pipe diameter and fill height.
NA This material is Not Acceptable for the given pipe diameter and fill height.
* May also use Standard Strength Clay Pipe

STORM SEWERS
KIND OF MATERIAL PERMITTED AND STRENGTH REQUIRED
FOR A GIVEN PIPE DIAMETERS AND FILL HEIGHTS OVER THE TOP OF THE PIPE

| Nominal Diameter in. | Type 3 | | | | | | | | Type 4 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Fill Height: Greater than 10' not exceeding 15' | | | | | | | | Fill Height: Greater than 15' not exceeding 20' | | | | | | |
| | RCCP | CSP | ESCP | PVC | CPVC | PE | CPE | CPP | RCCP | CSP | ESCP | PVC | CPVC | PE | CPP |
| 10 | NA | 2 | X | X | X | X | X | NA | NA | 3 | X | X | X | X | NA |
| 12 | III | 2 | X | X | X | X | NA | X | IV | NA | NA | X | X | X | NA |
| 15 | III | 3 | X | X | X | NA | NA | X | IV | NA | NA | X | X | NA | X |
| 18 | III | NA | X | X | X | X | NA | X | IV | NA | NA | X | X | X | NA |
| 21 | III | NA | NA | X | X | NA | NA | NA | IV | NA | NA | X | X | NA | NA |
| 24 | III | NA | NA | X | X | X | NA | NA | IV | NA | NA | X | X | X | NA |
| 27 | III | NA | NA | NA | NA | NA | NA | NA | IV | NA | NA | NA | NA | NA | NA |
| 30 | III | NA | NA | X | X | X | NA | X | IV | NA | NA | X | X | X | NA |
| 33 | III | NA | NA | NA | NA | NA | NA | NA | IV | NA | NA | NA | NA | NA | NA |
| 36 | III | NA | NA | X | X | X | NA | NA | IV | NA | NA | X | X | X | NA |
| 42 | III | NA | NA | X | NA | X | NA | NA | IV | NA | NA | X | NA | X | NA |
| 48 | III | NA | NA | X | NA | X | NA | NA | IV | NA | NA | X | NA | X | NA |
| 54 | III | NA | NA | NA | NA | NA | NA | NA | IV | NA | NA | NA | NA | NA | NA |
| 60 | III | NA | NA | NA | NA | NA | NA | NA | IV | NA | NA | NA | NA | NA | NA |
| 66 | III | NA | NA | NA | NA | NA | NA | NA | IV | NA | NA | NA | NA | NA | NA |
| 72 | III | NA | NA | NA | NA | NA | NA | NA | IV | NA | NA | NA | NA | NA | NA |
| 78 | III | NA | NA | NA | NA | NA | NA | NA | IV | NA | NA | NA | NA | NA | NA |
| 84 | III | NA | NA | NA | NA | NA | NA | NA | IV | NA | NA | NA | NA | NA | NA |
| 90 | III | NA | NA | NA | NA | NA | NA | NA | 1680 | NA | NA | NA | NA | NA | NA |
| 96 | III | NA | NA | NA | NA | NA | NA | NA | 1690 | NA | NA | NA | NA | NA | NA |
| 102 | IV | NA | NA | NA | NA | NA | NA | NA | 1700 | NA | NA | NA | NA | NA | NA |
| 108 | 1360 | NA | NA | NA | NA | NA | NA | NA | 1710 | NA | NA | NA | NA | NA | NA |

RCCP Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
CSP Concrete Sewer, Storm drain, and Culvert Pipe
PVC Polyvinyl Chloride Pipe
CPVC Corrugated Polyvinyl Chloride Pipe
ESCP Extra Strength Clay Pipe
PE Polyethylene Pipe with a Smooth Interior
CPE Corrugated Polyethylene Pipe with a Smooth Interior
CPP Corrugated Polypropylene pipe with a Smooth Iinterior
X This material may be used for the given pipe diameter and fill height.
NA This material is Not Acceptable for the given pipe diameter and fill height.
* May also use Standard Strength Clay Pipe
Note RCCP with a number instead of a Roman numeral shall be furnished according to AASHTO M170 Section 6. This number represents the D-load to produce a 0.01 in crack.

STORM SEWERS (metric)
KIND OF MATERIAL PERMITTED AND STRENGTH REQUIRED
FOR A GIVEN PIPE DIAMETERS AND FILL HEIGHTS OVER THE TOP OF THE PIPE

| Nominal Diameter in. | Type 3 | | | | | | | | Type 4 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Fill Height: Greater than 3 m not exceeding 4.5 m | | | | | | | | Fill Height: Greater than 4.5 m not exceeding 6 m | | | | | | |
| | RCCP | CSP | ESCP | PVC | CPVC | PE | CPE | CPP | RCCP | CSP | ESCP | PVC | CPVC | PE | CPP |
| 250 | NA | 2 | X | X | X | X | X | NA | NA | 3 | X | X | X | X | NA |
| 300 | III | 2 | X | X | X | X | NA | X | IV | NA | NA | X | X | X | NA |
| 375 | III | 3 | X | X | X | NA | NA | X | IV | NA | NA | X | X | NA | X |
| 450 | III | NA | X | X | X | X | NA | X | IV | NA | NA | X | X | X | NA |
| 525 | III | NA | NA | X | X | NA | NA | NA | IV | NA | NA | X | X | NA | NA |
| 600 | III | NA | NA | X | X | X | NA | NA | IV | NA | NA | X | X | X | NA |
| 675 | III | NA | NA | NA | NA | NA | NA | NA | IV | NA | NA | NA | NA | NA | NA |
| 750 | III | NA | NA | X | X | X | NA | X | IV | NA | NA | X | X | X | NA |
| 825 | III | NA | NA | NA | NA | NA | NA | NA | IV | NA | NA | NA | NA | NA | NA |
| 900 | III | NA | NA | X | X | X | NA | NA | IV | NA | NA | X | X | X | NA |
| 1050 | III | NA | NA | X | NA | X | NA | NA | IV | NA | NA | X | NA | X | NA |
| 1200 | III | NA | NA | X | NA | X | NA | NA | IV | NA | NA | X | NA | X | NA |
| 1350 | III | NA | NA | NA | NA | NA | NA | NA | IV | NA | NA | NA | NA | NA | NA |
| 1500 | III | NA | NA | NA | NA | NA | NA | NA | IV | NA | NA | NA | NA | NA | NA |
| 1650 | III | NA | NA | NA | NA | NA | NA | NA | IV | NA | NA | NA | NA | NA | NA |
| 1800 | III | NA | NA | NA | NA | NA | NA | NA | IV | NA | NA | NA | NA | NA | NA |
| 1950 | III | NA | NA | NA | NA | NA | NA | NA | IV | NA | NA | NA | NA | NA | NA |
| 2100 | III | NA | NA | NA | NA | NA | NA | NA | IV | NA | NA | NA | NA | NA | NA |
| 2250 | III | NA | NA | NA | NA | NA | NA | NA | 80 | NA | NA | NA | NA | NA | NA |
| 2400 | III | NA | NA | NA | NA | NA | NA | NA | 80 | NA | NA | NA | NA | NA | NA |
| 2550 | IV | NA | NA | NA | NA | NA | NA | NA | 80 | NA | NA | NA | NA | NA | NA |
| 2700 | 70 | NA | NA | NA | NA | NA | NA | NA | 80 | NA | NA | NA | NA | NA | NA |

RCCP Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
CSP Concrete Sewer, Storm drain, and Culvert Pipe
PVC Polyvinyl Chloride Pipe
CPVC Corrugated Polyvinyl Chloride Pipe
ESCP Extra Strength Clay Pipe
PE Polyethylene Pipe with a Smooth Interior
CPE Corrugated Polyethylene Pipe with a Smooth Interior
CPP Corrugated Polypropylene pipe with a Smooth Interior
X This material may be used for the given pipe diameter and fill height.
NA This material is Not Acceptable for the given pipe diameter and fill height.
* May also use Standard Strength Clay Pipe

Note RCCP with a number instead of a Roman numeral shall be furnished according to AASHTO M170 Section 6. This number represents the metric D-load to produce a 25.4 micro-meter crack.

STORM SEWERS
KIND OF MATERIAL PERMITTED AND STRENGTH REQUIRED
FOR A GIVEN PIPE DIAMETERS AND FILL HEIGHTS OVER THE TOP OF THE PIPE

| Nominal Diameter in. | Type 5 Fill Height: Greater than 20' not exceeding 25' | | | Type 6 Fill Height: Greater than 25' not exceeding 30' | | | Type 7 Fill Height: Greater than 30' not exceeding 35' | |
|---|---|---|---|---|---|---|---|---|
| | RCCP | PVC | CPVC | RCCP | PVC | CPVC | RCCP | CPVC |
| 10 | NA | X | X | NA | X | X | NA | X |
| 12 | IV | X | X | V | X | X | V | X |
| 15 | IV | X | X | V | X | X | V | X |
| 18 | IV | X | X | V | X | X | V | X |
| 21 | IV | X | X | V | X | X | V | X |
| 24 | IV | X | X | V | X | X | V | X |
| 27 | IV | NA | NA | V | NA | NA | V | NA |
| 30 | IV | X | X | V | X | X | V | X |
| 33 | IV | NA | NA | V | NA | NA | V | NA |
| 36 | IV | X | X | V | X | X | V | X |
| 42 | IV | X | NA | V | X | NA | V | NA |
| 48 | IV | X | NA | V | X | NA | V | NA |
| 54 | IV | NA | NA | V | NA | NA | V | NA |
| 60 | IV | NA | NA | V | NA | NA | V | NA |
| 66 | IV | NA | NA | V | NA | NA | V | NA |
| 72 | V | NA | NA | V | NA | NA | V | NA |
| 78 | 2020 | NA | NA | 2370 | NA | NA | 2730 | NA |
| 84 | 2020 | NA | NA | 2380 | NA | NA | 2740 | NA |
| 90 | 2030 | NA | NA | 2390 | NA | NA | 2750 | NA |
| 96 | 2040 | NA | NA | 2400 | NA | NA | 2750 | NA |
| 102 | 2050 | NA | NA | 2410 | NA | NA | 2760 | NA |
| 108 | 2060 | NA | NA | 2410 | NA | NA | 2770 | NA |

RCCP Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
PVC Polyvinyl Chloride Pipe
CPVC Corrugated Polyvinyl Chloride Pipe
ESCP Extra Strength Clay Pipe
X This material may be used for the given pipe diameter and fill height.
NA This material is Not Acceptable for the given pipe diameter and fill height.
Note RCCP with a number instead of a Roman numeral shall be furnished according to AASHTO M170 Section 6. This number represents the D-load to produce a 0.01 in crack.

| STORM SEWERS (metric)<br>KIND OF MATERIAL PERMITTED AND STRENGTH REQUIRED<br>FOR A GIVEN PIPE DIAMETERS AND FILL HEIGHTS OVER THE TOP OF THE PIPE | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Nominal Diameter in. | Type 5<br>Fill Height: Greater than 20' not exceeding 25' | | | Type 6<br>Fill Height: Greater than 25' not exceeding 30' | | | Type 7<br>Fill Height: Greater than 30' not exceeding 35' | |
| | RCCP | PVC | CPVC | RCCP | PVC | CPVC | RCCP | CPVC |
| 250 | NA | X | X | NA | X | X | NA | X |
| 300 | IV | X | X | V | X | X | V | X |
| 375 | IV | X | X | V | X | X | V | X |
| 450 | IV | X | X | V | X | X | V | X |
| 525 | IV | X | X | V | X | X | V | X |
| 600 | IV | X | X | V | X | X | V | X |
| 675 | IV | NA | NA | V | NA | NA | V | NA |
| 750 | IV | X | X | V | X | X | V | X |
| 825 | IV | NA | NA | V | NA | NA | V | NA |
| 900 | IV | X | X | V | X | X | V | X |
| 1050 | IV | X | NA | V | X | NA | V | NA |
| 1200 | IV | X | NA | V | X | NA | V | NA |
| 1350 | IV | NA | NA | V | NA | NA | V | NA |
| 1500 | IV | NA | NA | V | NA | NA | V | NA |
| 1650 | IV | NA | NA | V | NA | NA | V | NA |
| 1800 | V | NA | NA | V | NA | NA | V | NA |
| 1950 | 100 | NA | NA | 110 | NA | NA | 130 | NA |
| 2100 | 100 | NA | NA | 110 | NA | NA | 130 | NA |
| 2250 | 100 | NA | NA | 110 | NA | NA | 130 | NA |
| 2400 | 100 | NA | NA | 120 | NA | NA | 130 | NA |
| 2550 | 100 | NA | NA | 120 | NA | NA | 130 | NA |
| 2700 | 100 | NA | NA | 120 | NA | NA | 130 | NA |

RCCP Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
PVC Polyvinyl Chloride Pipe
CPVC Corrugated Polyvinyl Chloride Pipe
ESCP Extra Strength Clay Pipe
X This material may be used for the given pipe diameter and fill height.
NA This material is Not Acceptable for the given pipe diameter and fill height.
Note RCCP with a number instead of a Roman numeral shall be furnished according to AASHTO M170 Section 6. This number represents the metric D-load to produce a 25.4 micro-meter crack.

Revise the sixth paragraph of Article 550.06 of the Standard Specifications to read:

"PVC, PE and CPP pipes shall be joined according to the manufacturer's specifications."

Revise the first and second paragraphs of Article 550.08 of the Standard Specifications to read:

"**550.08 Deflection Testing for Storm Sewers.** All PVC, PE, and CPP storm sewers shall be tested for deflection not less than 30 days after the pipe is installed and the backfill compacted. The testing shall be performed in the presence of the Engineer.

For PVC, PE, and CPP storm sewers with diameters 24 in. (600 mm) or smaller, a mandrel drag shall be used for deflection testing. For PVC, PE, and CPP storm sewers with diameters over 24 in. (600 mm), deflection measurements other than by a mandrel shall be used."

Revise the fifth paragraph of Article 550.08 to read as follows.

"The outside diameter of the mandrel shall be 95 percent of the base inside diameter. For all PVC pipe the base inside diameter shall be defined using ASTM D 3034 methodology. For all PE and CPP pipe, the base inside diameter shall be defined as the average inside diameter based on the minimum and maximum tolerances specified in the corresponding ASTM or AASHTO material specifications."

Revise the first paragraph of Article 1040.03 of the Standard Specifications to read:

"**1040.03 Polyvinyl Chloride (PVC) Pipe.** Acceptance testing of PVC pipe and fittings shall be accomplished during the same construction season in which they are installed. The section properties shall be according to the manufacturer pre-submitted geometric properties on file with the Department. The manufacturer shall submit written certification that the material meets those properties. The pipe shall meet the following additional requirements."

Delete Articles 1040.03(e) and (f) of the Standard Specifications.

Revise Articles 1040.04(c) and (d) of the Standard Specifications to read:

"(c) PE Profile Wall Pipe for Insertion Lining. The pipe shall be according to ASTM F 894. When used for insertion lining of pipe culverts, the pipe liner shall have a minimum pipe stiffness of 46 psi (317 kPa) at five percent deflection for nominal inside diameters of 42 in. (1050 mm) or less. For nominal inside diameters of greater than 42 in. (1050 mm), the pipe liner shall have a minimum pipe stiffness of 32.5 psi (225 kPa) at five percent deflection. All sizes shall have wall construction that presents essentially smooth internal and external surfaces.

(d) PE Pipe with a Smooth Interior. The pipe shall be according to ASTM F 714 (DR 32.5) with a minimum cell classification of PE 335434 as defined in ASTM D 3350. The section properties shall be according to the manufacturer pre-submitted geometric properties on file with the Department. The manufacturer shall submit written certification that the material meets those properties and the resin used to manufacture the pipe meets or exceeds the minimum cell classification requirements."

Add the following to Section 1040 of the Standard Specifications:

"**1040.08 Polypropylene (PP) Pipe.** Storage and handling shall be according to the manufacturer's recommendations, except in no case shall the pipe be exposed to direct sunlight for more than six months. Acceptance testing of the pipe shall be accomplished during the same construction season in which it is installed. The section properties shall be according to the manufacturer pre-submitted geometric properties on file with the Department. The

manufacturer shall submit written certification that the material meets those properties. The pipe shall meet the following additional requirements.

(a) Corrugated PP Pipe with a Smooth Interior. The pipe shall be according to AAHSTO M 330 (nominal size – 12 to 60 in. (300 to 1500 mm)). The pipe shall be Type S or D.

(b) Perforated Corrugated PP Pipe with A Smooth Interior. The pipe shall be according to AASHTO M 330 (nominal size – 12 to 60 in. (300 to 1500 mm)). The pipe shall be Type SP. In addition, the top centerline of the pipe shall be marked so that it is readily visible from the top of the trench before backfilling, and the upper ends of the slot perforations shall be a minimum of ten degrees below the horizontal."

Designer Note: Insert into all contracts with cast-in-place concrete. This special replaces Recurring Check Sheet #31 of the same name, so do not use Check Sheet #31.

## QUALITY CONTROL/QUALITY ASSURANCE OF CONCRETE MIXTURES (BDE)

Effective: January 1, 2012
Revised: November 1, 2013

Add the following to Section 1020 of the Standard Specifications:

"**1020.16 Quality Control/Quality Assurance of Concrete Mixtures**. This Article specifies the quality control responsibilities of the Contractor for concrete mixtures (except Class PC and PS concrete), cement aggregate mixture II, and controlled low-strength material incorporated in the project, and defines the quality assurance and acceptance responsibilities of the Engineer.

A list of quality control/quality assurance (QC/QA) documents is provided in Article 1020.16(g), Schedule D.

A Level I Portland Cement Concrete (PCC) Technician shall be defined as an individual who has successfully completed the Department's training for concrete testing.

A Level II Portland Cement Concrete (PCC) Technician shall be defined as an individual who has successfully completed the Department's training for concrete proportioning.

A Level III Portland Cement Concrete (PCC) Technician shall be defined as an individual who has successfully completed the Department's training for concrete mix design.

A Concrete Tester shall be defined as an individual who has successfully completed the Department's training to assist with concrete testing and is monitored on a daily basis.

Aggregate Technician shall be defined as an individual who has successfully completed the Department's training for gradation testing involving aggregate production and mixtures.

Mixture Aggregate Technician shall be defined as an individual who has successfully completed the Department's training for gradation testing involving mixtures.

Gradation Technician shall be defined as an individual who has successfully completed the Department's training to assist with gradation testing and is monitored on a daily basis.

(a) Equipment/Laboratory. The Contractor shall provide a laboratory and test equipment to perform their quality control testing.

The laboratory shall be of sufficient size and be furnished with the necessary equipment, supplies, and current published test methods for adequately and safely performing all required tests. The laboratory will be approved by the Engineer according to the current Bureau of Materials and Physical Research Policy Memorandum "Minimum Private Laboratory Requirements for Construction Materials Testing or Mix Design". Production

of a mixture shall not begin until the Engineer provides written approval of the laboratory. The Contractor shall refer to the Department's "Required Sampling and Testing Equipment for Concrete" for equipment requirements.

Test equipment shall be maintained and calibrated as required by the appropriate test method, and when required by the Engineer. This information shall be documented on the Department's "Calibration of Concrete Testing Equipment" form.

Test equipment used to determine compressive or flexural strength shall be calibrated each 12 month period by an independent agency, using calibration equipment traceable to the National Institute of Standards and Technology (NIST). The Contractor shall have the calibration documentation available at the test equipment location.

The Engineer will have unrestricted access to the plant and laboratory at any time to inspect measuring and testing equipment, and will notify the Contractor of any deficiencies. Defective equipment shall be immediately repaired or replaced by the Contractor.

(b) Quality Control Plan. The Contractor shall submit, in writing, a proposed Quality Control (QC) Plan to the Engineer. The QC Plan shall be submitted a minimum of 45 calendar days prior to the production of a mixture. The QC Plan shall address the quality control of the concrete, cement aggregate mixture II, and controlled low-strength material incorporated in the project. The Contractor shall refer to the Department's "Model Quality Control Plan for Concrete Production" to prepare a QC Plan. The Engineer will respond in writing to the Contractor's proposed QC Plan within 15 calendar days of receipt.

Production of a mixture shall not begin until the Engineer provides written approval of the QC Plan. The approved QC Plan shall become a part of the contract between the Department and the Contractor, but shall not be construed as acceptance of any mixture produced.

The QC Plan may be amended during the progress of the work, by either party, subject to mutual agreement. The Engineer will respond in writing to a Contractor's proposed QC Plan amendment within 15 calendar days of receipt. The response will indicate the approval or denial of the Contractor's proposed QC Plan amendment.

(c) Quality Control by Contractor. The Contractor shall perform quality control inspection, sampling, testing, and documentation to meet contract requirements. Quality control includes the recognition of obvious defects and their immediate correction. Quality control also includes appropriate action when passing test results are near specification limits, or to resolve test result differences with the Engineer. Quality control may require increased testing, communication of test results to the plant or the jobsite, modification of operations, suspension of mixture production, rejection of material, or other actions as appropriate. The Engineer shall be immediately notified of any failing tests and subsequent remedial action. Passing tests shall be reported no later than the start of the next work day.

When a mixture does not comply with specifications, the Contractor shall reject the material; unless the Engineer accepts the material for incorporation in the work, according to Article 105.03.

(1) Personnel Requirements. The Contractor shall provide a Quality Control (QC) Manager who will have overall responsibility and authority for quality control. The jobsite and plant personnel shall be able to contact the QC Manager by cellular phone, two-way radio or other methods approved by the Engineer.

The QC Manager shall visit the jobsite a minimum of once a week. A visit shall be performed the day of a bridge deck pour, the day a non-routine mixture is placed as determined by the Engineer, or the day a plant is anticipated to produce more than 1000 cu yd (765 cu m). Any of the three required visits may be used to meet the once per week minimum requirement.

The Contractor shall provide personnel to perform the required inspections, sampling, testing and documentation in a timely manner. The Contractor shall refer to the Department's "Qualifications and Duties of Concrete Quality Control Personnel" document.

A Level I PCC Technician shall be provided at the jobsite during mixture production and placement, and may supervise concurrent pours on the project. For concurrent pours, a minimum of one Concrete Tester shall be required at each pour location. If the Level I PCC Technician is at one of the pour locations, a Concrete Tester is still required at the same location. Each Concrete Tester shall be able to contact the Level I PCC Technician by cellular phone, two-way radio or other methods approved by the Engineer. A single Level I PCC Technician shall not supervise concurrent pours for multiple contracts.

A Level II PCC Technician shall be provided at the plant, or shall be available, during mixture production and placement. A Level II PCC Technician may supervise a maximum of three plants. Whenever the Level II PCC Technician is not at the plant during mixture production and placement, a Concrete Tester or Level I PCC Technician shall be present at the plant to perform any necessary concrete tests. The Concrete Tester, Level I PCC Technician, or other individual shall also be trained to perform any necessary aggregate moisture tests, if the Level II PCC Technician is not at the plant during mixture production and placement. The Concrete Tester, Level I PCC Technician, plant personnel, and jobsite personnel shall have the ability to contact the Level II PCC Technician by cellular phone, two-way radio, or other methods approved by the Engineer.

For a mixture which is produced and placed with a mobile portland cement concrete plant as defined in Article 1103.04, a Level II PCC Technician shall be provided. The Level II PCC Technician shall be present at all times during mixture production and placement. However, the Level II PCC Technician may request to be available if operations are satisfactory. Approval shall be obtained from the Engineer, and jobsite personnel shall have the ability to contact the Level II PCC Technician by cellular phone, two-way radio, or other methods approved by the Engineer.

A Concrete Tester, Mixture Aggregate Technician, and Aggregate Technician may provide assistance with sampling and testing. A Gradation Technician may provide assistance with testing. A Concrete Tester shall be supervised by a Level I or Level II PCC Technician. A Gradation Technician shall be supervised by a Level II PCC Technician, Mixture Aggregate Technician, or Aggregate Technician.

(2) Required Plant Tests. Sampling and testing shall be performed at the plant, or at a location approved by the Engineer, to control the production of a mixture. The required minimum Contractor plant sampling and testing is indicated in Article 1020.16(g) Schedule A.

(3) Required Field Tests. Sampling and testing shall be performed at the jobsite to control the production of a mixture, and to comply with specifications for placement. For standard curing, after initial curing, and for strength testing; the location shall be approved by the Engineer. The required minimum Contractor jobsite sampling and testing is indicated in Article 1020.16(g), Schedule B.

(d) Quality Assurance by Engineer. The Engineer will perform quality assurance tests on independent samples and split samples. An independent sample is a field sample obtained and tested by only one party. A split sample is one of two equal portions of a field sample, where two parties each receive one portion for testing. The Engineer may request the Contractor to obtain a split sample. Aggregate split samples and any failing strength specimen shall be retained until permission is given by the Engineer for disposal. The results of all quality assurance tests by the Engineer will be made available to the Contractor. However, Contractor split sample test results shall be provided to the Engineer before Department test results are revealed. The Engineer's quality assurance independent sample and split sample testing is indicated in Article 1020.16(g), Schedule C.

(1) Strength Testing. For strength testing, Article 1020.09 shall apply, except the Contractor and Engineer strength specimens may be placed in the same field curing box for initial curing and may be cured in the same water storage tank for final curing.

(2) Comparing Test Results. Differences between the Engineer's and the Contractor's split sample test results will be considered reasonable if within the following limits:

| Test Parameter | Acceptable Limits of Precision |
|---|---|
| Slump | 0.75 in. (20 mm) |
| Air Content | 0.9% |
| Compressive Strength | 900 psi (6200 kPa) |
| Flexural Strength | 90 psi (620 kPa) |
| Slump Flow (Self-Consolidating Concrete (SCC)) | 1.5 in. (40 mm) |
| Visual Stability Index (SCC) | Not Applicable |
| J-Ring (SCC) | 1.5 in. (40 mm) |
| L-Box (SCC) | 10 % |
| Hardened Visual Stability Index (SCC) | Not Applicable |
| Dynamic Segregation Index (SCC) | 1.0 % |
| Flow (Controlled Low-Strength Material (CLSM)) | 1.5 in. (40 mm) |
| Strength (Controlled Low-Strength Material (CLSM)) | 40 psi (275 kPa) |
| Aggregate Gradation | See "Guideline for Sample Comparison" in Appendix "A" of the Manual of Test Procedures for Materials. |

When acceptable limits of precision have been met, but only one party is within specification limits, the failing test shall be resolved before the material may be considered for acceptance.

(3)Test Results and Specification Limits.

a. Split Sample Testing. If either the Engineer's or the Contractor's split sample test result is not within specification limits, and the other party is within specification limits; immediate retests on a split sample shall be performed for slump, air content, slump flow, visual stability index, J-Ring, L-Box, dynamic segregation index, flow (CLSM), or aggregate gradation. A passing retest result by each party will require no further action. If either the Engineer's or Contractor's slump, air content, slump flow, visual stability index, J-Ring, L-Box, dynamic segregation index, flow (CLSM), or aggregate gradation split sample retest result is a failure; or if either the Engineer's or Contractor's strength or hardened visual stability index test result is a failure, and the other party is within specification limits; the following actions shall be initiated to investigate the test failure:

1. The Engineer and the Contractor shall investigate the sampling method, test procedure, equipment condition, equipment calibration, and other factors.

2. The Engineer or the Contractor shall replace test equipment, as determined by the Engineer.

3. The Engineer and the Contractor shall perform additional testing on split samples, as determined by the Engineer.

For aggregate gradation, jobsite slump, jobsite air content, jobsite slump flow, jobsite visual stability index, jobsite J-Ring, jobsite L-Box, jobsite dynamic segregation index, and jobsite flow (CLSM); if the failing split sample test result is not resolved according to 1., 2., or 3., and the mixture has not been placed, the Contractor shall reject the material; unless the Engineer accepts the material for incorporation in the work according to Article 105.03. If the mixture has already been placed, or if a failing strength or hardened visual stability index test result is not resolved according to 1., 2., or 3., the material will be considered unacceptable.

If a continued trend of difference exists between the Engineer's and the Contractor's split sample test results, or if split sample test results exceed the acceptable limits of precision, the Engineer and the Contractor shall investigate according to items 1., 2., and 3.

b. Independent Sample Testing. For aggregate gradation, jobsite slump, jobsite air content jobsite slump flow, jobsite visual stability index, jobsite J-Ring, jobsite L-Box, jobsite dynamic segregation index, jobsite flow (CLSM); if the result of a quality assurance test on a sample independently obtained by the Engineer is not within specification limits, and the mixture has not been placed, the Contractor shall reject the material, unless the Engineer accepts the material for incorporation in the work according to Article 105.03. If the mixture has already

been placed or the Engineer obtains a failing strength or hardened visual stability index test result, the material will be considered unacceptable.

(e) Acceptance by the Engineer. Final acceptance will be based on the Standard Specifications and the following:

(1) The Contractor's compliance with all contract documents for quality control.

(2) Validation of Contractor quality control test results by comparison with the Engineer's quality assurance test results using split samples. Any quality control or quality assurance test determined to be flawed may be declared invalid only when reviewed and approved by the Engineer. The Engineer will declare a test result invalid only if it is proven that improper sampling or testing occurred. The test result is to be recorded and the reason for declaring the test invalid will be provided by the Engineer.

(3) Comparison of the Engineer's quality assurance test results with specification limits using samples independently obtained by the Engineer.

The Engineer may suspend mixture production, reject materials, or take other appropriate action if the Contractor does not control the quality of concrete, cement aggregate mixture II, or controlled low-strength material for acceptance. The decision will be determined according to (1), (2), or (3).

(f) Documentation.

(1) Records. The Contractor shall be responsible for documenting all observations, inspections, adjustments to the mix design, test results, retest results, and corrective actions in a bound hardback field book, bound hardback diary, or appropriate Department form, which shall become the property of the Department. The documentation shall include a method to compare the Engineer's test results with the Contractor's results. The Contractor shall be responsible for the maintenance of all permanent records whether obtained by the Contractor, the consultants, the subcontractors, or the producer of the mixture. The Contractor shall provide the Engineer full access to all documentation throughout the progress of the work.

The Department's form MI 504M, form BMPR MI654, and form BMPR MI655 shall be completed by the Contractor, and shall be submitted to the Engineer weekly or as required by the Engineer. A correctly completed form MI 504M, form BMPR MI654, and form BMPR MI655 are required to authorize payment by the Engineer, for applicable pay items.

(2) Delivery Truck Ticket. The following information shall be recorded on each delivery ticket or in a bound hardback field book: initial revolution counter reading (final reading optional) at the jobsite, if the mixture is truck-mixed; time discharged at the jobsite; total amount of each admixture added at the jobsite; and total amount of water added at the jobsite.

(g) Basis of Payment and Schedules. Quality Control/Quality Assurance of portland cement concrete mixtures will not be paid for separately, but shall be considered as included in the cost of the various concrete contract items.

## SCHEDULE A

| CONTRACTOR PLANT SAMPLING AND TESTING | | | |
|---|---|---|---|
| Item | Test | Frequency | IL Modified AASHTO or Department Test Method [1/] |
| Aggregates (Arriving at Plant) | Gradation [2/] | As needed to check source for each gradation number | 2, 11, 27, and 248 |
| Aggregates (Stored at Plant in Stockpiles or Bins) | Gradation [2/] | 2,500 cu yd (1,900 cu m) for each gradation number [3/] | 2, 11, 27, and 248 |
| Aggregates (Stored at Plant in Stockpiles or Bins) | Moisture [4/]: Fine Aggregate | Once per week for moisture sensor, otherwise daily for each gradation number | Flask, Dunagan, Pychnometer Jar, or 255 |
| | Moisture [4/]: Coarse Aggregate | As needed to control production for each gradation number | Dunagan, Pychnometer Jar, or 255 |
| Mixture [5/] | Slump<br>Air Content<br>Unit Weight / Yield<br>Slump Flow (SCC)<br>Visual Stability Index (SCC)<br>J-Ring (SCC) [6/]<br>L-Box (SCC) [6/]<br>Temperature | As needed to control production | T 141 and T 119<br>T 141 and T 152 or T 196<br>T 141 and T 121<br>SCC-1 and SCC-2<br>SCC-1 and SCC-2<br>SCC-1 and SCC-3<br>SCC-1 and SCC-4<br>T 141 and T 309 |
| Mixture (CLSM) [7/] | Flow<br>Air Content<br>Temperature | As needed to control production | Illinois Test Procedure 307 |

1/ Refer to the Department's "Manual of Test Procedures for Materials".

2/ All gradation tests shall be washed. Testing shall be completed no later than 24 hours after the aggregate has been sampled.

3/ One per week (Sunday through Saturday) minimum unless the stockpile has not received additional aggregate material since the previous test.

One per day minimum for a bridge deck pour unless the stockpile has not received additional aggregate material since the previous test. The sample shall be taken and testing completed prior to the pour. The bridge deck aggregate sample may be taken the day before the pour or as approved by the Engineer.

4/ If the moisture test and moisture sensor disagree by more than 0.5 percent, retest. If the difference remains, adjust the moisture sensor to an average of two or more moisture tests. The Department's "Water/Cement Ratio Worksheet" form shall be completed when applicable.

5/ The Contractor may also perform strength testing according to Illinois Modified AASHTO T 141, T 23, and T 22 or T 177; or water content testing according to Illinois Modified AASHTO T 318.

The Contractor may also perform other available self-consolidating concrete (SCC) tests at the plant to control mixture production.

6/ The Contractor shall select the J-Ring or L-Box test for plant sampling and testing.

7/ The Contractor may also perform strength testing according to Illinois Test Procedure 307.

# SCHEDULE B

| CONTRACTOR JOBSITE SAMPLING & TESTING [1/] | | | |
|---|---|---|---|
| Item | Measured Property | Random Sample Testing Frequency per Mix Design and per Plant [2/] | IL Modified AASHTO Test Method |
| Pavement, Shoulder, Base Course, Base Course Widening, Driveway Pavement, Railroad Crossing, Cement Aggregate Mixture II | Slump [3/ 4/] | 1 per 500 cu yd (400 cu m) or minimum 1/day | T 141 and T 119 |
| | Air Content [3/ 5/ 6/] | 1 per 100 cu yd (80 cu m) or minimum 1/day | T 141 and T 152 or T 196 |
| | Compressive Strength [7/ 8/] or Flexural Strength [7/ 8/] | 1 per 1250 cu yd (1000 cu m) or minimum 1/day | T 141, T 22 and T 23 or T 141, T 177 and T 23 |
| Bridge Approach Slab [9/], Bridge Deck [9/], Bridge Deck Overlay [9/], Superstructure [9/], Substructure, Culvert, Miscellaneous Drainage Structures, Retaining Wall, Building Wall, Drilled Shaft Pile & Encasement Footing, Foundation, Pavement Patching, Structural Repairs | Slump [3/ 4/] | 1 per 50 cu yd (40 cu m) or minimum 1/day | T 141 and T 119 |
| | Air Content [3/ 5/ 6/] | 1 per 50 cu yd (40 cu m) or minimum 1/day | T 141 and T 152 or T 196 |
| | Compressive Strength [7/ 8/] or Flexural Strength [7/ 8/] | 1 per 250 cu yd (200 cu m) or minimum 1/day | T 141, T 22 and T 23 or T 141, T 177 and T 23 |
| Seal Coat | Slump [3/] | 1 per 250 cu yd (200 cu m) or minimum 1/day | T 141 and T 119 |
| | Air Content [3/ 5/ 6/] | 1 per 250 cu yd (200 cu m) or minimum 1/day when air is entrained | T 141 and T 152 or T 196 |
| | Compressive Strength [7/ 8/] or Flexural Strength [7/ 8/] | 1 per 250 cu yd (200 cu m) or minimum 1/day | T 141, T 22 and T 23 or T 141, T 177 and T 23 |

| CONTRACTOR JOBSITE SAMPLING & TESTING [1/] | | | |
|---|---|---|---|
| Curb, Gutter, Median, Barrier, Sidewalk, Slope Wall, Paved Ditch, Fabric Formed Concrete Revetment Mat [10/], Miscellaneous Items, Incidental Items | Slump [3/ 4/] | 1 per 100 cu yd (80 cu m) or minimum 1/day | T 141 and T 119 |
| | Air Content [3/ 5/ 6/] | 1 per 50 cu yd (40 cu m) or minimum 1/day | T 141 and T 152 or T 196 |
| | Compressive Strength [7/ 8/] or Flexural Strength [7/ 8/] | 1 per 400 cu yd (300 cu m) or minimum 1/day | T 141, T 22 and T 23 or T 141, T 177 and T 23 |
| The Item will use a Self-Consolidating Concrete Mixture | Slump Flow [3/]<br>VSI [3/]<br>J-Ring [3/ 11/]<br>L-Box [3/ 11/] | Perform at same frequency that is specified for the Item's slump | SCC-1 & SCC-2<br>SCC-1 & SCC-2<br>SCC-1 & SCC-3<br>SCC-1 & SCC-4 |
| The Item will use a Self-Consolidating Concrete Mixture | HVSI [12/] | Minimum 1/day at start of production for that day | SCC-1 and SCC-6 |
| The Item will use a Self-Consolidating Concrete Mixture | Dynamic Segregation Index (DSI) | Minimum 1/week at start of production for that week | SCC-1 and SCC-8 (Option C) |
| The Item will use a Self-Consolidating Concrete Mixture | Air Content [3/ 5/ 6/] | Perform at same frequency that is specified for the Item's air content | SCC-1 and T 152 or T 196 |
| The Item will use a Self-Consolidating Concrete Mixture | Compressive Strength 7/ 8/ or Flexural Strength [7/ 8/] | Perform at same frequency that is specified for the Item's strength | SCC-1, T 22 and T 23 or SCC-1, T 177 and T 23 |
| All | Temperature [3/] | As needed to control production | T 141 and T 309 |
| Controlled Low-Strength Material (CLSM) | Flow, Air Content, Compressive Strength (28-day) [13/], and Temperature | First truck load delivered and as needed to control production thereafter | Illinois Test Procedure 307 |

1/ Sampling and testing of small quantities of curb, gutter, median, barrier, sidewalk, slope wall, paved ditch, miscellaneous items, and incidental items may be waived by the Engineer if requested by the Contractor. However, quality control personnel are still required according to Article 1020.16(c)(1) The Contractor shall also provide recent evidence that similar material has been found to be satisfactory under normal sampling and testing procedures. The total quantity that may be waived for testing shall not exceed 100 cu yd (76 cu m) per contract.

If the Contractor's or Engineer's test result for any jobsite mixture test is not within the specification limits, all subsequent truck loads delivered shall be tested by the Contractor until the problem is corrected.

2/ If one mix design is being used for several construction items during a day's production, one testing frequency may be selected to include all items. The construction items shall have the same slump, air content, and water/cement ratio specifications. For self-consolidating concrete, the construction items shall have the same slump flow, visual

stability index, J-Ring, L-Box, air content, and water/cement ratio specifications. The frequency selected shall equal or exceed the testing required for the construction item.

One sufficiently sized sample shall be taken to perform the required test(s). Random numbers shall be determined according to the Department's "Method for Obtaining Random Samples for Concrete". The Engineer will provide random sample locations.

3/ The temperature, slump, and air content tests shall be performed on the first truck load delivered, for each pour. For self consolidating concrete, the temperature, slump flow, visual stability index, J-Ring or L-Box, and air content tests shall be performed on the first truck load delivered, for each pour. Unless a random sample is required for the first truck load, testing the first truck load does not satisfy random sampling requirements.

4/ The slump random sample testing frequency shall be a minimum 1/day for a construction item which is slipformed.

5/ If a pump or conveyor is used for placement, a correction factor shall be established to allow for a loss of air content during transport. The first three truck loads delivered shall be tested, before and after transport by the pump or conveyor, to establish the correction factor. Once the correction is determined, it shall be re-checked after an additional 50 cu yd (40 cu m) is pumped, or an additional 100 cu yd (80 cu m) is conveyored. This shall continue throughout the pour. If the re-check indicates the correction factor has changed, a minimum of two truckloads is required to re-establish the correction factor. The correction factor shall also be re-established when significant changes in temperature, distance, pump or conveyor arrangement, and other factors have occurred. If the correction factor is >3.0 percent, the Contractor shall take corrective action to reduce the loss of air content during transport by the pump or conveyor. The Contractor shall record all air content test results, correction factors and corrected air contents. The corrected air content shall be reported on form BMPR MI654.

6/ If the Contractor's or Engineer's air content test result is within the specification limits, and 0.2 percent or closer to either limit, the next truck load delivered shall be tested by the Contractor. For example, if the specified air content range is 5.0 to 8.0 percent and the test result is 5.0, 5.1, 5.2, 7.8, 7.9 or 8.0 percent, the next truck shall be tested by the Contractor.

7/ The test of record for strength shall be the day indicated in Article 1020.04. For cement aggregate mixture II, a strength requirement is not specified and testing is not required. Additional strength testing to determine early falsework and form removal, early pavement or bridge opening to traffic, or to monitor strengths is at the discretion of the Contractor. Strength shall be defined as the average of two 6 x 12 in. (150 x 300 mm) cylinder breaks, three 4 x 8 in. (100 x 200 mm) cylinder breaks, or two beam breaks for field tests. Per Illinois Modified AASHTO T 23, cylinders shall be 6 x 12 in. (150 x 300 mm) when the nominal maximum size of the coarse aggregate exceeds 1 in. (25 mm).

8/ In addition to the strength test, a slump test, air content test, and temperature test shall be performed on the same sample. For self-consolidating concrete, a slump flow test, visual stability index test, J-Ring or L-Box test, air content test, and temperature test shall be performed on the same sample as the strength test. For mixtures pumped or conveyored, the Contractor shall sample according to Illinois Modified AASHTO T 141.

9/ The air content test will be required for each delivered truck load.

10/ For fabric formed concrete revetment mat, the slump test is not required and the flexural strength test is not applicable.

11/ The Contractor shall select the J-Ring or L-Box test for jobsite sampling and testing.

12/ In addition to the hardened visual stability index (HVSI) test, a slump flow test, visual stability index (VSI) test, J-Ring or L-Box test, air content test, and temperature test shall be performed on the same sample. The Contractor shall retain all hardened visual stability index cut cylinder specimens until the Engineer notifies the Contractor that the specimens may be discarded.

13/ The test of record for strength shall be the day indicated in Article 1019.04. In addition to the strength test, a flow test, air content test, and temperature test shall be performed on the same sample. The strength test may be waived by the Engineer if future removal of the material is not a concern.

## SCHEDULE C

| ENGINEER QUALITY ASSURANCE INDEPENDENT SAMPLE TESTING | | |
|---|---|---|
| Location | Measured Property | Testing Frequency [1/] |
| Plant | Gradation of aggregates stored in stockpiles or bins, Slump and Air Content | As determined by the Engineer. |
| Jobsite | Slump, Air Content, Slump Flow, Visual Stability Index, J-Ring, L-Box, Hardened Visual Stability Index, Dynamic Segregation Index and Strength | As determined by the Engineer. |
| | Flow, Air Content, Strength (28-day), and Dynamic Cone Penetration for Controlled Low-Strength Material (CLSM) | As determined by the Engineer |

| ENGINEER QUALITY ASSURANCE SPLIT SAMPLE TESTING | | |
|---|---|---|
| Location | Measured Property | Testing Frequency [1/] |
| Plant | Gradation of aggregates stored in stockpiles or bins [2/] | At the beginning of the project, the first test performed by the Contractor. Thereafter, a minimum of 10% of total tests required of the Contractor will be performed per aggregate gradation number and per plant. |
| | Slump and Air Content | As determined by the Engineer. |
| Jobsite | Slump [2/], Air Content [2/ 3/], Slump Flow [2/], Visual Stability Index [2/], J-Ring [2/] and L-box [2/] | At the beginning of the project, the first three tests performed by the Contractor. Thereafter, a minimum of 20% of total tests required of the Contractor will be performed per plant, which will include a minimum of one test per mix design. |
| | Hardened Visual Stability Index [2/] | As determined by the Engineer. |
| | Dynamic Segregation Index [2/] | As determined by the Engineer. |
| | Strength [2/] | At the beginning of the project, the first test performed by the Contractor. Thereafter, a minimum of 20% of total tests required of the Contractor will be performed per plant, which will include a minimum of one test per mix design. |
| | Flow, Air Content, and Strength (28-day) for Controlled Low-Strength Material (CLSM) | As determined by the Engineer. |

1/ The Engineer will perform the testing throughout the period of quality control testing by the Contractor.

2/ The Engineer will witness and take immediate possession of or otherwise secure the Department's split sample obtained by the Contractor.

3/ Before transport by pump or conveyor, a minimum of 20 percent of total tests required of the Contractor will be performed per mix design and per plant. After transport by pump or conveyor, a minimum of 20 percent of total tests required of the Contractor will be performed per mix design and per plant.

SCHEDULE D

CONCRETE QUALITY CONTROL AND QUALITY ASSURANCE DOCUMENTS

(a) Model Quality Control Plan for Concrete Production (*)

(b) Qualifications and Duties of Concrete Quality Control Personnel (*)

(c) Development of Gradation Bands on Incoming Aggregate at Mix Plants (*)

(d) Required Sampling and Testing Equipment for Concrete (*)

(e) Method for Obtaining Random Samples for Concrete (*)

(f) Calibration of Concrete Testing Equipment (BMPR PCCQ01 through BMPR PCCQ09) (*)

(g) Water/Cement Ratio Worksheet (BMPR PCCW01) (*)

(h) Field/Lab Gradations (MI 504M) (*)

(i) Concrete Air, Slump and Quantity (BMPR MI654) (*)

(j) P.C. Concrete Strengths (BMPR MI655) (*)

(k) Aggregate Technician Course or Mixture Aggregate Technician Course (*)

(l) Portland Cement Concrete Tester Course (*)

(m) Portland Cement Concrete Level I Technician Course - Manual of Instructions for Concrete Testing (*)

(n) Portland Cement Concrete Level II Technician Course - Manual of Instructions for Concrete Proportioning (*)

(o) Portland Cement Concrete Level III Technician Course - Manual of Instructions for Design of Concrete Mixtures (*)

(p) Manual of Test Procedures for Materials

* Refer to Appendix C of the Manual of Test Procedures for Materials for more information."

Designer Note: Do not use this version in District Four. Use the District Special Provision of the same name.

**RECLAIMED ASPHALT PAVEMENT AND RECLAIMED ASPHALT SHINGLES (BDE)**

Effective: November 1, 2012
Revise: January 1, 2013November 1, 2013

Revise Section 1031 of the Standard Specifications to read:

**"SECTION 1031. RECLAIMED ASPHALT PAVEMENT AND RECLAIMED ASPHALT SHINGLES**

**1031.01 Description.** Reclaimed asphalt pavement and reclaimed asphalt shingles shall be according to the following.

(a) Reclaimed Asphalt Pavement (RAP). RAP is the material produced by cold milling or crushing an existing hot-mix asphalt (HMA) pavement. The Contractor shall supply written documentation that the RAP originated from routes or airfields under federal, state, or local agency jurisdiction.

(b) Reclaimed Asphalt Shingles (RAS). Reclaimed asphalt shingles (RAS). RAS is from the processing and grinding of preconsumer or post-consumer shingles. RAS shall be a clean and uniform material with a maximum of 0.5 percent unacceptable material, as defined in Bureau of Materials and Physical Research Policy Memorandum "Reclaimed Asphalt Shingle (RAS) Sources", by weight of RAS. All RAS used shall come from a Bureau of Materials and Physical Research approved processing facility where it shall be ground and processed to 100 percent passing the 3/8 in. (9.5 mm) sieve and 93 percent passing the #4 (4.75 mm) sieve based on a dry shake gradation. RAS shall be uniform in gradation and asphalt binder content and shall meet the testing requirements specified herein. In addition, RAS shall meet the following Type 1 or Type 2 requirements.

(1) Type 1. Type 1 RAS shall be processed, preconsumer asphalt shingles salvaged from the manufacture of residential asphalt roofing shingles.

(2) Type 2. Type 2 RAS shall be processed post-consumer shingles only, salvaged from residential, or four unit or less dwellings not subject to the National Emission Standards for Hazardous Air Pollutants (NESHAP).

**1031.02 Stockpiles.** RAP and RAS stockpiles shall be according to the following.

(a) RAP Stockpiles. The Contractor shall construct individual, sealed RAP stockpiles meeting one of the following definitions. No additional RAP shall be added to the pile after the pile has been sealed. Stockpiles shall be sufficiently separated to prevent intermingling at the base. Stockpiles shall be identified by signs indicating the type as listed below (i.e. "Homogeneous Surface").

Prior to milling, the Contractor shall request the District provide documentation on the quality of the RAP to clarify the appropriate stockpile.

(1) Fractionated RAP (FRAP). FRAP shall consist of RAP from Class I, HMA (High and Low ESAL) mixtures. The coarse aggregate in FRAP shall be crushed aggregate and may represent more than one aggregate type and/or quality but shall be at least C quality. All FRAP shall be fractionated prior to testing by screening into a minimum of two size fractions with the separation occurring on or between the #4 (4.75 mm) and 1/2 in. (12.5 mm) sieves. Agglomerations shall be minimized such that 100 percent of the RAP shall pass the sieve size specified below for the mix into which the FRAP will be incorporated.

| Mixture FRAP will be used in: | Sieve Size that 100% of FRAP Shall Pass |
|---|---|
| IL-25.0 | 2 in. (50 mm) |
| IL-19.0 | 1 1/2 in. (40 mm) |
| IL-12.5 | 1 in. (25 mm) |
| IL-9.5 | 3/4 in. (20 mm) |
| IL-4.75 | 1/2 in. (13 mm) |

(2) Homogeneous. Homogeneous RAP stockpiles shall consist of RAP from Class I, HMA (High and Low ESAL) mixtures and represent: 1) the same aggregate quality, but shall be at least C quality; 2) the same type of crushed aggregate (either crushed natural aggregate, ACBF slag, or steel slag); 3) similar gradation; and 4) similar asphalt binder content. If approved by the Engineer, combined single pass surface/binder millings may be considered "homogenous" with a quality rating dictated by the lowest coarse aggregate quality present in the mixture.

(3) Conglomerate. Conglomerate RAP stockpiles shall consist of RAP from Class I, HMA (High and Low ESAL) mixtures. The coarse aggregate in this RAP shall be crushed aggregate and may represent more than one aggregate type and/or quality but shall be at least C quality. This RAP may have an inconsistent gradation and/or asphalt binder content prior to processing. All conglomerate RAP shall be processed prior to testing by crushing to where all RAP shall pass the 5/8 in. (16 mm) or smaller screen. Conglomerate RAP stockpiles shall not contain steel slag.

(4) Conglomerate "D" Quality (DQ). Conglomerate DQ RAP stockpiles shall consist of RAP from Class I, HMA (High or Low ESAL), or "All Other" (as defined by Article 1030.04(a)(3)) mixtures. The coarse aggregate in this RAP may be crushed or round but shall be at least D quality. This RAP may have an inconsistent gradation and/or asphalt binder content. Conglomerate DQ RAP stockpiles shall not contain steel slag.

(5) Non-Quality. RAP stockpiles that do not meet the requirements of the stockpile categories listed above shall be classified as "Non-Quality".

RAP/FRAP containing contaminants, such as earth, brick, sand, concrete, sheet asphalt, bituminous surface treatment (i.e. chip seal), pavement fabric, joint sealants, etc., will be unacceptable unless the contaminants are removed to the satisfaction of the Engineer. Sheet asphalt shall be stockpiled separately.

(b) RAS Stockpiles. Type 1 and Type 2 RAS shall be stockpiled separately and shall not be intermingled. Each stockpile shall be signed indicating what type of RAS is present.

Unless otherwise approved specified by the Engineer, mechanically blending manufactured sand (FM 20 or FM 22) up to an equal weight of RAS with the processed

RAS will be permitted to improve workability. The sand shall be "B Quality" or better from an approved Aggregate Gradation Control System source. The sand shall be accounted for in the mix design and during HMA production.

Records identifying the shingle processing facility supplying the RAS, RAS type and lot number shall be maintained by project contract number and kept for a minimum of three years.

**1031.03 Testing.** RAP/FRAP and RAS testing shall be according to the following.

(a) RAP/FRAP Testing. When used in HMA, the RAP/FRAP shall be sampled and tested either during or after stockpiling.

(1) During Stockpiling. For testing during stockpiling, washed extraction samples shall be run at the minimum frequency of one sample per 500 tons (450 metric tons) for the first 2000 tons (1800 metric tons) and one sample per 2000 tons (1800 metric tons) thereafter. A minimum of five tests shall be required for stockpiles less than 4000 tons (3600 metric tons).

(2) After Stockpiling. For testing after stockpiling, the Contractor shall submit a plan for approval to the District proposing a satisfactory method of sampling and testing the RAP/FRAP pile either in-situ or by restockpiling. The sampling plan shall meet the minimum frequency required above and detail the procedure used to obtain representative samples throughout the pile for testing.

Each sample shall be split to obtain two equal samples of test sample size. One of the two test samples from the final split shall be labeled and stored for Department use. The Contractor shall extract the other test sample according to Department procedure. The Engineer reserves the right to test any sample (split or Department-taken) to verify Contractor test results.

(b) RAS Testing. RAS or RAS blended with manufactured sand shall be sampled and tested during stockpiling according to Illinois Department of Transportation Policy Memorandum, "Reclaimed Asphalt Shingle (RAS) Source".

Samples shall be collected during stockpiling at the minimum frequency of one sample per 200 tons (180 metric tons) for the first 1000 tons (900 metric tons) and one sample per 250 tons (225 metric tons) thereafter. A minimum of five samples are required for stockpiles less than 1000 tons (900 metric tons). Once a ≤ 1000 ton (900 metric ton), five-sample/test stockpile has been established it shall be sealed. Additional incoming RAS or RAS blended with manufactured sand shall be stockpiled in a separate working pile as designated in the Quality Control plan and only added to the sealed stockpile when the test results of the working pile are complete and are found to meet the tolerances specified herein for the original sealed RAS stockpile.

Before testing, each sample shall be split to obtain two test samples. One of the two test samples from the final split shall be labeled and stored for Department use. The Contractor shall perform a washed extraction and test for unacceptable materials on the other test sample according to Department procedures. The Engineer reserves the right to test any sample (split or Department-taken) to verify Contractor test results.

If the sampling and testing was performed at the shingle processing facility in accordance with the QC Plan, the Contractor shall obtain and make available all of the test results from start of the initial stockpile.

**1031.04 Evaluation of Tests.** Evaluation of tests results shall be according to the following.

(a) Evaluation of RAP/FRAP Test Results. All of the extraction results shall be compiled and averaged for asphalt binder content and gradation and, when applicable $G_{mm}$. Individual extraction test results, when compared to the averages, will be accepted if within the tolerances listed below.

| Parameter | FRAP/Homogeneous /Conglomerate | Conglomerate "D" Quality |
|---|---|---|
| 1 in. (25 mm) | | ± 5 % |
| 1/2 in. (12.5 mm) | ± 8 % | ± 15 % |
| No. 4 (4.75 mm) | ± 6 % | ± 13 % |
| No. 8 (2.36 mm) | ± 5 % | |
| No. 16 (1.18 mm) | | ± 15 % |
| No. 30 (600 µm) | ± 5 % | |
| No. 200 (75 µm) | ± 2.0 % | ± 4.0 % |
| Asphalt Binder | ± 0.4 % 1/ | ± 0.5 % |
| $G_{mm}$ | ± 0.03 | |

1/ The tolerance for FRAP shall be ± 0.3 %.

If more than 20 percent of the individual sieves and/or asphalt binder content tests are out of the above tolerances, the RAP/FRAP shall not be used in HMA unless the RAP/FRAP representing the failing tests is removed from the stockpile. All test data and acceptance ranges shall be sent to the District for evaluation.

With the approval of the Engineer, the ignition oven may be substituted for extractions according to the Illinois Test Procedure, "Calibration of the Ignition Oven for the Purpose of Characterizing Reclaimed Asphalt Pavement (RAP)".

(b) Evaluation of RAS and RAS Blended with Manufactured Sand Test Results. All of the test results, with the exception of percent unacceptable materials, shall be compiled and averaged for asphalt binder content and gradation. Individual test results, when compared to the averages, will be accepted if within the tolerances listed below.

| Parameter | RAS |
|---|---|
| No. 8 (2.36 mm) | ± 5 % |
| No. 16 (1.18 mm) | ± 5 % |
| No. 30 (600 µm) | ± 4 % |
| No. 200 (75 µm) | ± 2.0 % |
| Asphalt Binder Content | ± 1.5 % |

If more than 20 percent of the individual sieves and/or asphalt binder content tests are out of the above tolerances, or if the percent unacceptable material exceeds 0.5 percent by weight of material retained on the # 4 (4.75 mm) sieve, the RAS or RAS blend shall not be used in Department projects. All test data and acceptance ranges shall be sent to the District for evaluation.

**1031.05 Quality Designation of Aggregate in RAP/FRAP.**

(a) RAP. The aggregate quality of the RAP for homogenous, conglomerate, and conglomerate "D" quality stockpiles shall be set by the lowest quality of coarse aggregate in the RAP stockpile and are designated as follows.

(1) RAP from Class I, Superpave/HMA (High ESAL), or (Low ESAL) IL-9.5L surface mixtures are designated as containing Class B quality coarse aggregate.

(2) RAP from Superpave/HMA (Low ESAL) IL-19.0L binder mixture is designated as Class D quality coarse aggregate.

(3) RAP from Class I, Superpave/HMA (High ESAL) binder mixtures, bituminous base course mixtures, and bituminous base course widening mixtures are designated as containing Class C quality coarse aggregate.

(4) RAP from bituminous stabilized subbase and BAM shoulders are designated as containing Class D quality coarse aggregate.

(b) FRAP. If the Engineer has documentation of the quality of the FRAP aggregate, the Contractor shall use the assigned quality provided by the Engineer.

If the quality is not known, the quality shall be determined as follows. Coarse and fine FRAP stockpiles containing plus #4 (4.75 mm) sieve coarse aggregate shall have a maximum tonnage of 5,000 tons (4,500 metric tons). The Contractor shall obtain a representative sample witnessed by the Engineer. The sample shall be a minimum of 50 lb (25 kg). The sample shall be extracted according to Illinois Modified AASHTO T 164 by a consultant prequalified by the Department for the specified testing. The consultant shall submit the test results along with the recovered aggregate to the District Office. The cost for this testing shall be paid by the Contractor. The District will forward the sample to the BMPR Aggregate Lab for MicroDeval Testing, according to Illinois Modified AASHTO T 327. A maximum loss of 15.0 percent will be applied for all HMA applications.

**1031.06 Use of RAP/FRAP and/or RAS in HMA.** The use of RAP/FRAP and/or RAS shall be a Contractor's option when constructing HMA in all contracts.

(a) RAP/FRAP. The use of RAP/FRAP in HMA shall be as follows.

(1) Coarse Aggregate Size. The coarse aggregate in all RAP shall be equal to or less than the nominal maximum size requirement for the HMA mixture to be produced.

(2) Steel Slag Stockpiles. Homogeneous RAP stockpiles containing steel slag will be approved for use in all HMA (High ESAL and Low ESAL) Surface and Binder Mixture applications.

(3) Use in HMA Surface Mixtures (High and Low ESAL). RAP/FRAP stockpiles for use in HMA surface mixtures (High and Low ESAL) shall be FRAP or homogeneous in which the coarse aggregate is Class B quality or better. RAP/FRAP from Conglomerate stockpiles shall be considered equivalent to limestone for frictional considerations. Known frictional contributions from plus #4 (4.75 mm) homogeneous RAP and FRAP stockpiles will be accounted for in meeting frictional requirements in the specified mixture.

(4) Use in HMA Binder Mixtures (High and Low ESAL), HMA Base Course, and HMA Base Course Widening. RAP/FRAP stockpiles for use in HMA binder mixtures (High and Low ESAL), HMA base course, and HMA base course widening shall be FRAP, homogeneous, or conglomerate, in which the coarse aggregate is Class C quality or better.

(5) Use in Shoulders and Subbase. RAP/FRAP stockpiles for use in HMA shoulders and stabilized subbase (HMA) shall be FRAP, homogeneous, conglomerate, or conglomerate DQ.

(6) When the Contractor chooses the RAP option, the percentage of RAP shall not exceed the amounts indicated in Article 1031.06(c)(1) below for a given N Design.

(b) RAS. RAS meeting Type 1 or Type 2 requirements will be permitted in all HMA applications as specified herein.

(c) RAP/FRAP and/or RAS Usage Limits. Type 1 or Type 2 RAS may be used alone or in conjunction with RAP or FRAP in HMA mixtures up to a maximum of 5.0% by weight of the total mix.

(1) RAP/RAS. When RAP is used alone or RAP is used in conjunction with RAS, the percentage of virgin asphalt binder replacement shall not exceed the amounts listed in the Max RAP/RAS ABR table listed below for the given Ndesign.

**RAP/RAS Maximum Asphalt Binder Replacement (ABR) Percentage**

| HMA Mixtures 1/, 2/ | RAP/RAS Maximum ABR % | | |
|---|---|---|---|
| Ndesign | Binder/Leveling Binder | Surface | Polymer Modified |
| 30 | 30 | 30 | 10 |
| 50 | 25 | 15 | 10 |
| 70 | 15 | 10 | 10 |
| 90 | 10 | 10 | 10 |
| 105 | 10 | 10 | 10 |

1/ For HMA "All Other" (shoulder and stabilized subbase) N-30, the RAP/RAS ABR shall not exceed 50 percent of the mixture.

2/ When RAP/RAS ABR exceeds 20 percent, the high and low virgin asphalt binder grades shall each be reduced by one grade (i.e. 25 percent ABR would require a virgin asphalt binder grade of PG64-22 to be reduced to a PG58-28). If warm mix asphalt (WMA) technology is utilized, and production temperatures do not exceed 275 °F (135 °C) the high and low virgin asphalt binder grades shall each be reduced by one grade when RAP/RAS ABR exceeds 25 percent (i.e. 26 percent RAP/RAS ABR would require a virgin asphalt binder grade of PG64-22 to be reduced to a PG58-28).

(2) FRAP/RAS. When FRAP is used alone or FRAP is used in conjunction with RAS, the percentage of virgin asphalt binder replacement shall not exceed the amounts listed in the FRAP/RAS tables listed below for the given N design.

**Level 1 - FRAP/RAS Maximum Asphalt Binder Replacement (ABR) Percentage**

| HMA Mixtures 1/, 2/ | Level 1 - FRAP/RAS Maximum ABR % | | |
|---|---|---|---|
| Ndesign | Binder/Leveling Binder | Surface | Polymer Modified 3/, 4/ |
| 30 | 35 | 35 | 10 |
| 50 | 30 | 25 | 10 |
| 70 | 25 | 20 | 10 |
| 90 | 20 | 15 | 10 |
| 105 | 10 | 10 | 10 |

1/ For HMA "All Other" (shoulder and stabilized subbase) N30, the FRAP/RAS ABR shall not exceed 50 percent of the mixture.

2/ When FRAP/RAS ABR exceeds 20 percent for all mixes the high and low virgin asphalt binder grades shall each be reduced by one grade (i.e. 25 percent ABR would require a virgin asphalt binder grade of PG64-22 to be reduced to a PG58-28). If warm mix asphalt (WMA) technology is utilized, and production temperatures do not exceed 275 °F (135 °C) the high and low virgin asphalt binder grades shall each be reduced by one grade when FRAP/RAS ABR exceeds 25 percent (i.e. 26 percent ABR would require a virgin asphalt binder grade of PG64-22 to be reduced to a PG58-28).

3/ For SMA the FRAP/RAS ABR shall not exceed 20 percent.

4/ For IL-4.75 mix the FRAP/RAS ABR shall not exceed 20 percent.

**Level 2 – FRAP/RAS Maximum Asphalt Binder Replacement (ABR) Percentage**

| HMA Mixtures 1/, 2/ | Level 2 – FRAP/RAS Maximum ABR % | | |
|---|---|---|---|
| Ndesign | Binder/Leveling Binder | Surface | Polymer Modified 3/, 4/ |
| 30 | 40 | 40 | 10 |
| 50 | 40 | 30 | 10 |
| 70 | 30 | 20 | 10 |
| 90 | 30 | 20 | 10 |
| 105 | 30 | 15 | 10 |

1/ For HMA "All Other" (shoulder and stabilized subbase) N30, the FRAP/RAS ABR shall not exceed 50 percent of the mixture.

2/ When FRAP/RAS ABR exceeds 20 percent for all mixes the high and low virgin asphalt binder grades shall each be reduced by one grade (i.e. 25 percent ABR would require a virgin asphalt binder grade of PG64-22 to be reduced to a PG58-28). If warm mix asphalt (WMA) technology is utilized, and production temperatures do not exceed 275 °F (135 °C) the high and low virgin asphalt binder grades shall each be reduced by one grade when FRAP/RAS ABR exceeds 25 percent (i.e. 26 percent ABR would require a virgin asphalt binder grade of PG64-22 to be reduced to a PG58-28).

3/ For SMA the FRAP/RAS ABR shall not exceed 20 percent.

4/ For IL-4.75 mix the FRAP/RAS ABR shall not exceed 30 percent.

**1031.07 HMA Mix Designs.** At the Contractor's option, HMA mixtures may be constructed utilizing RAP/FRAP and/or RAS material meeting the above detailed requirements specified herein.

FRAP/RAS mix designs exceeding the Level 1 FRAP/RAS Maximum ABR percentages shall be tested prior to submittal for verification, according to Illinois Modified AASHTO T 324 (Hamburg Wheel) and shall meet the following requirements.

| Asphalt Binder Grade | # Repetitions | Max. Rut Depth in. (mm) |
|---|---|---|
| PG76-XX | 20,000 | 1/2 (12.5) |
| PG70-XX | 15,000 | 1/2 (12.5) |
| PG64-XX | 7,500 | 1/2 (12.5) |
| PG58-XX | 5,000 | 1/2 (12.5) |

(a) RAP/FRAP and/or RAS. RAP/FRAP and/or RAS mix designs shall be submitted for volumetric verification. If additional RAP/FRAP stockpiles are tested and found that no more than 20 percent of the results, as defined under "Testing" herein, are outside of the control tolerances set for the original RAP/FRAP stockpile and HMA mix design, and meets all of the requirements herein, the additional RAP/FRAP stockpiles may be used in the original mix design at the percent previously verified.

(b) RAS. Type 1 and Type 2 RAS are not interchangeable in a mix design. A RAS stone bulk specific gravity (Gsb) of 2.500 shall be used for mix design purposes.

**1031.08 HMA Production.** Mixture production where the FRAP/RAS ABR percentage exceeds the Level 1 limits, shall be sampled within the first 500 tons (450 metric tons) on the first day of production with a split reserved for the Department. The mix sample shall be tested according to the Illinois Modified AASHTO T 324 and shall meet the requirements specified herein. Mix production shall not exceed 1500 tons (1350 metric tons) or one day's production, whichever comes first, until the testing is completed and the mixture is found to be in conformance. The requirement to cease mix production may be waived if the plant produced mixture conformance is demonstrated prior to start of mix production for a State contract.HMA production utilizing RAP/FRAP and/or RAS shall be as follows.

(a) RAP/FRAP. The coarse aggregate in all RAP/FRAP used shall be equal to or less than the nominal maximum size requirement for the HMA mixture being produced.

To remove or reduce agglomerated material, a scalping screen, gator, crushing unit, or comparable sizing device approved by the Engineer shall be used in the RAP feed system to remove or reduce oversized material. If material passing the sizing device adversely affects the mix production or quality of the mix, the sizing device shall be set at a size specified by the Engineer.

If the RAP/FRAP control tolerances or QC/QA test results require corrective action, the Contractor shall cease production of the mixture containing RAP/FRAP and either switch to the virgin aggregate design or submit a new RAP/FRAP design.

(b) RAS. RAS shall be incorporated into the HMA mixture either by a separate weight depletion system or by using the RAP weigh belt. Either feed system shall be interlocked with the aggregate feed or weigh system to maintain correct proportions for

all rates of production and batch sizes. The portion of RAS shall be controlled accurately to within ± 0.5 percent of the amount of RAS utilized. When using the weight depletion system, flow indicators or sensing devices shall be provided and interlocked with the plant controls such that the mixture production is halted when RAS flow is interrupted.

When producing HMA containing RAS, a positive dust control system shall be utilized.

(c) RAP/FRAP and/or RAS. HMA plants utilizing RAP/FRAP and/or RAS shall be capable of automatically recording and printing the following information.

(1) Dryer Drum Plants.

a. Date, month, year, and time to the nearest minute for each print.

b. HMA mix number assigned by the Department.

c. Accumulated weight of dry aggregate (combined or individual) in tons (metric tons) to the nearest 0.1 ton (0.1 metric ton).

d. Accumulated dry weight of RAP/FRAP/RAS in tons (metric tons) to the nearest 0.1 ton (0.1 metric ton).

e. Accumulated mineral filler in revolutions, tons (metric tons), etc. to the nearest 0.1 unit.

f. Accumulated asphalt binder in gallons (liters), tons (metric tons), etc. to the nearest 0.1 unit.

g. Residual asphalt binder in the RAP/FRAP material as a percent of the total mix to the nearest 0.1 percent.

h. Aggregate and RAP/FRAP moisture compensators in percent as set on the control panel. (Required when accumulated or individual aggregate and RAP/FRAP are printed in wet condition.)

(2) Batch Plants.

a. Date, month, year, and time to the nearest minute for each print.

b. HMA mix number assigned by the Department.

c. Individual virgin aggregate hot bin batch weights to the nearest pound (kilogram).

d. Mineral filler weight to the nearest pound (kilogram).

f. RAP/FRAP/RAS weight to the nearest pound (kilogram).

g. Virgin asphalt binder weight to the nearest pound (kilogram).

h. Residual asphalt binder in the RAP/FRAP/RAS material as a percent of the total mix to the nearest 0.1 percent.

The printouts shall be maintained in a file at the plant for a minimum of one year or as directed by the Engineer and shall be made available upon request. The printing system will be inspected by the Engineer prior to production and verified at the beginning of each construction season thereafter.

**1031.09 RAP in Aggregate Surface Course and Aggregate Shoulders.** The use of RAP in aggregate surface course (temporary access entrances only) and aggregate wedge shoulders Type B shall be as follows.

(a) Stockpiles and Testing. RAP stockpiles may be any of those listed in Article 1031.02, except "Non-Quality" and "FRAP". The testing requirements of Article 1031.03 shall not apply. RAP used to construct aggregate surface course and aggregate shoulders shall be according to the current Bureau of Materials and Physical Research's Policy Memorandum, "Reclaimed Asphalt Pavement (RAP) for Aggregate Applications".

(b) Gradation. One hundred percent of the RAP material shall pass the 1 1/2 in. (37.5 mm) sieve. The RAP material shall be reasonably well graded from coarse to fine. RAP material that is gap-graded or single sized will not be accepted."

Designer Note: Insert in all contracts with cast-in-place concrete, precast concrete and precast pre-stressed concrete.

**PORTLAND CEMENT CONCRETE EQUIPMENT (BDE)**

Effective: November 1, 2013

Add the following to the first paragraph of Article 1103.03(a)(5) of the Standard Specifications to read:

"As an alternative to a locking key, the start and finish time for mixing may be automatically printed on the batch ticket. The start and finish time shall be reported to the nearest second."

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District Special Provisions

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SECTION 700

District Special Provisions

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District Special Provisions

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# SECTION 900

## District Special Provisions

| Standard Specifications | Item/Description | Doc. # |
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SECTION 1000

District Special Provisions

| Standard Specifications | Item/Description | Doc. # |
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| 1103.00 | PCC QC/QA ELECTRONIC REPORT SUBMITTAL | 110300 |
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# District Special Provisions

Designer Note: Use in all contracts with potential utility involvement.

## UTILITIES – LOCATIONS/INFORMATION ON PLANS

Effective: November 8, 2013

The locations of existing water mains, gas mains, sewers, electric power lines, telephone lines, and other utilities as shown on the plans are based on field investigation and locations provided by the utility companies, but they are not guaranteed. Unless elevations are shown, all utility locations shown on the cross sections are based on the approximate depth supplied by the utility company. It shall be the Contractor's responsibility to ascertain their exact location from the utility companies and by field inspection.

Designer Note: This special provision requires a 12' wide milling machine. Check with Construction before using. This provision shall be used in lieu of either DSP 440.03B or Check Sheet #13 "Hot-Mix Asphalt Surface Correction." Intended for use on rural "SMART" and other types of extended length cold milling projects to develop a smooth pavement profile for resurfacing. Do not require on urban or intersection type projects. This special provision should be limited to jobs with more than 25,000 sq. yds. (20,000 square meters) of mainline milling.

The designer should check existing field conditions and as built plans to determine the existing overlay thickness is so that we can eliminate spalling of the bituminous surface that is to remain in place after the cold milling.

Discuss cleanup equipment with Construction, then insert the following: (a) For rural projects, a "mechanical broom" for cleanup is acceptable. (b) For urban projects. it is recommended to require use of a "self-propelled street sweeper with power vacuum capability". If (b) is used, then revise and underline the "cleanup" paragraph and put a revised date on the special provision.

This special as written covers the standard milling and resurfacing situations. If unusual circumstances such as grade correction, cross slope correction, etc. are to be performed, the special may need to be revised and a detail showing the treatment included in the plans.

CADD drawing "Hot-Mix Asphalt Surface Removal" (which includes the required surface texture as written at the end of this special provision as well as the desired cross section of the CM required) shall be included.

**Designer shall insert thickness or range of thickness here.

**HOT-MIX ASPHALT SURFACE REMOVAL, " ( MM)**

Effective March 1, 1993
Revised November 8, 2013

Description: This work shall consist of removing a portion of the existing hot-mix asphalt concrete surface course in accordance with the applicable portions of Section 440 and 1101 of the Standard Specifications, this special provision, details in the plans and as directed by the Engineer. The cold milled salvaged aggregate resulting from this operation shall become the property of the Contractor.

Equipment: The machine used for milling and planing shall be a self-propelled grinding machine having a minimum 12' (3.6 m) wide drum at least 28" (710 mm) in diameter. When a milling width in excess of 12' is required and the Contractor's milling machine is less than the required width shown in the plans, the remaining area shall be milled with a machine capable of meeting the requirements of this special provision. Milling attachments used with skid steer tractors will not be allowed for longitudinal areas to mill additional widths.

When the teeth become worn so that they do not produce a uniform surface texture, they shall all be changed at the same time (as a unit). Occasionally, individual teeth may be changed if they lock up or break, but this method shall not be used to avoid changing the set of teeth as a unit. Occasional gouges, due to deteriorated pavement condition, or separation of lifts will not

be cause to replace all teeth. The Engineer will be the sole judge of the cause of the pavement gouging and the corrective work required. Corrective work due to negligence or poor workmanship shall be at the Contractor's expense.

The moldboard is critical in obtaining the desired surface texture. It shall be straight, true, and free of excessive nicks or wear, and it shall be replaced as necessary to uniformly produce the required surface texture. Gouging of the pavement by more than 1/4 inch (6 mm) shall be sufficient cause to require replacement of all teeth.

## Construction Requirements

General: Weather conditions, when milling work is performed, must be such that short term or temporary pavement markings can be placed the day the surface is milled in accordance with Section 703 "Work Zone Pavement Markings".

An automatic grade control device shall be used when milling mainline pavement and shall be capable of controlling the elevation of the drum relative to either a preset grade control stringline or a grade reference device traveling on the adjacent pavement surface. The automatic grade control device may be utilized only on one side of the machine with a automatic slope control device controlling the opposite side. The traveling grade reference device shall not be less than 30 feet (9 m) in length. When milling cross roads, turn lanes, intersections, crossovers, or other miscellaneous areas, the Engineer may permit the matching shoe. The Contractor, at his option, may also substitute an approved 6' wide (1.8 m) machine for areas other than mainline pavement.

The Contractor shall mill _____ inch (_____ mm) at the centerline and project the proposed cross slope to the edge of pavement. In the event the milling at the outer edge of the lane would exceed _____ inches (_____ mm); then the Contractor shall reduce the cut at the centerline to provide the maximum cut of _____ inches (_____ mm) at the edge of pavement. If deemed necessary, the Contractor may reduce the cross slope from normal 1.5% to 1%.

Surface tests will be performed in accordance with Article 407.09(a) of the Standard Specifications. The longitudinal profile will be taken 3 ft. (0.9 m) from and parallel to each edge of pavement and 3 ft. (0.9 m) from and parallel to the centerline on each side. If a shadow area is found at the 3 ft. (0.9 m) points the pavement smoothness tester will be moved sufficient distance either side to measure the Contractor's milling efforts. Any surface variations exceeding the tolerance of Table 1 of Article 407.09 shall be corrected by reprofiling at no additional expense to the Department. In addition, the Contractor shall be responsible for refilling with approved hot-mix asphalt mixtures any area that lowered the pavement profile as a result of faulty milling operations if directed by the Engineer. The Contractor shall be responsible for providing the pavement smoothness tester described elsewhere to retest the pavement profile obtained.

If the milling depth is intended to expose the original concrete pavement, then additional hand or machine work may be necessary to remove any remaining veneer of bituminous pavement which may be left in place behind the milling machine. Such work will be at the direction of the Engineer and at no extra cost to the Department.

The Contractor shall provide a 10 foot (3 m) straightedge equipped with a carpenter's level or a 7 foot (2.1 m) electronic straightedge to check the cross slope of the roadway at regular intervals as directed by the Engineer.

Surface Texture: Each tooth on the cutting drum shall produce a series of discontinuous longitudinal striations. There shall be 16 to 20 striations (tooth marks) for each tooth for each 6 feet (1.8 m) in the longitudinal direction, and each striation shall be 1.7 inches_+/- 0.2 inch (43 +/- 5 mm) in length after the area is planed by the moldboard. Thus, the planed length between each pair of striations shall be 2.3 inches +/- 0.2 inch (58 +/- 5 mm). There shall be 80 to 96 rows of discontinuous longitudinal striations for each 5 feet (1.5 m) in the transverse dimension. The areas between the striations in both the longitudinal and transverse directions shall be flat topped and coplaner. The moldboard shall be used to cut this plane; and any time the operation fails to produce this flat plane interspersed with a uniform pattern of discontinuous longitudinal striations, the operation shall be stopped and the cause determined and corrected before recommencing. Other similar patterns of uniform discontinuous longitudinal striations interspersed on a flat plane may be approved by the Engineer. The drawing titled "Hot-Mix Asphalt Surface Removal" showing the desired surface texture is included in the plans.

The start-up milling speed shall be limited to a maximum of 50 foot (15 m) per minute. The Contractor shall limit his operations to this speed to demonstrate his ability to obtain the striations and ride ability as described above. If the Contractor is able to demonstrate that he can consistently obtain the desired striations and ride ability at a greater speed he will be permitted to run at the increased speed.

Cleanup: After cold milling a traffic lane and before opening the lane to traffic, the pavement shall be swept by a **(a) mechanical broom (b) self-propelled street sweeper with power vacuum capability** to prevent compaction of the cuttings onto the pavement. All loose material shall be removed from the roadway. Before the prime coat is placed, the pavement shall be cleaned of all foreign material to the satisfaction of the Engineer.

This cleanup work shall be considered included in the contract unit price per square meter (square yard) for HOT-MIX ASPHALT SURFACE REMOVAL of the depth specified, and no additional compensation will be allowed.

Method of Measurement:

(a) Contract Quantities. The requirements for the use of Contract Quantities shall be Article 202.07(a) of the Standard Specifications.

(b) Measured Quantities. Cold milling and planing will be measured and the area computed in square yards (square meters) of surface.

Areas not milled (shadowed areas) due to rutting in the existing pavement surface will be included in the area measured for payment.

Basis of Payment: The cold milling and planing will be paid for at the contract unit price per square yard (square meter) for HOT-MIX ASPHALT SURFACE REMOVAL of the depth specified. Payment as specified will include variations in depth of cuts due to rutting, superelevations, and pavement crown and no additional compensation will be allowed.

Designer Note: This special provision requires use of a 6' milling machine. Check with Construction before using. This provision shall be used instead of either DSP 440.03AD or Check Sheet #13 "Hot-Mix Asphalt Surface Correction." Intended for use on urban project or rural project with less than 25,000 square yards (20,000 square meters) of cold milling and is intended to develop a smooth pavement profile for resurfacing.

The designer should check existing field conditions and as built plans to determine the existing overlay thickness is so that we can eliminate spalling of the hot-mix asphalt surface that is to remain in place after the cold milling.

This special as written covers the standard milling and resurfacing situations. If unusual circumstances such as grade correction, cross slope correction, etc. are to be performed, the special may need to be revised and a detail showing the treatment included in the plans.

CADD drawing "Hot-Mix Asphalt Surface Removal" (which includes the required surface texture as written at the end of this special provision as well as the desired cross section of the CM required) shall be included.

Discuss cleanup equipment with Construction then insert the following: (a) For urban only projects, a "self-propelled street sweeper with power vacuum capability" for cleanup is required. (b) For rural projects, a "mechanical broom" for cleanup is acceptable. If (b) is used, then revise and underline the "cleanup" paragraph and put a revised date on the special provision. You may have a project with both urban and rural characteristics. In that case you would need both (a) and (b) statements.

**Designer shall insert thickness or range of thickness here.

**HOT-MIX ASPHALT SURFACE REMOVAL, " ( MM)**

Effective February 5, 1993 Revised November 8, 2013

Description: This work shall consist of removing a portion of the existing hot-mix asphalt concrete surface course in accordance with the applicable portions of Section 440 and 1101 of the Standard Specifications, this special provision, details in the plans and as directed by the Engineer. The cold milled salvaged aggregate resulting from this operation shall become the property of the Contractor.

When the teeth become worn so that they do not produce a uniform surface texture, they shall all be changed at the same time (as a unit). Occasionally, individual teeth may be changed if they lock up or break, but this method shall not be used to avoid changing the set of teeth as a unit.

The moldboard is critical in obtaining the desired surface texture. It shall be straight, true, and free of excessive nicks or wear, and it shall be replaced as necessary to uniformly produce the required surface texture. Gouging of the pavement by more than 1/4 inch (6 mm) shall be sufficient cause to require replacement of all teeth. Occasional gouges, due to deteriorated pavement condition, or separation of lifts will not be cause to replace all teeth. The Engineer will be the sole judge of the cause of the pavement gouging and the corrective work required. Corrective work due to negligence or poor workmanship will be at the Contractor's expense.

## Construction Requirements

General: Weather conditions, when milling work is performed, must be such that short term or temporary pavement markings can be placed the day the surface is milled in accordance with Section 703 "Work Zone Pavement Markings."

An automatic grade control device shall be used when milling mainline pavement and shall be capable of controlling the elevation of the drum relative to either a preset grade control stringline or a grade reference device traveling on the adjacent pavement surface. The automatic grade control device may be utilized on only one side of the machine with an automatic slope control device controlling the opposite side. The traveling grade reference device shall not be less than 30 feet (9 m) in length for rural areas. For urban areas, a device not less than 20 feet (6 m) in length will be required. When milling cross roads, turn lanes, intersections, crossovers, or other miscellaneous areas, the Engineer may permit the use of a matching shoe.

The Contractor shall mill _____ inch ( _____ mm) at the centerline and project the proposed cross slope to the edge of pavement. In the event the milling at the outer edge of the lane would exceed _____ inch ( _____ mm); then the Contractor shall reduce the cut at the centerline to provide the maximum cut of _____ inch ( _____ mm) at the edge of pavement. If deemed necessary, the Contractor may reduce the cross slope from normal to 1.5% to 1%.

Surface tests will be performed according to Article 407.09(a) of the Standard Specifications. The profile will be taken 3 ft. (0.9 m) from and parallel to each edge of pavement and 3 ft. (0.9 m) from and parallel to the centerline on each side. If a shadow area is found at the 3 ft. (0.9 m) points, the pavement smoothness tester will be moved sufficient distance either side to measure the Contractor's milling efforts. If any (milled) surface variations found to be over 1/4" in 10' (6 mm in 3 m), then the roadway shall be reprofiled at no additional cost. In addition, the Contractor shall be responsible for refilling, with approved hot-mix asphalt mixtures, any area that lowered the pavement profile as a result of his faulty milling operations if directed by the Engineer. The Contractor shall be responsible for providing the pavement smoothness tester described elsewhere to retest the pavement profile obtained.

If the milling depth is intended to expose the original concrete pavement, then additional hand or machine work may be necessary to remove any remaining veneer of bituminous pavement which may be left in place behind the milling machine. Such work will be at the direction of the Engineer and at no extra cost to the State.

The Contractor shall provide a 10' (3 m) straightedge equipped with a carpenter's level or a 7' (2.1 m) electronic straightedge to check the cross slope of the roadway at regular intervals as directed by the Engineer.

Surface Texture: Each tooth on the cutting drum shall produce a series of discontinuous longitudinal striations. There shall be 16 to 20 striations (tooth marks) for each tooth for each 6' (1.8 m) in the longitudinal direction, and each striation shall be 1.7 inches +/- 0.2 inch (43 +- 5 mm) in length after the area is planed by the moldboard. Thus, the planed length between each pair of striations shall be 2.3 inches +/- 0.2 inch (58 +/- 5 mm). There shall be 80 to 96 rows of discontinuous longitudinal striations for each 5' (1.5 m) in the transverse dimension. The areas between the striations in both the longitudinal and transverse directions shall be flat topped and coplaner. The moldboard shall be used to cut this plane; and any time the operation fails to produce this flat plane interspersed with a uniform pattern of discontinuous longitudinal striations, the operation shall be stopped and the cause determined and corrected

before recommencing. Other similar patterns of uniform discontinuous longitudinal striations interspersed on a flat plane may be approved by the Engineer.

The startup milling speed shall be limited to a maximum of 50' (15 m) per minute. The Contractor shall limit his operations to this speed to demonstrate his ability to obtain the striations and rideability as described above. If the Contractor is able to demonstrate that he can consistently obtain the desired striations and rideability at a greater speed he will be permitted to run at the increased speed.

Cleanup: After cold milling a traffic lane and before opening the lane to traffic, the pavement shall be swept by a **(a) self-propelled street sweeper with power vacuum capability or (b) mechanical broom** to prevent compaction of the cuttings onto the pavement. All loose material shall be removed from the roadway. Before the prime coat is placed, the pavement shall be cleaned of all foreign material to the satisfaction of the Engineer.

This cleanup work shall be considered included in the contract unit price per square yard (square meter) for HOT-MIX ASPHALT SURFACE REMOVAL of the depth specified, and no additional compensation will be allowed.

Method of Measurement:

(a) Contract Quantities. The requirements for the use of Contract Quantities shall be Article 202.07(a) of the Standard Specifications.

(b) Measured Quantities. Cold milling and planing will be measured and the area computed in square yards (square meters) of surface.

Areas not milled (shadow areas) due to rutting in the existing pavement surface will be included in the area measured for payment.

Basis of Payment: The cold milling and planing will be paid for at the contract unit price per square yard (square meter) for HOT-MIX ASHPALT SURFACE REMOVAL of the depth specified. Payment as specified will include variations in depth of cuts due to rutting, superelevations, and pavement crown and no additional compensation will be allowed.

Designer Note: Designer to include the appropriate inlet type and either specify the casting to be installed within this special provision or provide a table in the plans. *Shall be replaced by "A" or "B".

**INLETS, TYPE "__*__", WITH SPECIAL FRAME AND GRATE**

Effective: August 2, 2013

This work shall consist of furnishing equipment, labor, and materials for the construction of inlets in accordance with Section 602 of the Standard Specifications, Highway Standards 602301 or 602306, and the details in the plans.

Add "INLETS, TYPE "__*__", WITH SPECIAL FRAME AND GRATE" to Article 602.16 of the Standard Specifications.

This work will be paid for at the contract unit price per Each for INLETS, TYPE "__*__", WITH SPECIAL FRAME AND GRATE.

Designer Note: Designer to include the diameter and either specify the casting to be installed within this special provision or provide a table in the plans. "*" Shall be replaced by the diameter in feet.

**MANHOLE, TYPE A, OF THE DIAMETER SPECIFIED WITH SPECIAL FRAME AND GRATE**

Effective: August 2, 2013

This work shall consist of furnishing equipment, labor, and materials for the construction of MANHOLE, TYPE A, OF THE DIAMETER SPECIFIED WITH SPECIAL FRAME AND GRATE of the diameter specified in accordance with Section 602 of the Standard Specifications and the details in the plans.

Add "MANHOLE, TYPE A, OF THE DIAMETER SPECIFIED WITH SPECIAL FRAME AND GRATE" of the diameter specified to Article 602.16 of the Standard Specifications.

This work will be paid for at the contract unit price per Each for MANHOLE, TYPE A "__*__", WITH SPECIAL FRAME AND GRATE of the diameter specified.

Designer Note: Include in all contracts with cast in place concrete items.

**PCC AUTOMATIC BATCHING EQUIPMENT**

Effective April 23, 2010 Revised November 8, 2013

Portland cement concrete provided shall be produced from batch plants that conform to the requirements of Article 1103.03 (a) and (b) of the Standard Specifications for Road and Bridge Construction. Semi-automatic batching will not be allowed.

In addition, the batching plant shall be a computerized plant interfaced with a printer and shall print actual batch weights, added water, tempering water, mixing time, and amount of each additive per batch. At the discretion of the Engineer, archived electronic versions of batch proportions will be acceptable. Truck delivery tickets will still be required as per Article 1020.11 (a)(7).

# District General Notes

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August 15, 2013

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# District General Notes

# Section 100

Effective August 1, 2003 Revised November 8, 2013

Designer Note: Include in all plans which have electronic files of plan sheets that may be provided to the Contractor.

## AVAILABILITY OF ELECTRONIC FILES

MicroStation and GEOPAK files of this project will be made available to the Contractor after contract award. If there is a conflict between the electronic files and the printed contract plans and documents, the printed contract plans and documents shall take precedence over the electronic files. The Contractor shall accept all risk associated with using the electronic files and shall hold the Department harmless for any errors or omissions in the electronic files and the data contained therein. Errors or delays resulting from the use of the electronic files by the Contractor shall not result in an extension of time for any interim or final completion date or shall not be considered cause for additional compensation. The Contractor shall not use, share, or distribute these electronic files except for the purpose of constructing this contract. Any claims by third parties due to use or errors shall be the sole responsibility of the Contractor. The Contractor shall include this disclaimer with the transfer of these electronic files to any other parties and shall include appropriate language binding them to similar responsibilities.

# Section 200

Effective June 1, 1999 Revised August 2, 2013

Designer Note: Use when borrow is required or where waste material will be generated from construction activities. Waste materials may include, but not limited to, the following removal items: pavement removal, pavement patching activities, and concrete removal items.

## ENVIRONMENTAL REVIEWS

Prior to the use of any proposed borrow areas, use areas (temporary access roads, detours, run-arounds, etc.) and/or waste areas, the Contractor shall file the required environmental resource request surveys according to Section 107.22 of the Standard Specifications. These surveys are required in order for the Department to conduct cultural and biological resource surveys for the proposed site.

Prior to any waste materials being removed from the construction site the required environmental resource surveys will need to be obtained and filed by the Contractor. Excess waste products removed from the construction site shall be disposed of as required in Section 202.03 of the Standard Specifications.

Any protruding metal bars shall be removed prior to the disposal of broken concrete at approved disposal sites.

The required environmental resource documentation shall include the following:

- BDE Form 2289 (Cultural and Natural Resources Review of Borrow Areas)
- BDE Form 2290 (Waste/Use Area Review)
- A location map showing the size limits and location of the use area
- Color photographs depicting the use area
- Borrow Area Entry Agreement form – D4 PI0101

Please note that a minimum of four weeks shall be allowed for the District to obtain the required waste site environmental clearances and six weeks for the required borrow site environmental clearances.