MICHIGAN CONCRETE ASSOCIATION

MDOT 2020 Spec Book Update: Concrete-Related Changes

presented by Steve Waalkes, P.E., MCA's Director of Engineering – W. Mich.

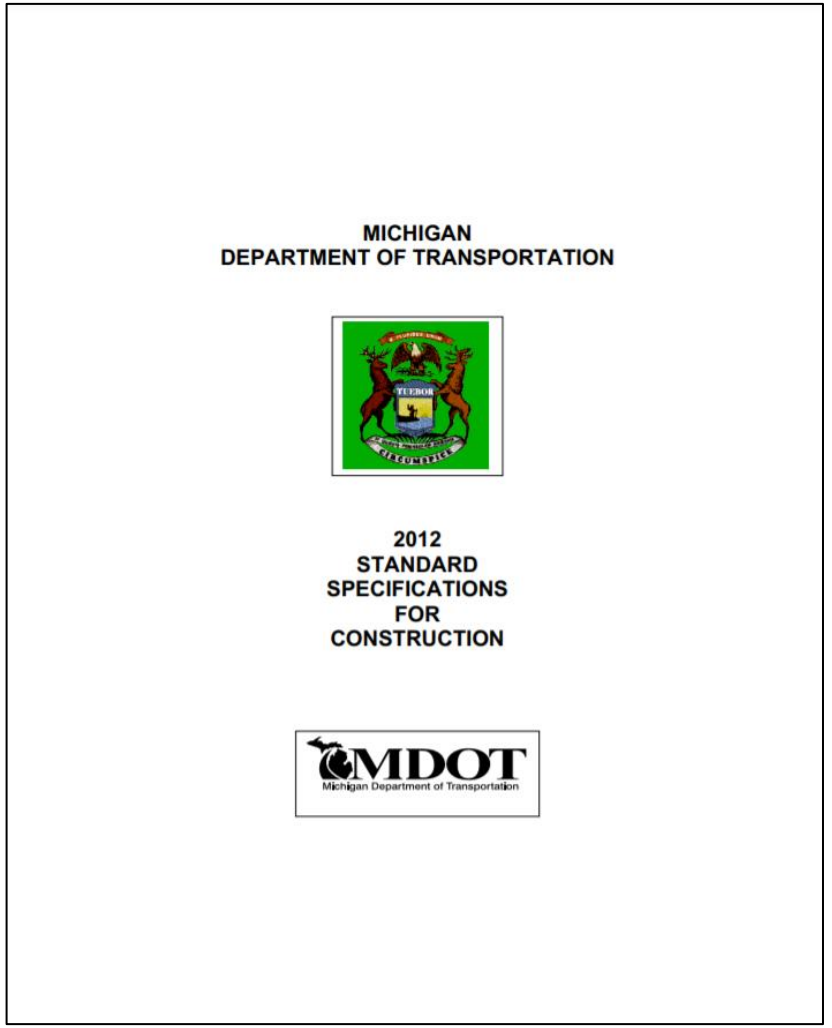
Thursday, February 4, 2021 10:00 to 11:30 am Eastern

Topics Covered Today

- Background on Current (2012) Spec Book
- Timeline of Implementation
- Overall Changes to 2020 Book
- Division 6 – Concrete Pavements
- Division 7 – Structures
- Division 8 – Incidental Construction
- Division 10 – Concrete Mixtures
- Reminders of what hasn't changed?

Current MDOT Spec Book: 2012 Version

- Div. 1 – General Provisions
- Div. 2 – Earthwork
- Div. 3 – Bases
- Div. 4 – Drainage
- Div. 5 – HMA
- Div. 6 – Concrete Pavements
- Div. 7 – Structures
- Div. 8 – Incidental Construction
- Div. 9 – Materials



2012 Spec Book: Concrete Pavement Grades (Div. 6)

Table 601-2
Concrete Pavement Mixtures

Concrete Grade (b, c, g)	Section Number Reference (i)	Cement Content (d,h)		Minimum Class Design Strength (a)							
				Flexural Strength (psi)				Compressive Strength (psi)			
		lb/cyd	sacks	3days	7days	14days	28days	3days	7days	14days	28days
P-NC	603, 801	658	7.0	550	600	—	650	2,600	3,000	—	3,500
P1M (f)	602, 603	470 – 564	5.0 – 6.0	—	550	600	650	—	2,600	3,000	3,500
P1	602, 603, 801, 802, 803, 810	564	6.0	—	550	600	650	—	2,600	3,000	3,500
		526 (e)	5.6								
P2	602, 803, 804, 806, 808, 810, 813, 814, 819	517	5.5	—	500	550	600	—	2,200	2,600	3,000
		489 (e)	5.2								
M	Commercial grade concrete containing 517 lb/cyd (5½ sacks/cyd) of cement. If substituting 1.0 lb of fly ash for each pound of cement removed, the Contractor may reduce portland cement up to 20%, by weight.										
X	Unless otherwise specified, Grade X concrete contains at least 282 lb/cyd (3.0 sacks/cyd) of cement. If substituting 1.0 lb of fly ash for each pound of cement removed, the Contractor may reduce portland cement up to 20% by weight.										

2012 Spec Book: Concrete Pavement Grades

So what concrete goes where?

P1M — High Performance Concrete Pavement
All MDOT trunkline highways that are paved with concrete

P1 — Concrete pavement
Old standard still used for low traffic roadways, small projects and local agency work

P2 — Concrete shoulders
Used for concrete shoulders (but can also use P1 or P1M)

2012 Spec Book: Concrete Pavement Grades (cont.)

P-NC Concrete pavement Repair

Joint and full-depth repairs of concrete pavements

NC requires non-chloride accelerator, 7 sack is standard

M Commercial Concrete

Typically used for non-MDOT concrete outside the right-of-way

2012 Spec Book: Structural Concrete Grades (Div. 7)

Table 701-1A
Concrete Structure Mixtures by Slump

Concrete Grade (e, h)	Section Number Reference (i)	Cement content per cubic yard (b, c)		Slump (in)			
				Type A, D or no Admixture	Type MR, F, or G Admixtures (g)		
		lb	sack		Before Admixture	After Admixture (Type MR)	After Admixture (Type F or G)
D (a)	706, 711, 712	658 (d)	7.0	0 – 3	0 – 3	0 – 6	0 – 7
S1	705	611	6.5	3 – 5	0 – 3	3 – 6	3 – 7
T	705, 706	611	6.5	3 – 7	0 – 4	3 – 7	3 – 8
S2 (a)	401, 705, 706, 712, 713, 801, 802, 803, 810	564	6.0	0 – 3	0 – 3	0 – 6	0 – 7
		526 (d)	5.6				
S3	402, 403, 803, 804, 806	517	5.5	0 – 3	0 – 3	0 – 6	0 – 7
		489 (d)	5.2				

Note: See Table 701-1B below for table notes.

Table 701-1B
Concrete Structure Mixtures by Strength of Concrete

Concrete Grade (e, h)	Section Number Reference (i)	Cement content per cubic yard (b, c)		Minimum Strength of Concrete (f)					
				Flexural, (psi)			Compressive, (psi)		
		lb	sack	7 day	14 day	28 day	7 day	14 day	28 day
D (a)	706, 711, 712	658 (d)	7.0	625	700	725	3,200	4,000	4,500
S1	705	611	6.5	600	650	700	3,000	3,500	4,000
T	705, 706	611	6.5	550	600	650	2,600	3,000	3,500
S2 (a)	401, 705, 706, 712, 713, 801, 802, 803, 810	564	6.0	550	600	650	2,600	3,000	3,500
		526 (d)	5.6						
S3	402, 403, 803, 804, 806	517	5.5	500	550	600	2,200	2,600	3,000
		489 (d)	5.2						

2012 Spec Book: Structural Concrete Grades

So what concrete goes where?

S1	Foundations and Piles
S2	Bridge Structure, Curb/Gutter, and Driveways
S2M	High Performance Bridge Structure High traffic, high profile/long life bridges, bridge approach slabs
S3	Sidewalks

2012 Spec Book: Structural Concrete Grades (cont.)

D Bridge Deck/Railing

- will be called 4500 in new spec book

DM High Performance Bridge Deck and Railings

High traffic, high profile bridge decks and railings or where longer life is required

- will be called 4500 HP in new spec book

T Tremie Concrete

Underwater placements, usually for bridge foundation work

- will be called 3500 in new spec book

12SP-604A – QC/QA PCC for Local Agency Projects

Table 1: Minimum Mix Design Requirements for Concrete

Mix Design Parameter	Grade of Concrete						
	P1M (a,b,e)	P1 (a,b)	D,DM (a,b,e)	T	S1 (a)	S2,S2M (a,b,e)	S3/P2 (a)
Lower Specification Limit (LSL) (28-day compressive, psi)	3500	3500	4500	3500	4000	3500	3000
Rejection Limit for an Individual Strength Sample Test Result	3000	3000	4000	3000	3500	3000	2500
Maximum Water/Cementitious Ratio (lb/lb) (c)	0.45						
Cementitious Material Content (lb/yd3) (d)	470-564	517-611	517-658	517-611	517-611	517-611	489-517
Air Content (percent) (f)	5.5-8.5						
Slump (inch) (max.)	(g)						
Section Number Reference (h)	602, 603	602, 603, 801, 802, 803, 810	706, 711, 712	706, 718	705	401, 706, 712, 713, 718, 801, 802, 803, 810, 819	402, 403, 602, 803, 804, 806, 808, 810, 813, 814

12SP-604B – QA/QC for PCC

Table 1: Minimum Mix Design Requirements for Concrete

Mix Design Parameter	Grade of Concrete						
	P1M (a,b,e)	P1 (a,b)	D,DM (a,b,e)	T	S1 (a)	S2,S2M (a,b,e)	S3/P2 (a)
PWL Applications							
Lower Specification Limit (LSL) (28-day compressive, psi)	3500	3500	—	—	—	—	—
Rejection Limit for an Individual Strength Sample Test Result	2500	2500					
Non-PWL Applications							
Lower Specification Limit (LSL) (28-day compressive, psi)	3500	3500	4500	3500	4000	3500	3000
Rejection Limit for an Individual Strength Sample Test Result	3000	3000	4000	3000	3500	3000	2500
All Concrete Applications							
Maximum Water/Cementitious Ratio (lb/lb) (c)	0.45						
Cementitious Material Content (lb/yd3) (d)	470-564	517-611	517-658	517-611	517-611	517-611	489-517
Air Content (percent) (f)	5.5-8.5						
Slump (inch) (max.)	(g)						
Section Number Reference (h)	602, 603	602, 603, 801, 802, 803, 810	706, 711, 712	706, 718	705	401, 706, 712, 713, 718, 801, 802, 803, 810, 819	402, 403, 602, 803, 804, 806, 808, 810, 813, 814

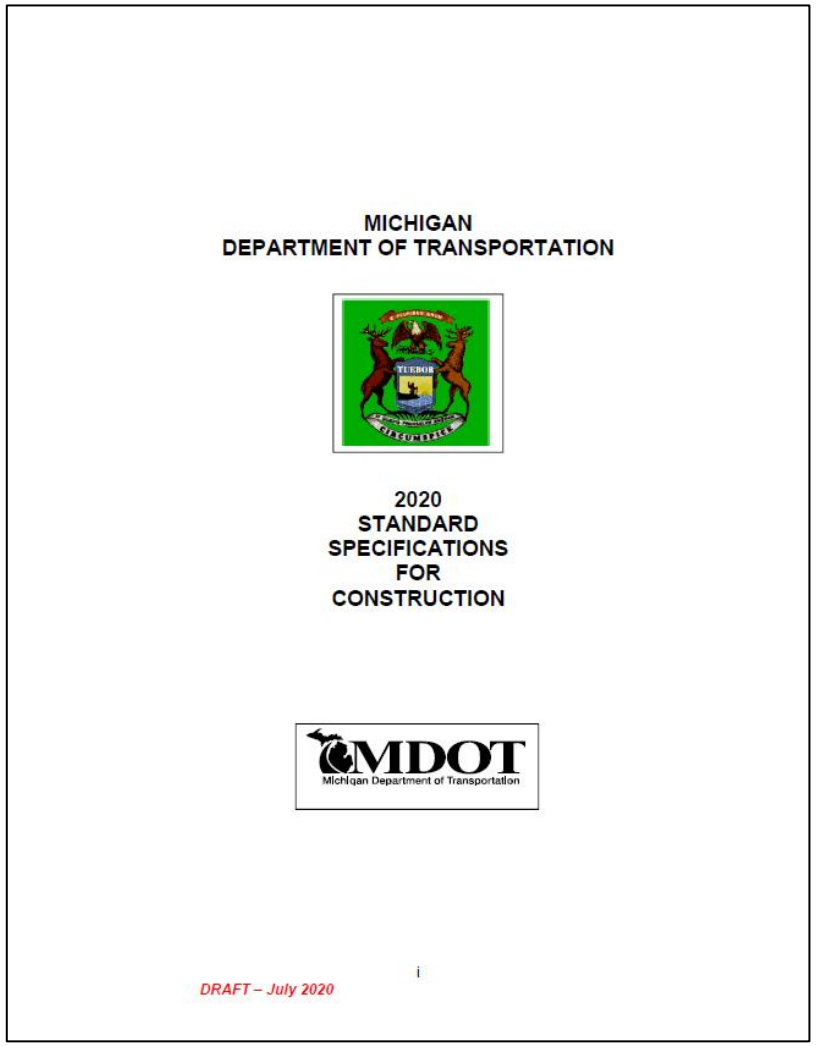
ASR Testing (Fine Aggregate only)

- ASTM C 1260
  - Expansion < 0.10% at 14 days
- ASTM C 1293
  - Expansion < 0.040% at 1 year
- ASTM C 1567
  - Must use replacement of portland cement with slag cement or fly ash
  - Expansion < 0.10% at 14 days

Currently in the S.P. for now; Might be removed as an option in future versions

Draft MDOT 2020 Spec Book

- Latest full draft published July 2020
  - Div.'s 2 & 3 have more recent drafts (Feb. '21)
- Available on MDOT's website
  - Reports, Publications and Specs
- In the process of being finalized
- Printed copies and final PDF version available "late spring/early summer 2021"
- In full effect for August 6, 2021 letting


MICHIGAN
DEPARTMENT OF TRANSPORTATION

2020
STANDARD
SPECIFICATIONS
FOR
CONSTRUCTION

MDOT
Michigan Department of Transportation

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DRAFT – July 2020

Overall Changes to the 2020 Spec Book

- 601 (Conc for Pavts) + 701 (Conc for Structures) now combined and moved to Division 10 (Portland Cement Concrete Mixtures)
- Sections 702 (Mortar and Grout) and 703 (Patching, Repair, and Overlay Mixes) are also moved into Division 10
- Sections 604 (Contractor QC for Concrete) and 605 (QA for Concrete) are now gone
  - Info from those sections is now in the standard spec (Division 10 – 1002 for QC, and 1003 for QA) or retained in a special provision.

Overall Changes to the 2020 Spec Book (cont.)

- Divisions 6 and 7 now contain mostly construction-related information only
- Materials-related information for concrete will be found in Division 9 (aggregates, cementitious, water, admixtures, etc.) and Division 10 (concrete)

Division 6 – Concrete Pavements

Division 6 – FUSPs incorporated into Std. Specs

FUSP #	Description
12SP-602B	Joint Layout for Concrete Intersections
12SP-602D	High Performance Concrete Pavement (Grade P1M)
12SP-602E	Bridge Approach, Reinf
12SP-602I	Coating for Dowel Bars, Mod
12SP-603A	Longitudinal Grooving
12SP-604A	QC/QA for Local Agency Projects
12SP-604B	QC/QA for Trunkline Highways

Division 6 – Pay Item Changes

Pay Items Added

- Section 603 – Concrete Pavement Restoration
  - Diamond Grooving Conc Pavt ($/syd)
  - Diamond Grinding and Grooving Conc Pavt ($/syd)

Pay Items Removed

- Section 603 – Concrete Pavement Restoration
  - ~~Sawing & Sealing Longit Pavt Joints~~ still have Resealing Longit Joints w/ Hot Poured Rubber
  - ~~Sawing & Sealing Trans Pavt Joints~~ still have Resealing Trans Joints w/ Hot Poured Rubber

Division 6 (Concrete Pavements)

- Section 601 now BLANK (Reserved)
  - moved to 1001 and 1004
- Section 602 (Concrete Pavement Construction):
  - Pull-out testing now only required for lane ties that are adhesive-anchored into the hardened concrete. Bars that are cast into the fresh concrete do not require verification of pull-out strength.

Division 6 (Concrete Pavements) – Section 602

- Dowel alignment is now 1/2" for the length of the bar, versus 1/4".

- "Test joint" language (beyond headers, used to check dowel alignment in DBI placements) cleaned up and clarified.

Division 6 (Concrete Pavements) – Section 602

- Texturing machine now required to be steering-controlled instead of a "track machine."
- Coring for QC or contractor's information is not allowed; only the Department will core for QA (payment) purposes

Division 6 (Concrete Pavements) – Section 602

- Procedures for patching spalls in new pavements is changed:
  - Minor spalls (less than 1 inch wide) – are now to be filled with joint sealant
  - Intermediate spalls (less than 4 inches x 2 feet) – sawcut edges and chip; fill with material from QPL, per 914.05
  - Major spalls – now repaired per Standard Plan R-44 (Concrete Pavement Repair)

Division 6 (Concrete Pavements) – Section 602

- Cleaning joints prior to sealing
  - Vertical faces inside the joint need to be roughened to a CSP 2 (concrete surface profile) per ICRI (International Concrete Repair Institute)
  - Gone are the specific requirements for water pressure blasting, sand blasting, and/or compressed air

Division 6 (Concrete Pavements) – Section 602

- Cold weather limitations
  - Plastic sheeting needed for air temps 33°F to 40°F
  - For temperatures 32°F and below, insulation with an R-value of at least 7 required

Division 7 – Structures

Division 7 – Concrete FUSPs incorporated into Std. Specs

FUSP #s	Description
12SP-706C	High Performance Conc Superstructure (Grade DM)
12SP-706E	High Performance Bridge Approach (DM or P1M)
12SP-706G	High Performance Bridge Substructure (Grade S2M)
12SP-711C	High Perf. Textured Aesthetic Bridge Railing (DM)
12SP-711D	High Performance Bridge Railing (Grade DM)

Division 7 - Other Concrete-Related Items

- No interruption of deck wet cure
- Other concrete – 3 days and 70%
- Night pours – end 1 hour before sunrise
- Pour sequence changes require 7-day notice

Division 8 – Incidental Construction

Section 803 (Concrete Sidewalk, Curb Ramps, Steps)

- Change in terminology, no longer called a "Sidewalk Ramp"
  - Being referred to as "Curb Ramp"
- Landings now included in the "Curb Ramp" measurement
  - Before, "Sidewalk Ramp" pay item excluded landings, which had typically been included in the Sidewalk pay item
- Added pay item for "Curb Ramp Opening, Conc" paid by the foot (has been in a SP prior)
  - To differentiate between standard curb profiles versus the transition area as well as the opening itself which has to conform to ADA requirements

Division 9 – Materials

Division 9 – Materials

- 902 Aggregates
  - Fines from crushed concrete can no longer be used as fine granular aggregate backfill
  - All errata incorporated in spec
    - Loss by Wash
      - 2% max for coarse
      - 3% max for intermediate
      - 3% max for fine

(New) Division 10 – Portland Cement Concrete Mixtures

Division 10 (Concrete Mixtures)

- 1001 Concrete Production Equipment and Facilities
- 1002 Contractor Quality Control for Concrete
- 1003 Quality Assurance (Acceptance) for Concrete
- 1004 Portland Cement Concrete Mixtures
- 1005 Mortar and Grout Mixtures
- 1006 Patching, Repair, and Overlay Mixtures

Section 1001 (Conc. Production Equip. & Facilities)

Table 1001-1 (formerly 601-1) – Time btw Charging Mixer and Placing Conc.

- Lower temperature limit changed from 60°F to 65°F, effectively giving producers more time to haul/discharge in slightly warmer conditions

Type of Unit	Concrete Temperature (ASTM C 1064)		
	<65°F	65 to 85°F	>85°F
Open Top Trucks	60	45	30
Open Top Agitating Units	60	60	30
Closed Top Agitating Units and Truck Mixers	90	60	45
Truck Mixers and Closed Top Agitating Units with Water-Reducing Retarding Admixture	120	90	70
All times shown are in minutes.			

Section 1001 (Conc. Production Equip. & Facilities)

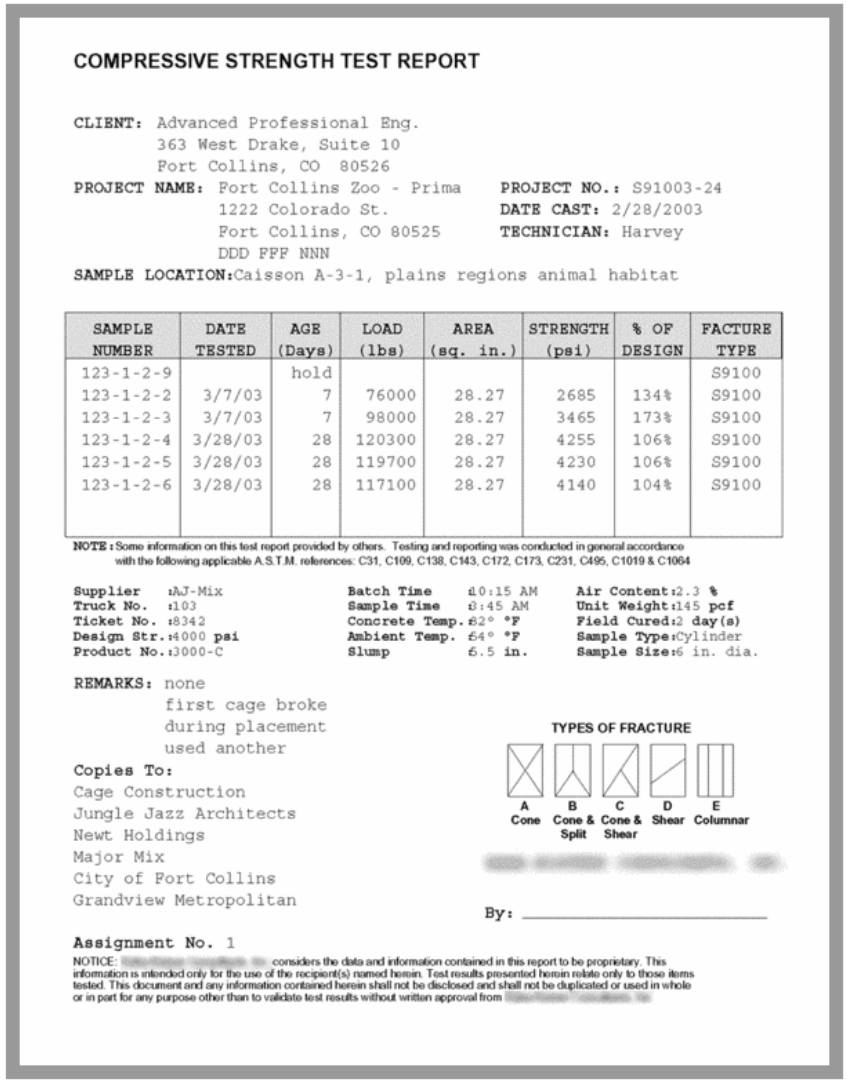
- Clarifies that adding water to mixer trucks **on-site** can consist of one or more increments of water, as long as they are added within fifteen (15) minutes
  - This is similar to the language already in ASTM C94
  - All additions have to occur prior to the start of discharge

Section 1002 (Contractor Quality Control for Conc.)

- Side-by-side correlation of QC and QA testers/equipment
  - Requires the same sample
  - Also done with new/changed equipment or personnel
  - Also when a significant difference exists between QC and QA test results

Section 1003 (Quality Assurance/Acceptance for Conc.)

- QA records to be submitted to the QC Plan Administrator within 24 hours after receiving the corresponding QC records/results



COMPRESSIVE STRENGTH TEST REPORT

CLIENT: Advanced Professional Eng.
363 West Drake, Suite 10
Fort Collins, CO 80526

PROJECT NAME: Fort Collins Zoo - Prima
1222 Colorado St.
Fort Collins, CO 80525
DDD FFF NNN

PROJECT NO.: S91003-24
DATE CAST: 2/28/2003
TECHNICIAN: Harvey

SAMPLE LOCATION: Caisson A-3-1, plains regions animal habitat

SAMPLE NUMBER	DATE TESTED	AGE (Days)	LOAD (lbs)	AREA (sq. in.)	STRENGTH (psi)	% OF DESIGN	FACTURE TYPE
123-1-2-9		hold					S9100
123-1-2-2	3/7/03	7	76000	28.27	2685	134%	S9100
123-1-2-3	3/7/03	7	98000	28.27	3465	173%	S9100
123-1-2-4	3/28/03	28	120300	28.27	4255	106%	S9100
123-1-2-5	3/28/03	28	119700	28.27	4230	106%	S9100
123-1-2-6	3/28/03	28	117100	28.27	4140	104%	S9100

NOTE: Some information on this test report provided by others. Testing and reporting was conducted in general accordance with the following applicable A.S.T.M. references: C31, C109, C138, C143, C172, C173, C231, C495, C1019 & C1064

Supplier: AJ-Mix
Truck No.: 103
Ticket No.: 8342
Design Str.: 4000 psi
Product No.: 3000-C

Batch Time: 10:15 AM
Sample Time: 9:45 AM
Concrete Temp.: 82° °F
Ambient Temp.: 64° °F
Slump: 6.5 in.

Air Content: 2.3 %
Unit Weight: 145 pcf
Field Cured: 2 day(s)
Sample Type: Cylinder
Sample Size: 6 in. dia.

REMARKS: none
first cage broke
during placement
used another

Copies To:
Cage Construction
Jungle Jazz Architects
Newt Holdings
Major Mix
City of Fort Collins
Grandview Metropolitan

TYPES OF FRACTURE

A Cone | B Cone & Split | C Cone & Shear | D Shear | E Columnar

By: _____

Assignment No. 1

NOTICE: [redacted] considers the data and information contained in this report to be proprietary. This information is intended only for the use of the recipient(s) named herein. Test results presented herein relate only to those items tested. This document and any information contained herein shall not be disclosed and shall not be duplicated or used in whole or in part for any purpose other than to validate test results without written approval from [redacted]

Section 1004 (Portland Cement Concrete Mixtures)

- Nomenclature of concrete grades changed
- Now using concrete compressive strength (psi) system

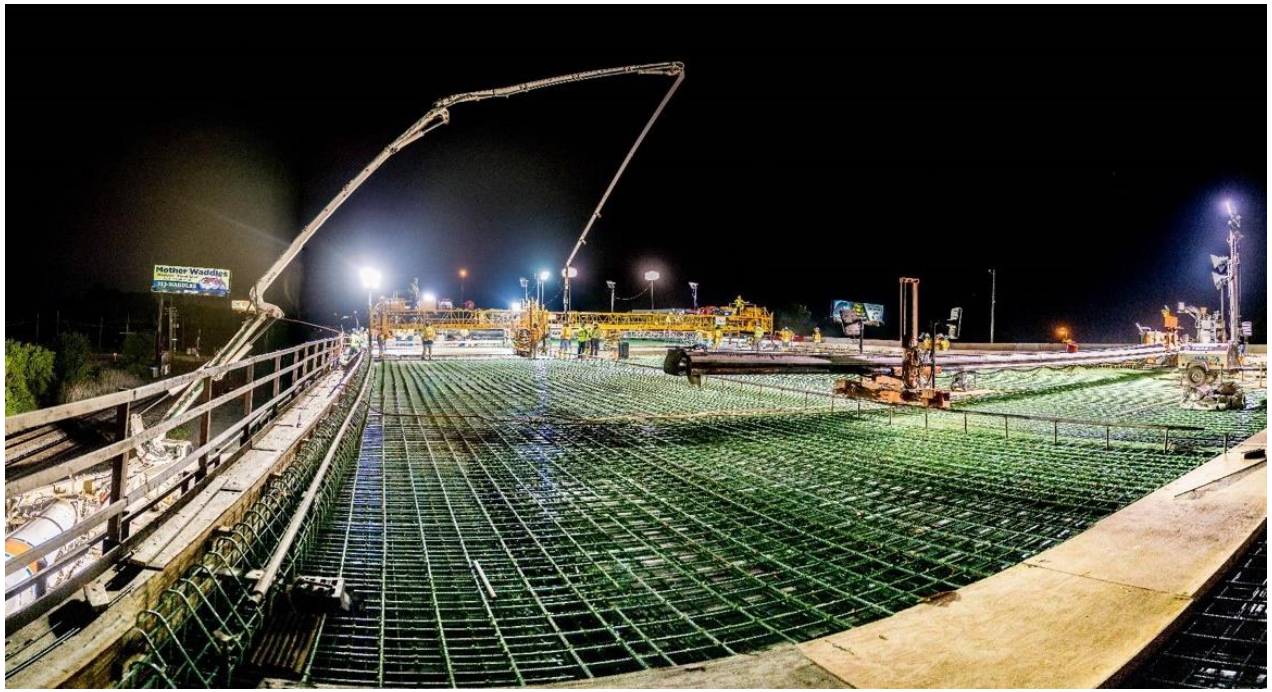
Section 1004 (Portland Cement Concrete Mixtures)

Nomenclature has changed to strength classificiation:

- P1 (Concrete Pavement) is now 3500
- P2 (Concrete Shoulders) is now 3000
- P1M (High Performance Concrete Pavement) is now 3500HP
- D (Bridge Deck / Railing) is now 4500
- DM (High Performance Bridge Deck / Railing) is now 4500HP
- P-NC (Concrete Pavement Repair) will stay as P-NC; Minimum 7-sack, maximum 8-sack (for air temps <50F); Non-chloride still optional; 300 psi flexural opening strength; 28-day cylinders not necessary

Section 1004 (Portland Cement Concrete Mixtures)

- T (Tremie) is now 3500
- S1 (Foundation/Piles) is now 4000
- S2 (Bridge Structure, Curb & Gutter, Driveways) is now 3500
- S2M (High Performance Bridge Structure) is now 3500HP
- S3 (Sidewalks) is now 3000
- M (Commercial Concrete) and X both stay as-is



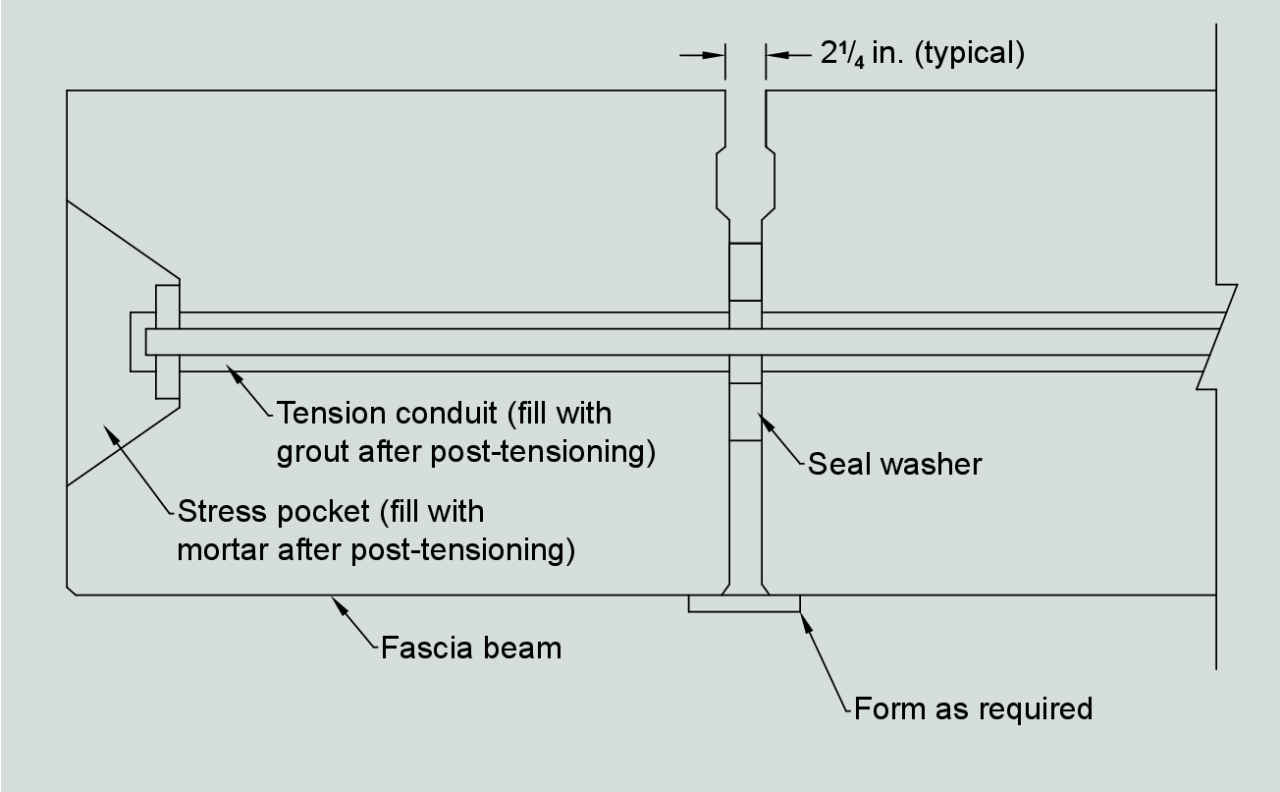
Section 1004 (Portland Cement Concrete Mixtures)

Nomenclature Summary:

New	3000	3500	3500HP	4000	4500	4500HP	P-NC
Old	S3, P2	P1, S2, T	P1M, S2M	S1	D	DM	P-NC
Used for	Sidewalks Shoulders	Pavement Curb & Gutter Driveways Bridge Substructure	High Performance Concrete Pavements High Performance Concrete Curb & Gutter	Foundations Piles	Bridge Decks Bridge Railing	High Performance Bridge Decks Concrete Barrier Wall	Full Depth Concrete Pavement Repairs

Section 1005 (Mortar and Grout)

- Section 702 moved to section 1005
- No change

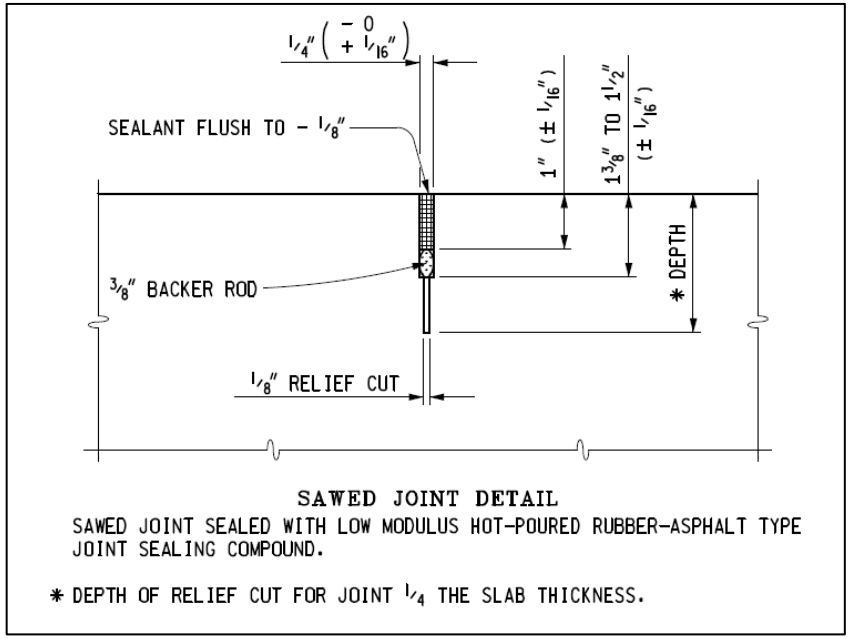


Section 1006 (Patching, Repair, and Overlay Mixtures)

- P-NC does **not** require 28-day compressive strength test cylinders
- When opening to traffic strength (300 psi flexural) is reached, the patch/repair is accepted and payment is to be made

What Hasn't Changed in the New Spec Book?

- ASR testing of sand sources – good for two years
- Any pumped concrete requires optimization of aggregates
- Optimization requirements (MQAP 3.09)
- JMF Form 1976 submittals / reviews
- Air loss testing
- Testing personnel certification requirements
- QC Plan requirements
- Joint seal recess requirements →



SAWED JOINT DETAIL

SAWED JOINT SEALED WITH LOW MODULUS HOT-POURED RUBBER-ASPHALT TYPE JOINT SEALING COMPOUND.

* DEPTH OF RELIEF CUT FOR JOINT 1/4 THE SLAB THICKNESS.

Summary of What's New with MDOT's 2020 Spec Book

- New Division in the Spec Book: Division 10 – Concrete Materials
- Nomenclature (Grades of Concrete) now in terms of compressive strength
- Lane tie pull-out only required for adhesive-anchored bars
- New pay item for "Curb Ramp Opening, Conc"
- Minor tweaks to Haul Time, Spall Repair, Joint Cleaning, Cold Weather

Questions?

swaalkes@miconcrete.net

616-633-9629