Illinois Tollway
2700 Ogden Avenue
Downers Grove, Illinois 60515-1703
630-241-6800
Fax 630-241-6105

To: IRTBA **Date:** November 13, 2012

From: Steven L. Gillen, Materials Manager

Re: **Strength Data on Illinois Tollway Black Rock Concrete**

As requested, attached for distribution to your members is mix design information and strength data for the Illinois Tollway black rock concrete that has been placed to date. The placements have been in 2012 on the I-88 reconstruction contract in Aurora, and on the Milwaukee Avenue ramp reconstruction project on the North Tri-State in 2010. Note that the construction contract mix designs are proprietary.

Also attached are the performance based special provision for the black rock concrete mix design, and the special provision for the composite concrete pavement.

Further details about black rock concrete mix properties are available in the publication "Fractionated Reclaimed Asphalt Pavement (FRAP) as a Coarse Aggregate Replacement in a Ternary Blended Concrete Pavement," Illinois Center for Transportation Research Report ICT-12-008. This report fully describes the black rock research the Tollway has conducted through the Illinois Center for Transportation, including test results of numerous trial batches conducted for the research. The report is available on the ICT website using this link:

http://ict.illinois.edu/publications/report%20files/ICT-12-008.pdf

Also attached are details of the latest plant trial mix designs and strength data for black rock concrete produced for ICT composite pavement research. There mixes were produced at a local concrete plant and used to cast two-lift slabs for load testing. All lab and plant trial mixes produced for ICT research used Chicago-area virgin aggregates, and coarse FRAP taken from various locations on I-90.

cc: Paul Kovacs, Greg Stukel, Pete Foernssler

Illinois Tollway

A-30

Concrete Mix Design Report

DESIGN DATE 5/2/2012 **IL Tollway Contract No.**

PROJECT LOC **SUPPLIER'S MIX No.** 4094

CONTRACTOR **SUPPLIER** OZINGA

PLANT LOC **PLANT IDOT CODE No.**

IL Tollway Mix No. **IL Tollway Class of Concrete** FRAP MIX

SPECIFIED COMPRESSIVE STRENGTH (psi): 2850/3500 **AT** 5/14 **DAYS**

SPECIFIED SLUMP RANGE (inches): 1-3" **SPECIFIED AIR CONTENT (%) :** 5-8%

☐ **ACCEPTED**

☐ **ACCEPTED AS NOTED**

☐ **REJECTED AS NOTED**

NAME:

Illinois Tollway Materials Engine

DATE:

MATERIAL DESCRIPTION AND SPECIFICATIION		WEIGHT PER ONE CUBIC YARD (SSD)
CEMENT Type:	BUZZI - FESTUS	
CEMENT Source & Code No.:	6097-06	
		CEMENT Proportion (lbs.):
FLY ASH Class:	LAFARGE PLEASANT PRAIRIE	
FLY ASH Source & Code No.:	52403-02	
		FLY ASH Proportion (lbs.):
Additional Pozzolan Type:	SLAG - HOLCIM S. CHICAGO	
Pozzolan Source & Code No.:	544-07	
		Additional Pozzolan Proportion (lbs.):
Additional Pozzolan Type:		
Pozzolan Source & Code No.:		
		Additional Pozzolan Proportion (lbs.):
FINE AGGREGATE Grade/Description:	027FM02	
FINE AGGREGATE Quality Class:	A **Absorption:** 1.7	
FINE AGGREGATE Source & Code No.:	LAFARGE ELBURN 50890-27	
		FINE AGGREGATE Proportion (lbs.):
COARSE AGG. #1 Grade/Description:	022CM11	
COARSE AGG. #1 Quality Class:	A **Absorption:** 1.3	
COARSE AGG. #1 Source & Code No.:	LAFARGE CONCO 50892-01	
		COARSE AGGREGATE #1 Proportion (lbs.):
COARSE AGG. #2 Grade/Description:	PCIFRA02	
COARSE AGG. #2 Quality Class:	**Absorption:**	
COARSE AGG. #2 Source & Code No.:	PLOTE BARTLETT 50435-06	
		COARSE AGGREGATE #2 Proportion (lbs.):
ADDED WATER Quality Description:	POTABLE	
		TOTAL WATER Proportion (lbs.):
WATER REDUCER ADMIXTURE ASTM Designation:	ASTM C494 TYPE A	
WATER REDUCER ADMIXTURE Source:	GRACE MIRA 110 43870	
		WATER REDUCER ADMIXTURE Proportion (Fl. Oz.):
AIR ENTRAINING ADMIXTURE ASTM Designation:	ASTM C260	
AIR ENTRAINING ADMIXTURE Source:	GRACE DARAVAIR 1400 42147	
		AIR ENTRAINING ADMIXTURE Proportion (Fl. Oz.):
ADDITIONAL ADMIXTURE Description:		
ADDITIONAL ADMIXTURE ASTM Designation:		
ADDITIONAL ADMIXTURE Source:		
		ADDITONAL ADMIXTURE Proportion (Unit):
ADDITIONAL ADMIXTURE Description:		
ADDITIONAL ADMIXTURE ASTM Designation:		
ADDITIONAL ADMIXTURE Source:		
		ADDITONAL ADMIXTURE Proportion (Unit):

Black Rock is 21% of Coarse Aggregate Fraction

***Attach any trial mix or trial batch test data**

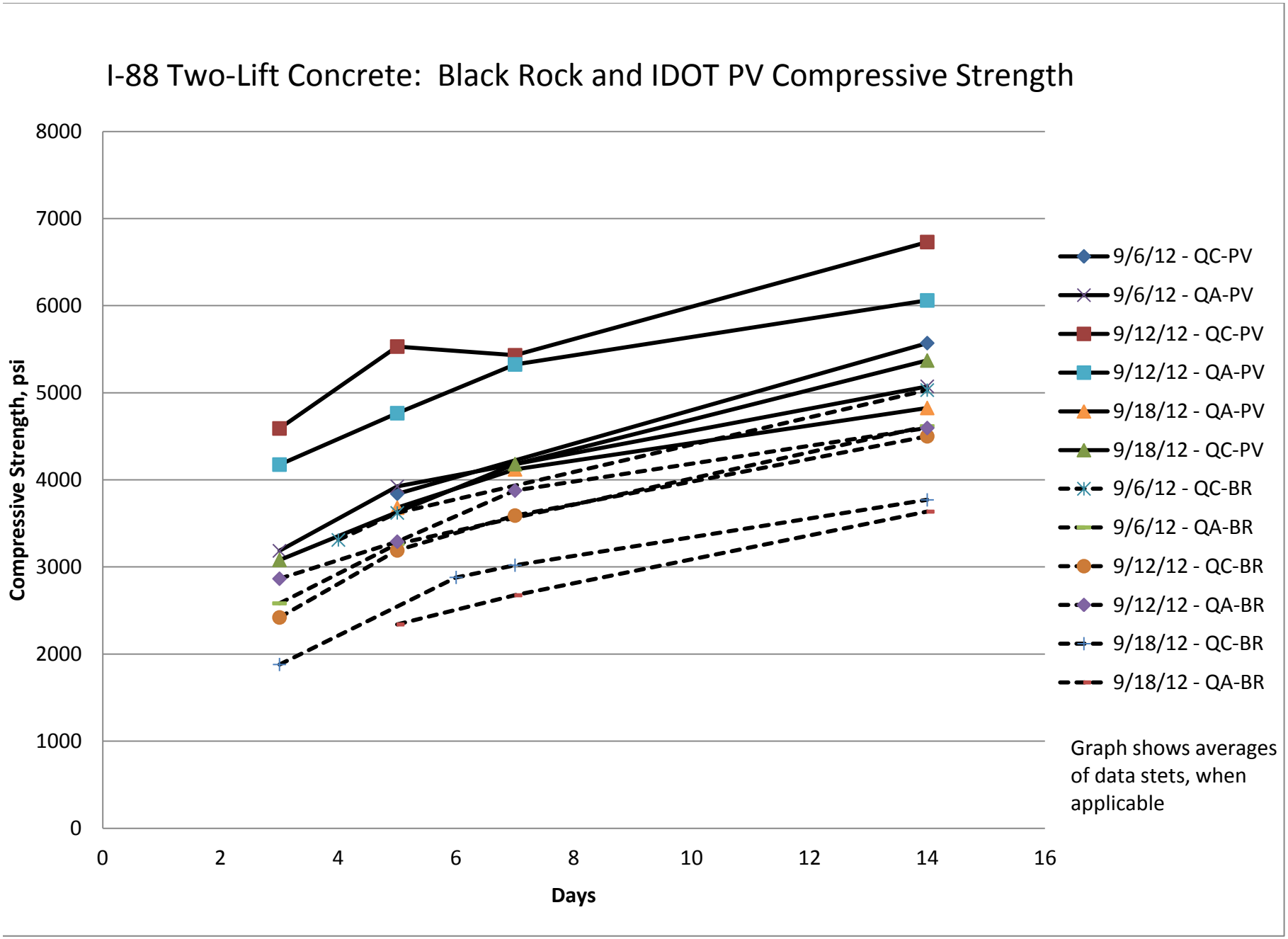
REMARKS:

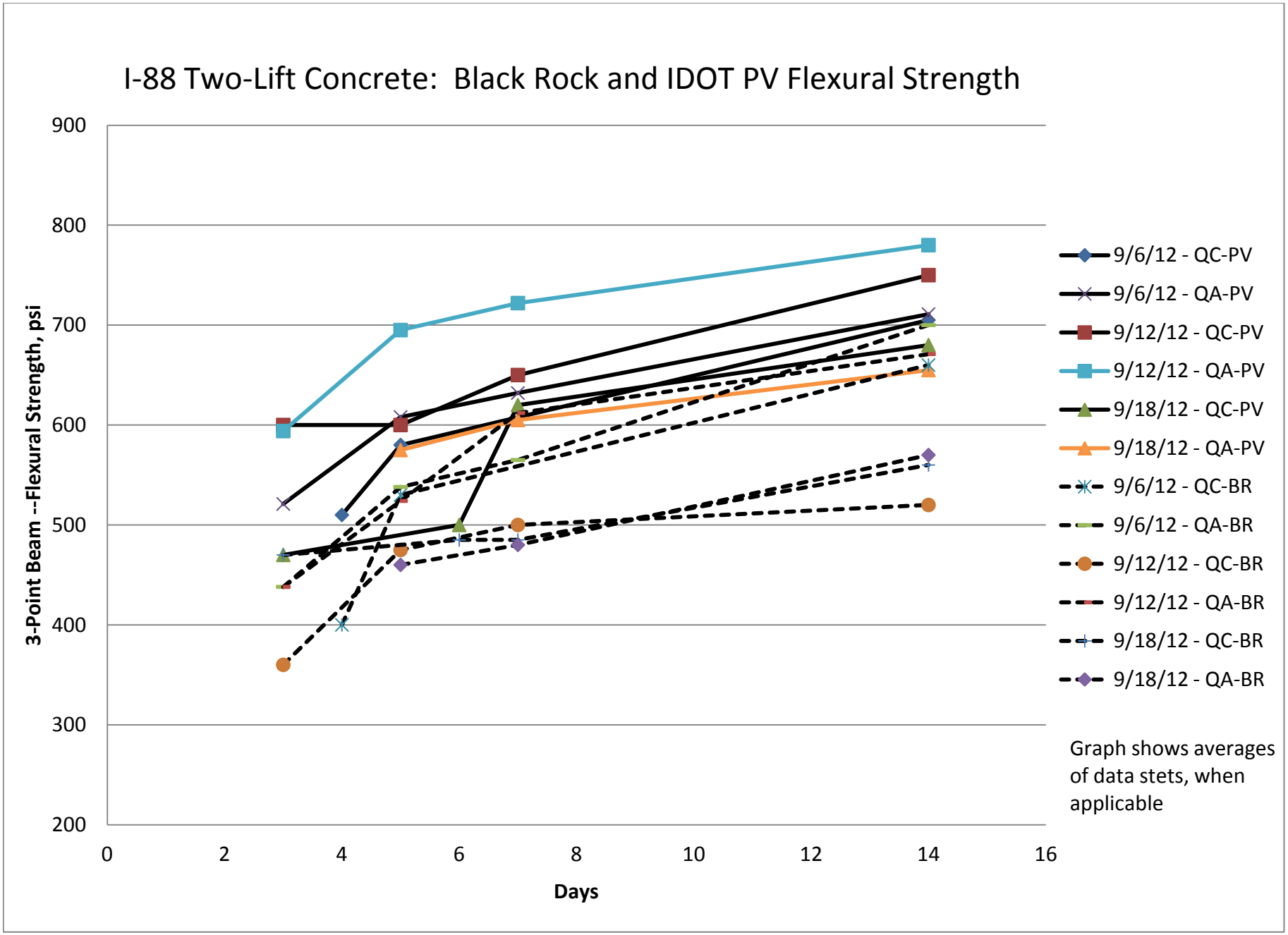
This submittal certifies that the materials to be used conform to the indicated specifications and are of the quality and gradation specified.

Designed by: _____ **(Signature)**

Title:

REV. 1/08


I-88 Two-Lift Concrete: Black Rock and IDOT PV Compressive Strength
Compressive Strength, psi
8000
7000
6000
5000
4000
3000
2000
1000
0
0
2
4
6
8
10
12
14
16
Days
9/6/12 - QC-PV
9/6/12 - QA-PV
9/12/12 - QC-PV
9/12/12 - QA-PV
9/18/12 - QA-PV
9/18/12 - QC-PV
9/6/12 - QC-BR
9/6/12 - QA-BR
9/12/12 - QC-BR
9/12/12 - QA-BR
9/18/12 - QC-BR
9/18/12 - QA-BR
Graph shows averages of data stets, when applicable


I-88 Two-Lift Concrete: Black Rock and IDOT PV Flexural Strength
3-Point Beam --Flexural Strength, psi
900
800
700
600
500
400
300
200
0
2
4
6
8
10
12
14
16
Days
9/6/12 - QC-PV
9/6/12 - QA-PV
9/12/12 - QC-PV
9/12/12 - QA-PV
9/18/12 - QC-PV
9/18/12 - QA-PV
9/6/12 - QC-BR
9/6/12 - QA-BR
9/12/12 - QC-BR
9/12/12 - QA-BR
9/18/12 - QC-BR
9/18/12 - QA-BR
Graph shows averages of data stets, when applicable

I-88 Two-Lift Concrete: IDOT PV Strengths

Date Cast	TestType	Set Number	Ages	Cyl/Beam	Mix	Strength, psi
9/6/2012	QC	1	5	C	PV	3840
9/6/2012	QC	1	14	C	PV	5570
9/6/2012	QC	1	4	B	PV	510
9/6/2012	QC	1	5	B	PV	580
9/6/2012	QC	1	14	B	PV	705
9/6/2012	QA	1	3	B	PV	565
9/6/2012	QA	1	5	B	PV	705
9/6/2012	QA	1	7	B	PV	730
9/6/2012	QA	1	14	B	PV	800
9/6/2012	QA	1	28	B	PV	830
9/6/2012	QA	1	3	C	PV	3540
9/6/2012	QA	1	5	C	PV	4740
9/6/2012	QA	1	14	C	PV	6260
9/6/2012	QA	2	3	B	PV	480
9/6/2012	QA	2	5	B	PV	545
9/6/2012	QA	2	7	B	PV	580
9/6/2012	QA	2	14	B	PV	670
9/6/2012	QA	2	28	B	PV	700
9/6/2012	QA	2	3	C	PV	3010
9/6/2012	QA	2	5	C	PV	3510
9/6/2012	QA	2	14	C	PV	4590
9/6/2012	QA	3	3	B	PV	510
9/6/2012	QA	3	5	B	PV	565
9/6/2012	QA	3	7	B	PV	590
9/6/2012	QA	3	14	B	PV	695
9/6/2012	QA	3	28	B	PV	730
9/6/2012	QA	3	3	C	PV	3230
9/6/2012	QA	3	5	C	PV	3630
9/6/2012	QA	3	14	C	PV	4815
9/6/2012	QA	4	3	B	PV	530
9/6/2012	QA	4	5	B	PV	615
9/6/2012	QA	4	7	B	PV	630
9/6/2012	QA	4	14	B	PV	680
9/6/2012	QA	4	28	B	PV	770
9/6/2012	QA	4	3	C	PV	2960
9/6/2012	QA	4	5	C	PV	3820
9/6/2012	QA	4	14	C	PV	4625
9/12/2012	QC	1	3	C	PV	4590
9/12/2012	QC	1	5	C	PV	5530
9/12/2012	QC	1	7	C	PV	5430
9/12/2012	QC	1	14	C	PV	6730
9/12/2012	QC	1	3	B	PV	600
9/12/2012	QC	1	5	B	PV	600
9/12/2012	QC	1	7	B	PV	650
9/12/2012	QC	1	14	B	PV	750

I-88 Two-Lift Concrete: IDOT PV Strengths

Date Cast	TestType	Set Number	Ages	Cyl/Beam	Mix	Strength, psi
9/12/2012	QA	1	3	B	PV	600
9/12/2012	QA	1	5	B	PV	690
9/12/2012	QA	1	7	B	PV	730
9/12/2012	QA	1	14	B	PV	785
9/12/2012	QA	1	28	B	PV	830
9/12/2012	QA	1	3	C	PV	4130
9/12/2012	QA	1	5	C	PV	4660
9/12/2012	QA	1	7	C	PV	5225
9/12/2012	QA	1	14	C	PV	5800
9/12/2012	QA	1	28	C	PV	6635
9/12/2012	QA	2	3	B	PV	560
9/12/2012	QA	2	5	B	PV	675
9/12/2012	QA	2	7	B	PV	685
9/12/2012	QA	2	14	B	PV	775
9/12/2012	QA	2	28	B	PV	830
9/12/2012	QA	2	3	C	PV	4220
9/12/2012	QA	2	5	C	PV	4930
9/12/2012	QA	2	7	C	PV	5425
9/12/2012	QA	2	14	C	PV	6320
9/12/2012	QA	2	28	C	PV	7020
9/12/2012	QA	3	3	B	PV	605
9/12/2012	QA	3	5	B	PV	655
9/12/2012	QA	3	7	B	PV	700
9/12/2012	QA	3	14	B	PV	760
9/12/2012	QA	3	28	B	PV	800
9/12/2012	QA	4	3	B	PV	610
9/12/2012	QA	4	5	B	PV	760
9/12/2012	QA	4	7	B	PV	775
9/12/2012	QA	4	14	B	PV	800
9/12/2012	QA	4	28	B	PV	840
9/18/2012	QC	1	3	C	PV	3080
9/18/2012	QC	1	7	C	PV	4180
9/18/2012	QC	1	14	C	PV	5370
9/18/2012	QC	1	3	B	PV	470
9/18/2012	QC	1	6	B	PV	500
9/18/2012	QC	1	7	B	PV	620
9/18/2012	QC	1	14	B	PV	680
9/18/2012	QA	1	5	B	PV	575
9/18/2012	QA	1	7	B	PV	605
9/18/2012	QA	1	14	B	PV	655
9/18/2012	QA	1	28	B	PV	700
9/18/2012	QA	1	5	C	PV	3680
9/18/2012	QA	1	7	C	PV	4120
9/18/2012	QA	1	14	C	PV	4825
9/18/2012	QA	1	28	C	PV	5705

I-88 Two-Lift Concrete: Black Rock Strengths

DateCast	TestType	Set Number	Ages	Cyl/Beam	Mix	Strength, psi
9/6/2012	QC	1	4	C	BR	3310
9/6/2012	QC	1	5	C	BR	3620
9/6/2012	QC	1	14	C	BR	5030
9/6/2012	QC	1	4	B	BR	400
9/6/2012	QC	1	5	B	BR	530
9/6/2012	QC	1	14	B	BR	660
9/6/2012	QA	1	3	B	BR	450
9/6/2012	QA	1	5	B	BR	550
9/6/2012	QA	1	7	B	BR	570
9/6/2012	QA	1	14	B	BR	700
9/6/2012	QA	1	28	B	BR	855
9/6/2012	QA	1	3	C	BR	2280
9/6/2012	QA	1	5	C	BR	2960
9/6/2012	QA	1	14	C	BR	3820
9/6/2012	QA	2	3	B	BR	435
9/6/2012	QA	2	5	B	BR	485
9/6/2012	QA	2	7	B	BR	510
9/6/2012	QA	2	14	B	BR	700
9/6/2012	QA	2	28	B	BR	770
9/6/2012	QA	2	3	C	BR	2680
9/6/2012	QA	2	5	C	BR	3380
9/6/2012	QA	2	14	C	BR	4900
9/6/2012	QA	3	3	B	BR	400
9/6/2012	QA	3	5	B	BR	515
9/6/2012	QA	3	7	B	BR	535
9/6/2012	QA	3	14	B	BR	655
9/6/2012	QA	3	28	B	BR	740
9/6/2012	QA	3	3	C	BR	2650
9/6/2012	QA	3	5	C	BR	3330
9/6/2012	QA	3	14	C	BR	4690
9/6/2012	QA	4	3	B	BR	465
9/6/2012	QA	4	5	B	BR	600
9/6/2012	QA	4	7	B	BR	645
9/6/2012	QA	4	14	B	BR	740
9/6/2012	QA	4	28	B	BR	805
9/6/2012	QA	4	3	C	BR	2720
9/6/2012	QA	4	5	C	BR	3390
9/6/2012	QA	4	14	C	BR	5055
9/12/2012	QC	1	3	C	BR	2420
9/12/2012	QC	1	5	C	BR	3190
9/12/2012	QC	1	7	C	BR	3590
9/12/2012	QC	1	14	C	BR	4500
9/12/2012	QC	1	3	B	BR	360
9/12/2012	QC	1	5	B	BR	475

I-88 Two-Lift Concrete: Black Rock Strengths

DateCast	TestType	Set Number	Ages	Cyl/Beam	Mix	Strength, psi
9/12/2012	QC	1	7	B	BR	500
9/12/2012	QC	1	14	B	BR	520
9/12/2012	QA	1	3	B	BR	430
9/12/2012	QA	1	5	B	BR	510
9/12/2012	QA	1	7	B	BR	600
9/12/2012	QA	1	14	B	BR	680
9/12/2012	QA	1	28	B	BR	805
9/12/2012	QA	1	3	C	BR	3230
9/12/2012	QA	1	5	C	BR	3645
9/12/2012	QA	1	7	C	BR	4120
9/12/2012	QA	1	14	C	BR	4960
9/12/2012	QA	1	28	C	BR	6210
9/12/2012	QA	2	3	B	BR	445
9/12/2012	QA	2	5	B	BR	535
9/12/2012	QA	2	7	B	BR	615
9/12/2012	QA	2	14	B	BR	660
9/12/2012	QA	2	28	B	BR	750
9/12/2012	QA	2	3	C	BR	2440
9/12/2012	QA	2	5	C	BR	2935
9/12/2012	QA	2	7	C	BR	3655
9/12/2012	QA	2	14	C	BR	4230
9/12/2012	QA	2	28	C	BR	4980
9/12/2012	QA	3	3	B	BR	435
9/12/2012	QA	3	5	B	BR	565
9/12/2012	QA	3	7	B	BR	650
9/12/2012	QA	3	14	B	BR	690
9/12/2012	QA	3	28	B	BR	775
9/12/2012	QA	4	3	B	BR	440
9/12/2012	QA	4	5	B	BR	485
9/12/2012	QA	4	7	B	BR	585
9/12/2012	QA	4	14	B	BR	655
9/12/2012	QA	4	28	B	BR	790
9/18/2012	QC	1	3	C	BR	1880
9/18/2012	QC	1	6	C	BR	2880
9/18/2012	QC	1	7	C	BR	3020
9/18/2012	QC	1	14	C	BR	3770
9/18/2012	QC	1	3	B	BR	470
9/18/2012	QC	1	6	B	BR	485
9/18/2012	QC	1	7	B	BR	485
9/18/2012	QC	1	14	B	BR	560
9/18/2012	QA	1	5	B	BR	460
9/18/2012	QA	1	7	B	BR	480
9/18/2012	QA	1	14	B	BR	570
9/18/2012	QA	1	28	B	BR	655

I-88 Two-Lift Concrete: Black Rock Strengths

DateCast	TestType	Set Number	Ages	Cyl/Beam	Mix	Strength, psi
9/18/2012	QA	1	5	C	BR	2340
9/18/2012	QA	1	7	C	BR	2675
9/18/2012	QA	1	14	C	BR	3635
9/18/2012	QA	1	28	C	BR	4870

Illinois State Toll Highway Authority

A-30

Concrete Mix Design Report

DESIGN DATE 10/12/2010 **ISTHA CONTRACT No.** RR-10-5609

PROJECT LOC Milwaukee Ave & I94 Gurnee **SUPPLIER'S MIX No.**

CONTRACTOR Alliance Cont **SUPPLIER** Meyer Material Company Yard #21

PLANT LOC North Chicago, IL **PLANT IDOT CODE No.** 1291-23

ISTHA MIX NO. **ISTHA CLASS OF CONCRETE** SI

SPECIFIED COMPRESSIVE STRENGTH (psi): 3500 **AT** 14 **DAYS AGE**

SPECIFIED SLUMP RANGE (inches): 1-4 **SPECIFIED AIR CONTENT (%) :** 5-8

☐ **ACCEPTED**

☐ **ACCEPTED AS NOTED**

☐ **REJECTED AS NOTED**

NAME: **ISTHA MATERIALS ENGINEER**

DATE:

MATERIAL DESCRIPTION AND SPECIFICATIION		WEIGHT PER ONE CUBIC YARD (SSD)
CEMENT Type:	ASTM C-150 (Type I/II)	
CEMENT Source & Code No.:	Holcim Saint Genevieve 544-09	
	CEMENT Proportion (lbs.):	
FLY ASH Class:	ASTM C-618 (Class C)	
FLY ASH Source & Code No.:	Lafarge North America (Pleasant Prairie) 52403-04	
	FLY ASH Proportion (lbs.):	
Additional Pozzolan Type:		
Pozzolan Source & Code No.:		
	Additional Pozzolan Proportion (lbs.):	
Additional Pozzolan Type:		
Pozzolan Source & Code No.:		
	Additional Pozzolan Proportion (lbs.):	
FINE AGGREGATE Grade/Desription:	027FM02	
FINE AGGREGATE Quality Class:	**Absorption:** 2.66	
FINE AGGREGATE Source & Code No.:	Meyer McH 51110-11	
	FINE AGGREGATE Proportion (lbs.):	
COARSE AGG. #1 Grade/Desription:	022CM11	
COARSE AGG. #1 Quality Class:	**Absorption:** 2.72	
COARSE AGG. #1 Source & Code No.:	Fox River Stone 50892-02	
	COARSE AGGREGATE #1 Proportion (lbs.):	
COARSE AGG. #2 Grade/Desription:	Ill State Tollway Authority/Rock Road Janesville	Black Rock is 30% of Coarse Aggregate Fraction
COARSE AGG. #2 Quality Class:	**Absorption:** 2.55	
COARSE AGG. #2 Source & Code No.:		
	COARSE AGGREGATE #2 Proportion (lbs.):	
ADDED WATER Quality Description:	Potable	
	TOTAL WATER Proportion (lbs.):	
WATER REDUCER ADMIXTURE ASTM Designation:	Sika 161	
WATER REDUCER ADMIXTURE Source:	43714	
	WATER REDUCER ADMIXTURE Proportion (Fl. Oz.):	
AIR ENTRAINING ADMIXTURE ASTM Designation:	Sika AEA 15	
AIR ENTRAINING ADMIXTURE Source:	42142	
	AIR ENTRAINING ADMIXTURE Proportion (Fl. Oz.):	
ADDITIONAL ADMIXTURE Description:		
ADDITIONAL ADMIXTURE ASTM Designation:		
ADDITIONAL ADMIXTURE Source:		
	ADDITONAL ADMIXTURE Proportion (Unit):	
ADDITIONAL ADMIXTURE Description:		
ADDITIONAL ADMIXTURE ASTM Designation:		
ADDITIONAL ADMIXTURE Source:		
	ADDITONAL ADMIXTURE Proportion (Unit):	

***Attach any trial mix or trial batch test data**

REMARKS:

This submittal certifies that the materials to be used conform to the indicated specifications and are of the quality and gradation specified.

Designed by: Brent Blankenhorn
(Signature)

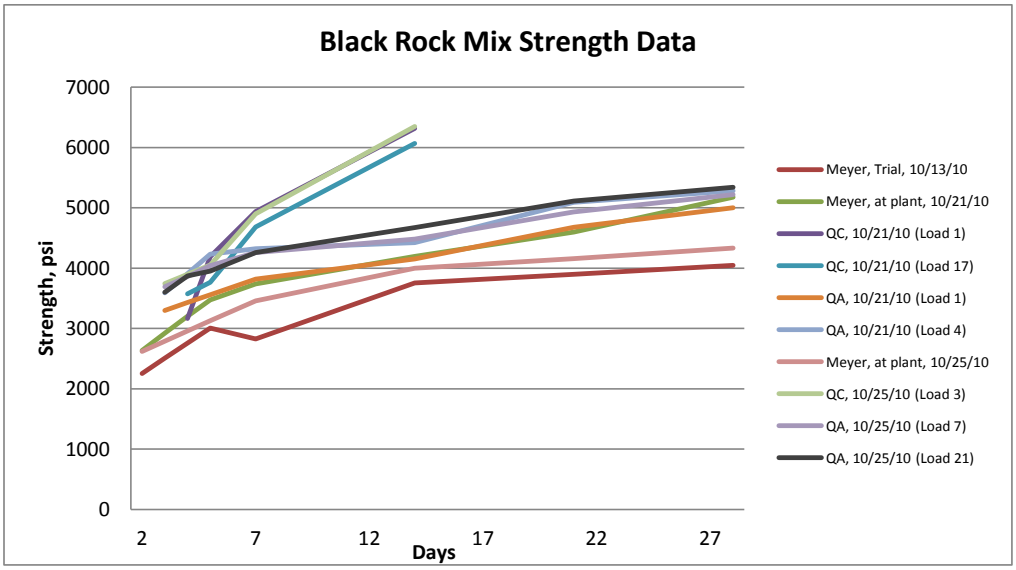
Title: Quality Control Technician

REV. 8/02

Concrete Test Results. "Black Rock" mix (90PCC1004), placed on Milwaukee Avenue Ramp

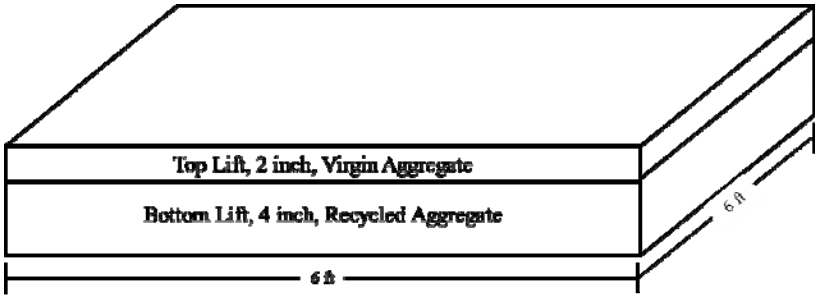
Data Source:	Meyer, Trial, 10/13/10	Meyer, at plant, 10/21/10	QC, 10/21/10 (Load 1)	QC, 10/21/10 (Load 17)	QA, 10/21/10 (Load 1)	QA, 10/21/10 (Load 4)	Meyer, at plant, 10/25/10	QC, 10/25/10 (Load 3)	QA, 10/25/10 (Load 7)	QA, 10/25/10 (Load 21)
Days	Strength	Strength	Strength	Strength	Strength	Strength	Strength	Strength	Strength	Strength
2	**2256**	**2635**					**2620**			
3					**3300**	**3590**		**3745**	**3690**	**3600**
4		**3202**	**3165**	**3575**						
5	**3009**		**4190**	**3765**		**4230**		**4050**	**4040**	**3950**
7	**2828**	**3738**	**4935**	**4685**	**3820**	**4320**	**3457**	**4900**	**4260**	**4260**
14	**3754**	**4196**	**6315**	**6065**	**4150**	**4420**	**3998**	**6350**	**4480**	**4670**
21						**5090**			**4930**	**5110**
28	**4045**	**5175**			**5000**	**5280**	**4330**		**5220**	**5340**
Air, %:	7.4	7.6	6.2	5.1	6.2	5.5	8.2	7.1	5.7	5.2
Slump, In.:	2.5	1.75	1.75	1	1.5	1	2	1.5	1.5	1.25
Conc temp, F:	68	58	64	65	64	64	62	67	67	71

Cylinder Curing: Meyer-Lab
QC- unsure
QA-Lab



- Additional ICT black rock research includes casting slabs and loading them to evaluate the properties of single lift and two-lift construction.
- The following information are the results of those slab mix properties.

Slab Casting



- Full depth:
  - Virgin aggregate
  - 45% FRAP
  - 100% RCA
  - 45-55 FRAP-RCA
- Two-lift:
  - Virgin over 45% FRAP
  - Virgin over 45% FRAP (with fibers)
  - Virgin over 100% RCA
  - Virgin over 45-55 FRAP-RCA

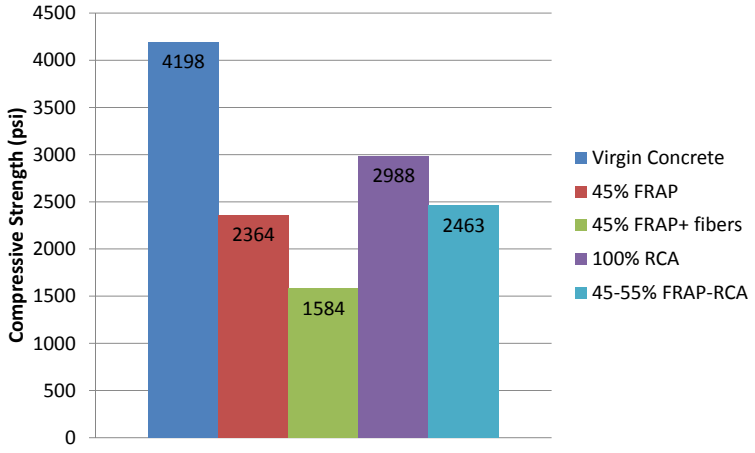
Slab Casting – Mix Designs

55%
35%
10%

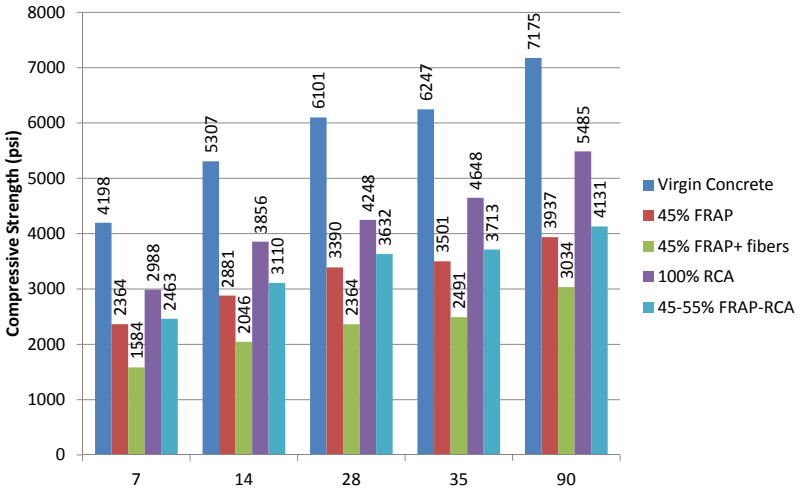
	Virgin Mix	45% FRAP	100% RCA	45-55% FRAP-RCA
Total Cementitious	610.0	610.0	610.0	610.0
Cement	335.5	335.5	335.5	335.5
Slag	213.5	213.5	213.5	213.5
Fly Ash	61.0	61.0	61.0	61.0
Total Coarse Aggregate (SSD)	1867.9	1822.3	1696.2	1724.9
Virgin Coarse Aggregate, CA11 (SSD)	1307.5	1002.3	0.0	0.0
Virgin Intermediate Aggregate, CA16 (SSD)	560.4	0.0	0.0	0.0
FRAP (SSD)	0.0	820.0	0.0	776.2
RCA (SSD)	0.0	0.0	1696.2	948.7
Virgin Fine Aggregate (SSD)	1216.9	1216.9	1216.9	1216.9
Water	226.4	226.4	226.4	226.4

w/cm = 0.37

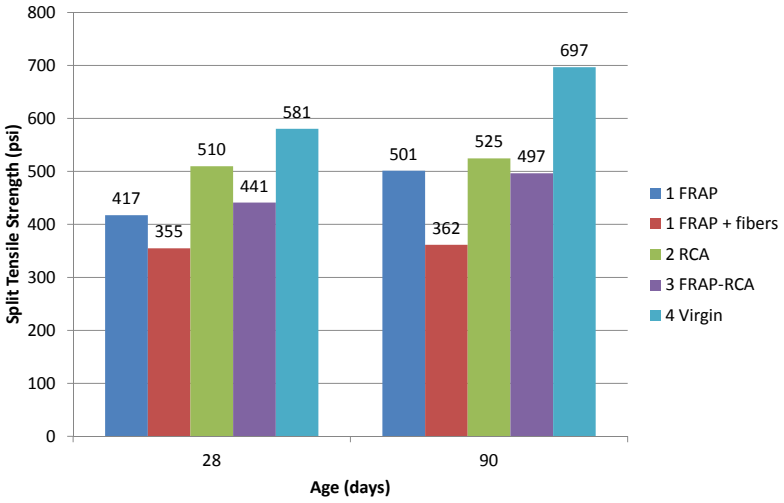
Slab Casting – 7-Day Compression



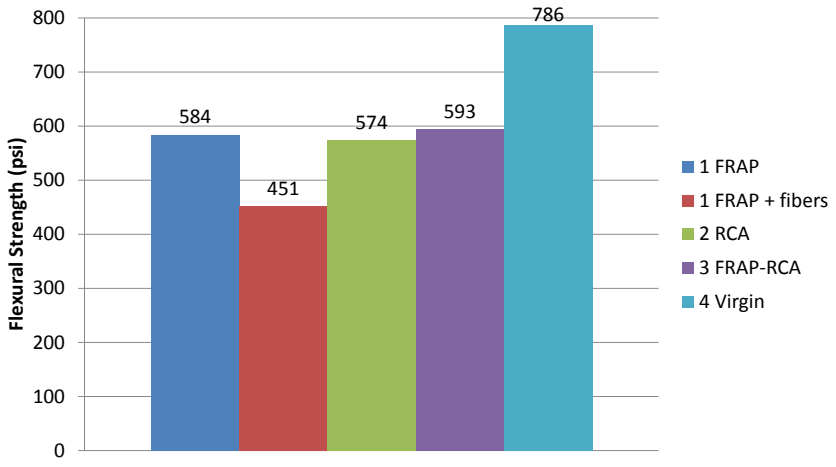
Compressive Strength



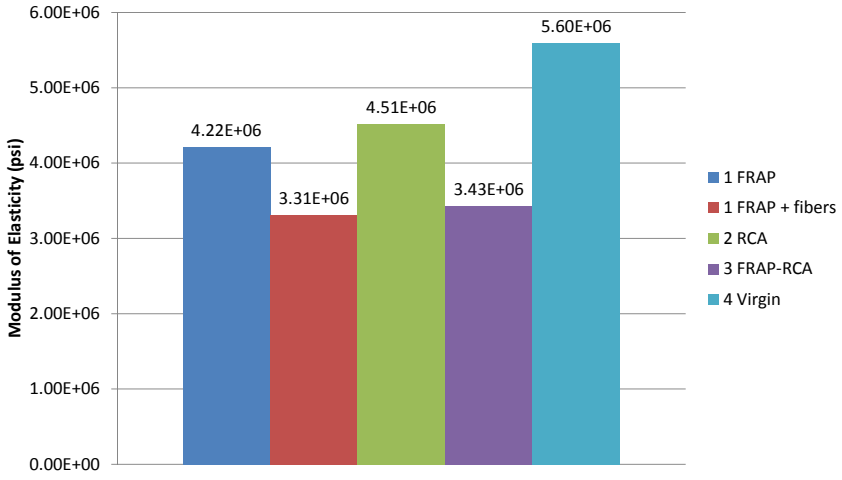
Split Tensile Strength



Flexural Strength (~35 days)



Modulus of Elasticity (~35 days)



PERFORMANCE RELATED SPECIAL PROVISION FOR TERNARY CONCRETE MIX DESIGNS FOR COMPOSITE PAVEMENTS (Tollway)

Effective: January 30, 2012
Revised: October 19, 2012

DESCRIPTION

This work consists of designing and furnishing ternary portland cement concrete for special applications to composite pavements. The objective of this performance related special provision is to provide the Illinois Tollway with a methodology to assure high quality concrete, while simultaneously allowing the Contractor the maximum freedom in deciding how to develop the mix design and place the concrete.

Ternary concrete refers to concrete that incorporates hydraulic portland cement, ground granulated blast furnace slag, fly ash and other supplementary cementitious materials (SCM) as cementitious constituent materials. A Type IT blended cement in accordance with AASHTO M 240 shall be acceptable. A Type IP or IS blended cement in accordance with AASHTO M 240 may be used when an SCM is combined as a constituent material to produce a ternary mix. Slag, fly ash, and any other SCM's combined as constituent materials in a mix or as part of a blended cement may consist of no less than 35% and no more than 50% of the total cementitious material in any mix design.

Composite pavement refers to a pavement that consists of multiple flexible and rigid layers or multiple rigid layers bonded together without separation. This special provision applies to the lower lift of a concrete composite pavement of multiple rigid layers.

REFERENCE STANDARDS

Except where modified by the Illinois Department of Transportation or the Tollway, the following Standards shall apply:

Illinois Department of Transportation (IDOT)

- Standard Specifications for Road and Bridge Construction, Adopted January 1, 2012.
- Supplemental Specifications and Recurring Special Provisions, Current Edition.
- Tollway Supplemental Specifications to the Illinois Department of Transportation Standard Specifications for Road and Bridge Construction, Current Edition.
- Test Procedures referenced herein, as described in the current edition of the Manual of Test Procedures for Materials, as well these test procedures:

    - AASHTO T 105 Chemical Analysis of Hydraulic Cement
    - AASHTO T 196 Air Content of Freshly Mixed Concrete by the Volumetric Method

- ASTM C 457 Microscopical Determination of Parameters of the Air-Void System in Hardened Concrete
- ASTM C 856 Petrographic Examination of Hardened Concrete
- ASTM C 1293 Determination of Length Change of Concrete Due to Alkali-Silica Reaction
- AASHTO T 161 Procedure A Modified Resistance of Concrete to Rapid Freezing and Thawing

REQUIREMENTS

Contractor shall provide a concrete mix design according to the following performance requirements. The testing shall be performed by an AASHTO-accredited laboratory.

Laboratory trials shall initially be performed by the Contractor to determine the basic strength, slump and air content properties of a mix. Once mixture proportions are determined through laboratory trials, a plant trial batch of the proposed mix design shall be required, and the trial mix shall be sampled and tested to confirm that the required properties listed below are obtained. The Contractor is required to contact the Engineer a minimum of 2 days prior to any plant trial batch mixing so that a Tollway representative can observe the process. The same 2-day notification is required prior to any physical testing on hardened concrete samples.

Compressive Strength

Interim compressive strength for opening to construction traffic shall be a minimum of 2,850 psi as tested in accordance with AASHTO T22 for both lifts of concrete at no less than 5 days of age.

Interim compressive strength of the bottom lift concrete for opening to public traffic shall be 3,200 psi at no less than 14 days age after the top lift concrete has obtained an interim compressive strength of 3,500 psi.

Ultimate compressive strength shall not be less than 3500 psi at 28 days. Test cylinders shall be made and cured in accordance with AASHTO T 23. Test results will also be presented at 7 and 14 days.

Flexural Strength

Interim flexural strength for opening to construction traffic shall be a minimum of 450 psi as tested in accordance with AASHTO T97 for both lifts of concrete at no less than 5 days of age.

Interim flexural strength for opening to public traffic shall be 575 psi at no less than 14 days age after the top lift concrete has obtained an interim flexural strength of 650 psi.

Ultimate flexural strength using AASHTO T97 for third point loading shall be 650 psi at 28 days, with test results also presented at 5, 7, and 14 days.

Plastic Air Content

Plastic Air Content determined using AASHTO T 152 test method shall be from 5.0 to 8.0 percent.

Hardened Air Content

Air-void system having the following characteristics as determined by ASTM C 457:

- Spacing factor not exceeding 0.008-in.
- Specific surface not less than 630 in^2/in^3
- Total air content not less than 4.0 percent

Slump

For slipform concrete pavement placement, place the concrete with a slump value that optimizes placement, except ensure the concrete does not slough or slump and is adequately consolidated and meets all other requirements. Maintain the concrete at a uniform consistency.

Slump range for formed or manual placement shall be 2 to 4 inch.

Alkali – Silica Reaction

Concrete shall be proportioned such that the maximum total alkali content contributed by Portland cement (as determined in accordance with AASHTO T 105) shall not exceed 5 lb/yd^3.

MATERIALS

Portland cement, mixing water, fine and coarse aggregates, supplementary cementitious materials, and concrete admixtures shall conform to the requirements of Section 1000 of Illinois Department of Transportation *Standard Specifications for Road and Bridge Construction*, Current Edition. Specific references are as follows:

Material	Section
Portland Cement	1001
Mixing Water	1002
Fine Aggregates (See Note 1)	1003
Coarse Aggregates (See Notes 1 & 2)	1004
Supplementary Cementitious Materials(See Note 3)	1010
Concrete Admixtures	1021
Other Materials	see Note 4

Note 1: Fine and coarse aggregate requirements shall be per the intended pavement application.

Note 2: Fractionated Reclaimed Asphalt Pavement (FRAP) or Recycled Concrete Aggregate (RCA) used as an aggregate source as allowed for the intended pavement application shall be in accordance with the Tollway special provisions for Coarse Aggregate for Composite Concrete Pavement.

Note 3: Blended cement shall be according to AASHTO M 240 with no additional restrictions. Blended cements with a percentage of supplementary cementitious materials differing by more than 5% shall be considered different cementitious materials. If a blended cement is used in a mix, a certification of compliance shall be provided and include a statement signed by the blended cement supplier that indicates the actual percentage by weight of supplementary cementitious materials in the blend. No more than 15% by weight of a cement shall consist of any processing addition. No more than 15% by weight of a cement shall consist of ground limestone.

Note 4: Fibrous reinforcement shall be permitted provided the material is used in accordance with the product manufacturer's recommendations and it is demonstrated that the concrete complies with the herein established performance requirements.

MIX GRADATION

The mixture for the bottom layer of a composite pavement shall contain coarse aggregate with no less than 15 percent of the coarse aggregate being a recycled aggregate in accordance with the contract special provision for Coarse Aggregate for Composite Portland Cement Concrete Pavement. The maximum amount of recycled coarse aggregate from an approved FRAP source allowed in a mixture may be 50 percent of the total coarse aggregate. The maximum amount of recycled coarse aggregate from an approved recycled concrete source allowed in a mixture may be 100 percent of the total coarse aggregate, or the percentage needed to make up for the

remaining amount of coarse aggregate needed in any mix containing 50% or less coarse FRAP aggregate. Fine virgin aggregate sources used in the mix shall be in accordance with Article 1003.02, and shall be FM-01 or FM-02 gradation. Coarse virgin aggregate sources used in the mix shall be in accordance with Article 1004.02, and shall be a combination of any gradation specified in Article 1004.1(c) of the Standard Specifications needed to obtain the desired blended aggregate gradation. The virgin and recycled aggregates used in the recycled mixture shall be blended to produce a combined aggregate gradation that complies with the following:

AGGREGATE BLEND FOR THE RECYCLED MIX
Percent by weight passing

Sieve Size	% Passing
1 in.	**100**
¾ in.	**88 - 98**
⅝ in.	**78 - 90**
½ in.	**66 – 86**
⅜ in.	**50 – 75**
# 4	**40 – 52**
# 8	**33 – 43**
# 16	**25 - 35**
# 30	**15 – 25**
# 50	**5 – 15**
#100	**1 – 8**
#200	**1.0 – 6.0**

This gradation specification may be used with virgin only aggregate sources to develop a special ternary concrete mix design for the upper lift of a multi-lift rigid pavement.

MIX SUBMITTAL

Submittal shall include:

1. Mix design, showing:
    a. Quantities, description, sources and mill certifications of all mix ingredients
    b. Design water-cementitious materials ratio (w/cm)
    c. Design Slump
    d. Design Air content
    e. Gradation and absorption of all aggregates
    f. Bulk specific gravity (SSD) of all cementitious materials and aggregates
    g. Theoretical mass and fresh density
    h. Admixture dosage
2. A trial batch report demonstrating that the concrete complies with the performance requirements herein specified.

MATERIAL TOLERANCES

Portland Cement

No re-submittal shall be required under the condition that the Portland cement (AASHTO M 85 and M 240) source complies with the following tolerances:

Acceptable tolerance for alkali content (Na_2O_{eq}): ± 0.10 percent.

Acceptable tolerance for tri-calcium aluminate content: - 2.0 percent, + 1.0 percent.

Acceptable tolerance for supplementary cementitious materials in a blended cement: ± 2%.

Fine Aggregate

Substitution of fine aggregates from different sources shall not be permitted without re-submittal.

Acceptable tolerance for fineness modulus: ± 0.20.

Coarse Aggregate

Substitution of coarse aggregate from different sources or different size classification shall not be permitted without re-submittal.

Supplementary Cementitious Materials

No change in type or classification shall be permitted without resubmittal.

Concrete Admixtures

Contractor may change between Type A and Type D admixtures as seasonal conditions warrant. With cold weather placements, the use of an accelerating admixture conforming to ASTM C 494, Type C or E will be allowed without the need for a re-submittal.

Other Materials

No change in brand or type shall be permitted without re-submittal.

TEMPERATURE CONTROL FOR PLACEMENT

The ambient temperature of the air where concrete is to be placed and the temperature of surfaces to receive ternary concrete shall not be less than 40°F. The temperature of the concrete when placed shall not be less than 60°F for ternary mixtures of any concrete with more than 20% fly ash or 35% slag replacement of Portland cement. Heating of the mixing water or aggregates will be required to regulate the concrete placing temperature with cold weather placements. Materials entering the mixer shall be free from ice, snow, or frozen lumps. The use of accelerating admixtures conforming to ASTM C 494, Type C or E is allowed.

QUALITY MANAGEMENT PLAN

At least 14 days prior to the first concrete placement, the Contractor shall submit a Quality Management Plan (QMP), for materials and construction in accordance with the Illinois Tollway recurring Special Provision for Contractor's Quality Program.

Production Facility and Transportation Equipment

The production facility and transportation equipment shall conform to the certification requirements of the Illinois Department of Transportation.

FIELD ACCEPTANCE

Acceptance to this specification shall be based on the following key characteristics:

- Strength
    - Interim
    - Ultimate
- Plastic air content – 5.0 to 8.0 percent
- Slump (Formed Placement) – Design ± 1.5 inches
- Slump (Slipform Placement) - Maintain the concrete at a uniform consistency. The Engineer will not allow an edge slump greater than ½ inch where no additional concrete work is to be constructed immediately adjacent to the pavement being placed. The Engineer will not allow an edge slump greater than ¼ inch where additional concrete work is to be constructed immediately adjacent to the pavement being placed.

- Water / cementitious materials ratio – Design -0.03, +0.00

COARSE AGGREGATE FOR COMPOSITE PORTLAND CEMENT CONCRETE PAVEMENT (Tollway)

Effective: January 30, 2012
Revised: October 29, 2012

Coarse aggregate for Portland Cement Concrete shall be in accordance with Section 1004 of the Standard Specifications except as modified below for the lower layer of composite Portland cement concrete pavement.

Add the following to Article 1004.02 of the Standard Specifications:

"(g) Recycled Coarse Aggregate (RCA). If recycled coarse aggregate is specified for use in a concrete mix design, the recycled coarse aggregate will be generated from a Tollway approved source of existing concrete or asphalt pavement. The recycled coarse aggregate may be processed from a non-AGCS certified location. The processing of recycled coarse aggregates for reuse in hydraulic cement concrete shall be as follows:

(1) Concrete pavement or structural concrete for recycled coarse aggregate from an approved source shall be broken with a guillotine (or similar) crusher, removed, and transported to a crushing location at a central recycling plant and be processed in accordance with IDOT's policy memo for Recycling Portland Cement concrete into Aggregate except as follows.

a. Removed concrete shall be crushed with an impact type crusher operating at less than full capacity to minimize the production of fines. Up to 5 percent of the recycled coarse aggregate from Portland cement concrete pavement sources may consist of asphalt containing particles.

b. Washing of the crushed concrete coarse aggregate is required. The extra absorptivity of the recycled concrete aggregates shall be accommodated by keeping the stockpiled aggregates wet and at the batching plant by controlling the appropriate amount of water to the concrete mix to achieve the desired water to cement ratio.

Processed RCA taken from unknown sources can only be considered for approval by the Engineer for reuse in concrete if the coarse aggregate has been processed and all physical properties are in compliance with AASHTO Standard MP 16.

(2) Coarse FRAP used for recycled coarse aggregate in concrete shall be Category 1 coarse FRAP processed and screened in accordance with the contract Tollway special provision for Reclaimed Asphalt Pavement.

Up to 15 percent of the recycled coarse aggregate from a Tollway approved RAP source may consist of agglomerated sand/asphalt particles. The total coarse aggregate blend used in the concrete mixture shall consist of no more than 7.5 percent agglomerated sand/asphalt particles."

COMPOSITE PORTLAND CEMENT CONCRETE PAVEMENTS (Tollway)

Effective: January 30, 2012
Revised: October 29, 2012

DESCRIPTION

This work consists of:

1. Furnishing, mixing, and placing ternary portland cement concrete for special applications to composite pavements as shown and described on the Drawings and in this Special Provision;

2. Supplying and installing all specified reinforcement;

3. Developing concrete mix design(s) that meets the performance requirements for the intended pavement;

4. Constructing a trial section as required;

5. Constructing the composite pavement on a prepared subgrade, or subbase, without forms.

6. Verifying dowel bar alignment with periodic magnetic particle scans of joints.

Ternary concrete refers to concrete that incorporates hydraulic portland cement, ground granulated blast furnace slag, fly ash, and other supplementary cementitious materials (SCM) as constituent materials. A Type IT blended ternary cement in accordance with AASHTO M 240 shall be acceptable. A Type IP or IS blended cement in accordance with AASHTO M 240 may be used when an SCM is combined as a constituent material to produce a ternary mix. Slag, fly ash, and any other SCM's combined as constituent materials in a mix or as part of a blended cement may consist of no less than 35% and no more than 50% of the total cementitious material in any mix design.

Composite pavement refers to a pavement that consists of multiple flexible and rigid layers or multiple rigid layers bonded together without separation. This special provision only applies to a concrete composite pavement of multiple rigid layers.

REFERENCE STANDARDS

Except where modified by the Illinois Department of Transportation or the Tollway, the following Standards shall apply:

Illinois Department of Transportation (IDOT)

- Standard Specifications for Road and Bridge Construction, Adopted January 1, 2012.
- Supplemental Specifications and Recurring Special Provisions, Current Edition.
- Tollway Supplemental Specifications to the Illinois Department of Transportation Standard Specifications for Road and Bridge Construction, Current Edition.

MATERIALS

Materials shall be according to Article 420.02 of the Standard Specifications except as modified herein:

Concrete supplied for the bottom layer of a concrete composite pavement under this special provision will be designed in accordance with the Performance Related Special Provision for Ternary Concrete Mix Designs for Composite Pavement.

Concrete supplied for the top layer of a concrete composite pavement under this special provision will be designed in accordance with Section 1020 of the Standard Specifications as an IDOT approved Class PV mix, or in accordance with the Performance Related Special Provision for Ternary Concrete Mix Designs for Composite Pavement with only virgin aggregate sources that are certified by IDOT as 30 year life aggregates. An IDOT approved Class PV mix shall be required for top layer placements when composite pavements are placed before the date of April 1st or after the date of October 15th.

EQUIPMENT

Equipment shall be according to Article 420.03 of the Standard Specifications except as modified herein.

Add the following to Article 420.03 of the Standard Specifications:

"(k) MIT-Scan-2. Tollway QA shall use a MIT-Scan-2 device which is manufactured by MIT GmbH to measure dowel bar alignment during placement. The device shall be calibrated on the Tollway's approved MIT Scan calibration system for the specific dowel bar size or load transfer device being placed, and is operating within the manufacturer's tolerances.

CONSTRUCTION METHODS

The Composite Portland Cement Concrete Pavement shall be constructed as a Jointed Plain Concrete Pavement according to Articles 420.04 through 420.18 of the Standard Specifications except as modified herein.

Add the following paragraph to Article 420.05(a) of the Standard Specifications:

"Both transverse and longitudinal joints of composite concrete pavements shall be cut at depth of 3.5 inches below the finished surface. For paving of 2 lanes or wider, the longitudinal joints shall be saw cut at the same time as transverse joints are cut. If sparks are witnessed during saw cutting operations at a transverse joint, the joint shall be marked for removal and full-depth patching at the Contractor's expense."

Replace Article 420.05(c)(2) of the Standard Specifications with the Following:

(2) Dowel Bar Assemblies/Insertions. When dowel bars are specified in the Contract, they shall be installed with the dowel bars parallel to the proposed pavement surface and to each other. Installation shall be within the tolerances and of the size, grade, and spacing specified. Dowel bars shall be furnished in a rigid welded assembly or placed by a dowel bar insertion (DBI) machine. With placements using a dowel bar assembly, the assembly shall be at right angles to the centerline of pavement.

With the use of assemblies, the assembly shall act as a rigid unit with each component securely held in position relative to the other members of the assembly. Horizontal support wires or shipping tie wires shall be non-deformed bars or wires with a diameter less than or equal to 0.307 inches (gauge 0 wire). The number of horizontal support wires or shipping tie wires shall be limited to five per assembly. The entire assembly shall be held securely in place by means of nails which shall penetrate the stabilized subbase. At least ten nails shall be used for each 10, 11, or 12 ft section of assembly. Bearing plates shall be punched to receive the nails. When bearing plates are omitted on stabilized subbase, other methods for securing the assembly with nails shall be provided.

Metal stakes shall be used instead of nails, with soil or granular subbase. The stakes shall loop over or attach to the top parallel spacer bar of the assembly and penetrate the subgrade or subbase at least 12 inches.

The horizontal support wires or shipping tie wires shall be cut prior to concrete placement. At the location of each dowel bar assembly, the subgrade or subbase shall be reshaped and re-tamped when necessary.

A dowel bar inserter (DBI) used with a formless paver meeting the requirements of Article 1103.16 may be used in lieu of the assemblies specified above. When a dowel bar inserter is used to install load transfer bars, space the bars according to design requirements. Dowel bar inserters shall insert dowel bars into plastic concrete which has been placed and consolidated to full depth. The bars shall be inserted ahead of the finishing beam or screed and the installing device shall so consolidate the concrete that no voids exist around the dowel bars. The forward movement of the finishing beam or screed shall not be interrupted by the inserting of the dowel bars.

When a DBI is used, the Contractor shall submit details and specifications of the proposed slip-form paver and DBI to the Engineer a minimum of 14 calendar days prior to the concrete pavement pre-paving meeting. The Contractor shall detail his methodology for ensuring correct marking of dowel bar insertion points

and correct sawing of the joints. The Contractor shall ensure that the slip-form paver is compatible with the DBI.

Add the following to Article 420.05(c) of the Standard Specifications:

(3) Verification of Dowel Bar Alignment.

(4) Dowel Alignment Tolerances. Dowel placement tolerances for 18" dowel bars shall be as follows:

Target Tolerances:

Horizontal & Vertical Translation ≤ 1.0 inch
Longitudinal (Side) Shift ≤ 2.0 inches (embedment ≥ 7.0 inches)
Horizontal & Vertical Rotational Alignment ≤ 0.5 inch

Rejection Tolerances:

Horizontal & Vertical Translation > 1.5 inch
Longitudinal (Side) Shift > 3.0 inches (embedment < 6.0 inches)
Horizontal & Vertical Rotational Alignment > 1.5 inch

A weighted-score system will be used to conduct a joint–by-joint evaluation of rotational misalignments of the dowel bars. The Joint Score, as defined in this evaluation, is a measure of the combined effects of rotational misaligned dowel bars at a joint. A Joint Score is determined by summing the product of the weights (given in the table below) and the number of bars in each misalignment category and adding 1. For example, if a joint has four misaligned bars in the 0.6 to 0.8 inch range, the joint score is 9; if a joint has one misaligned bar in the 0.6 to 0.8 inch range and one bar in the 1 to 1.5 inch range, the score is 8. A joint score of 12 is the critical level, above which the risk of joint locking is considered high.

Range of Rotational Misalignment	Weight
0.4 in. < d < 0.6 in.	0
0.6 in < d < 0.8 in.	2
0.8 in. < d < 1 in.	4
1 in. < d < 1.5 in.	5

Rejection Criteria:

Horizontal and Vertical Rotational Alignment –
Evaluate on joint-by-joint basis, using the Joint Score.
Isolated locked joints (as indicated by a Joint Score greater than 12) will be allowed, provided the adjacent joints have Joint Scores12 or less.
Reject any individual bars with misalignment greater than 1.5 in.

Longitudinal (side) Shift –

Reject any joints with fewer than three bars with a minimum embedment length of 6 in. under each wheel path.

Depth –

Reject any bar with the concrete cover above the bar less than 3 in. or the saw-cut depth.

Reject any joints with fewer than three bars with a minimum concrete cover below the bar of 3 inches in each wheel path.

Corrective Measures:

The following corrective measures will be considered for the bars or joints that fail to meet the minimum standard as described by the Rejection Criteria. The Contractor shall submit his method of repair to the Engineer for approval. All materials shall be preapproved.

Horizontal and Vertical Rotational Alignment -

Saw cut the misaligned bars.

Retrofit dowel bars to ensure that at least three dowel bars are provided in each wheel path that satisfies the Target Tolerances.

Longitudinal (side) Shift and Missing Bars –

Retrofit dowel bars to ensure that at least three dowel bars are provided in each wheel path that satisfies the Target Tolerances.

Depth –

Inadequate cover above the bar – If the problem bar can be removed, remove the entire bar and retrofit replacement bars to ensure that at least three dowel bars are provided in each wheel path that satisfy the Target Tolerances. If the problem bar(s) cannot be removed, perform full-depth repair/replacement of the joint.

Inadequate cover below the bar – Retrofit dowel bars to ensure that at least three dowel bars are provided in each wheel path that satisfies the Target Tolerances. If the problem bar(s) cannot be removed, perform full-depth repair/replacement of the joint.

In addition to the above written procedures, the Contractor may propose full depth removal and replacement of the joint as a Class B patch. If any individual dowel bar is found to be rejectable, the Contractor shall submit a proposal for remedial work to the Engineer for review. The Contractor shall not proceed with repairs until approval of the proposal has been given by the Engineer.

Regardless of the dowel bar placement method used, the Contractor shall demonstrate their ability to place dowel bars in conformance with the specifications by placement of a trial section."

Insert the following at the beginning of Article 420.06.

"Forms shall only be used for short stretches of pavement, such as at ramp transitions, between mainline bridges, or other areas inaccessible to formless pavers, and shall be

constructed in one lift using the concrete mix specified for the top lift of the composite pavement. Locations for manual single lift formed placements in place of two lift placements using formless pavers shall be approved by the Engineer and any manual single lift formed placements shall be performed at no additional cost to the Tollway."

Add the following to Article 420.07 of the Standard Specifications:

"(a)Composite Portland Cement Concrete Pavement. The pavement shall be placed in two lifts, with the second top lift being of a lesser thickness as designated by contract design and placed between 15 and 45 minutes after the placement of the first lower lift. Any portions of the bottom lift of concrete which have been placed more than 45 minutes without being covered with the top lift shall be removed and replaced with freshly mixed concrete, at the Contractor's expense if bonding between layers or consolidation of concrete is determined by the Engineer to be unsuitable. A 300-foot trial section shall be constructed by the Contractor at a location agreed upon by the Engineer. The purpose of the trial section is to replicate the actual construction process, equipment, materials (including dowel bars), placement methods, tining, smoothness, and haul times that will be used on the actual composite pavement mainline construction either for single lane or multiple lane placements.

The bottom concrete lift shall not require curing, texturing, or sawing before the top concrete lift is placed, and shall be struck off to provide a nominal bottom lift thickness that complies with the pavement design and allows for the top lift to be struck off after placement to obtain the minimum top lift thickness required and to allow for the finished total pavement to conform to the cross section shown on the plans. If a dowel bar inserter is used with a formless paver to place dowel bars, the dowels can be inserted during placement of either the top or bottom lift.

The frequency of the vibrators shall be established based on the workability of the concrete and experience from the demonstration slab. Electronic, internal, T-shaped, poker vibrators shall be used (either of the surface or internal vibration type). Other types of vibrating equipment may be approved by the Engineer. The vibrator impulses shall be delivered directly to the concrete and the intensity of vibration shall be sufficient to consolidate the concrete mass thoroughly and uniformly throughout its entire depth and width. The Contractor will be allowed to increase the speed of the vibrators with the permission of the Engineer.

Two slipform (formless) pavers shall be used in sequence for the composite pavement construction in accordance with Article 420.14 of the Standard Specifications. The Contractor may propose and demonstrate other formless placement methods / equipment for bottom lift placement through the trial section. The slipform paver and any other formless paving equipment that may be approved by the Engineer for bottom lift placement shall operate in such a way to distribute and evenly consolidate the concrete mixture and to maintain positive grade control. During production placement when an alternative to a slip form paver is used for the bottom lift, if more than 15% of the dowels are measured at any section location to exceed the specified rejection criteria and/or poor consolidation below dowel bars are found commonly present by the engineer at any location, the Contractor will be required to resume paving of composite pavements using two slip form pavers. Any

additional trial sections and equipment modifications required will be at the Contractor's expense. The second paver shall follow the first paver by no more than 45 minutes with a distance between pavers to be no more than 150 feet. Optimal timing between pavers is recommended to be between 15 and 30 minutes with a distance between pavers recommended to be less than 75 feet. The requirement of a spreader in front of the bottom lift paver may be waived if a slip form paver equipped with an automatic dowel bar inserter is used and a continuous operation can be maintained with concrete placed in front of the first paver.

Paving of composite concrete pavements shall be continuous between transverse joint locations shown on the plans. The composite pavement may be substituted with a single lift standard concrete pavement using the top lift concrete mix throughout the placement only at locations approved by the Engineer where isolated cut out or block out locations that do not exceed 500 ft. in length adjacent to mainline bridges, near crossovers or at ramp locations. Approved substitution of composite paving with single lift paving shall be at no additional cost to the Tollway.

a. Verification of Dowel Bar Alignment. When using either dowel bar assemblies or an automatic dowel bar inserter, the Tollway shall use the calibrated MIT-Scan-2 to verify the position and alignment of the dowel bars within the trial sections and during production. The Contractor shall ensure that the surface to be tested is clear of any loose stone or other debris. To facilitate data analysis, all joints evaluated shall be scanned by the Tollway with the MIT-Scan-2 moving in the same direction.

   Following placement of the trial section for composite pavements, the Contractor shall shut down the paving operations. During the shutdown period, the Tollway shall evaluate all joints in the trial section using the MIT-Scan-2 device in the presence of the Engineer on the next business day after placement, analyze the results, and submit the results to the Engineer. Paving operations shall not be restarted until the Engineer approves the trial section results, which should be completed by the Tollway within 5 days of the trial section placement. The trial section will be found acceptable if 85% of the dowel bars placed are found to be within the rejection criteria. All dowel bars exceeding the rejection criteria must be addressed using the above suggested corrective measures.

   Additional trial sections will be required for the following:

   1. When the slip-form paving equipment has been modified to accommodate a change in the paving width, or disassembled;
   2. At the beginning of each construction season; and
   3. When the slip-form paving equipment has been replaced by different equipment.

   If the Project has less than 500 linear feet of pavement, the trial section will not be required. If a Project does not have sections of continuous pavement greater than 45 linear feet, the trial section will not be required.

Upon completion of the trial section(s) and for each week of production, Tollway Quality Assurance shall prepare a report from the measurements obtained. All data shall be submitted in the manufacturer's native file format, along with the calibration files. Tollway Quality Assurance shall submit a standard report generated using MagnoProof or approved equivalent software (electronic Excel report) to the Engineer at the start of each working week during production for the previous week's work.

The electronic report shall include the following:

1. Contract number, date, highway number and direction of traffic.
2. Joint number, lane number and station.
3. Bar number and x-location of dowel bar.
4. Horizontal and vertical misalignment in inches.
5. Side shift in inches.
6. Depth to center of dowel bar in inches.
7. Joint Score.
8. All out-of-tolerance readings shall be highlighted in red.

Due to potential magnetic interference from tie bars, dowel bars located within 15 inches of a tied joint shall not be included in the evaluation. Joints located directly under high voltage power lines that cross over the roadway shall not be evaluated.

If the trial section is found to be unacceptable to the Engineer, the Contractor shall perform corrective actions and place a second trial section at the Contractor's expense. The Contractor shall develop a written plan outlining the steps to be taken in order to pave a successful trial section. This plan shall be submitted to the Engineer for review and approval. If the second trial section is found to be unacceptable, the Contractor shall pave no more than 500 feet per day until an acceptable trial section has been achieved.

b. During Production

Once a trial section is successfully completed and approved, dowel bar placement testing frequency by Tollway QA shall be a minimum of one location of each continuous traffic lane or ramp lane paved each day. Sections of mainline designed to be greater than 45 linear feet and less than 1,250 linear feet during a day of placement require a minimum of one test location. Testing locations shall be determined by a random procedure so that each area has a randomly selected transverse joint location. At each location, five consecutive joints shall be tested by Tollway QA using the MIT-Scan-2 device. Satisfactory control is considered to have been established when no rejectable dowel bars have been identified during three consecutive days of concrete paving. Once satisfactory control is established, a minimum of one joint within every five days of production shall be selected by the Engineer for evaluation.

Sections of continuous pavement constructed by the project less than 45 linear feet will not require dowel bar placement testing.

When any joint score is above 12 or any one bar in a single joint exceeds the rejection criteria, the frequency for Tollway MIT Scans and Contractor cut outs will resume to once per day's production until satisfactory control is established.

All delays or costs associated with proposed equipment being rejected for use by the Engineer will not be paid for by the Tollway.

(2) Verification of Consolidation. At each 300 ft. trial section placed with only one slip form paver, within 24 hours of placement the Contractor shall take one core through one joint of each 100 ft of the trial section. The cores shall be observed by the Tollway QA and the Engineer for verification of satisfactory consolidation below the dowels and to verify thickness as specified. During production, cores taken in accordance with Article 420.15 to determine pavement thickness shall be taken at a location 9 inches off a sawed joint to verify suitable consolidation under the dowels as well."

Revise Article 420.09(e)(1) of the Standard Specifications to read:

"Type A. Texturing of the top lift of plastic concrete shall be obtained by the use of an artificial turf drag followed immediately by a mechanically operated metal comb longitudinal tining device. Hand finishing methods will be permitted only in the event of breakdown of the mechanical equipment or for confined locations where the mechanical equipment cannot be operated. Hand methods may be used to strike off, consolidate, and finish the concrete only in the confined locations and where the concrete has already been deposited on the grade when the breakdown occurs.

The artificial turf shall be made of molded polyethylene with synthetic turf blades approximately 0.85 in (22-mm) long and contain approximately 7,200 individual blades per square foot (77,500 blades per square meter). The drag shall be suitably attached to an approved device that will permit control of the time and rate of texturing. The artificial turf shall be full pavement width and of sufficient size that during the finishing operation; approximately 2 ft (0.6 m) of the turf parallel to the pavement centerline will be in contact with the pavement surface. The drag shall be operated in a longitudinal direction so as to produce a uniform appearing finish meeting the approval of the Engineer. If necessary for maintaining intimate contact with the pavement surface, the drag may be weighted using lumber, rebar, or other suitable material.

The metal comb shall consist of a single line of tempered spring steel tines spaced at 0.75-in (19-mm) centers and securely mounted in a suitable head. The tines shall be flat and of a size and stiffness sufficient to produce a groove of the specified dimensions in the plastic concrete without tearing of the pavement edge or surface. The Contractor shall modify the equipment or operations if an acceptable pavement edge or surface is not produced. The mechanically operated metal comb shall be attached to an exclusive piece of equipment which is mechanically self-propelled.

The tining device shall be operated so as to produce a relatively uniform pattern of grooves parallel to the pavement centerline spaced at approximately 0.75-in (19-mm) centers, 0.13 to 0.19 in (3.2 to 4.8 mm) deep, and 0.13 in (3.2 mm) wide. Longitudinal tining shall stop at the edge of travel lanes. Tining devices shall be maintained clean and free from encrusted mortar and debris to ensure uniform groove dimensions. The tining finish shall not be performed too soon after pavement placement whereby the grooves may close up. The tining grooves shall be neat in appearance, parallel with the longitudinal joint, uniform in depth and in accordance with these specifications.

Hand tining or tining with a mechanically operated comb combined with the curing equipment specified in Article 1101.09 of the Standard Specifications will be permitted where the Specifications permit hand finishing or vibratory screeds, one lane construction up to 16 ft. wide, gaps, projects with a net length of ½ mile or less, and where the production rate on any paving day will be less than 1,500 cu yd per day. A foot bridge shall be provide for the hand tining operation for all pavement over 12 ft. wide, unless it can be demonstrated to the satisfaction of the Engineer that an alternate texturing operation produces satisfactory results."

Change the first paragraph of Article 420.14 to read:

"Slip form paving (formless paver) methods, according to the following, shall be the primary construction method used for the composite concrete pavements, and shall be required for any top lift placement, and required for any bottom lift placement unless it can be demonstrated to the satisfaction of the Engineer that an alternate formless placement method and equipment for the bottom lift can produce satisfactory results. . Slip form paving methods shall replace the strike off, consolidation, and finishing requirements of Article 420.09(a) unless equipment breakdown occurs."

Revise Article 420.15 of the Standard Specifications to read:

"Tolerance in Thickness. Determination of the total pavement thickness, computation of the pavement's total thickness, computation of the lift thicknesses, and requirements relative to deficient total thickness shall be according to Article 407.10 except for the following.

(a) Width of Sublots and Lots, or Units. The width of a sublot and lot, or unit, shall be the width from the pavement edge to the adjacent longitudinal joint, from one longitudinal joint to the next, or between pavement edges where there is no longitudinal joint.

(b) The Contractor shall strive to construct the total pavement and the top lift to the designed thickness. A thickness deficiency of the top lift up to 0.5 inches will not be penalized. A top lift thickness deficiency more than 0.5 inches will require removal and replacement by the Contractor at no expense to the Tollway."

SURFACE TESTS

Surface testing of the finished pavement shall be according to the IDOT BDE special provision for Surface Testing of Pavements.

OPENING TO TRAFFIC

Composite concrete pavement shall not be opened to construction paving or loaded supply truck equipment or other heavy equipment until both lifts of concrete have attained an age of 7 days if tests are not conducted; or until all specimens sampled for both lifts have reached a minimum flexural strength of 450 psi and a minimum compressive strength of 2,850 psi at no less than 5 days of age as approved by the Engineer.

Perform construction operations on new pavement as approved by the Engineer and in accordance with the following:

1) Construct a temporary ramp to prevent damage to the pavement slab when moving on and off the pavement.

2) Operate the paving equipment on protective mats to prevent damage to the pavement surface and joints. Sweep the pavement surface free of debris before placing the protective mats.

3) Operate equipment on a slab without causing damage. If damage results, suspend operations and take corrective action as approved by the Engineer. Do not operate the equipment wheels or tracks within 4 in. of the slab edge.

Composite concrete pavement shall be opened to public traffic according to Article 701.17(c)(5) of the Standard Specifications except as follows:

Revise the second and third sentences of Article 701.17(c)(5) of the Standard Specifications to read:

"The earliest the pavement will be opened to public traffic will be when test specimens for the top layer of concrete have attained a flexural strength of 650 psi or a compressive strength of 3,500 psi, and the test specimens for the bottom layer of concrete have attained a flexural strength of 575 psi and a compressive strength of 3,200 psi at no less than 14 days age. If such tests are not conducted, the pavement shall not be opened to traffic until 28 days when ternary mixtures are used for either lift."

Test specimens for strength measurements shall be obtained from both lifts of concrete.

The determination of compressive or flexural strength shall be based on the following:

Test cylinders for the concrete of both lifts shall be fabricated at the time of placement and at the same locations of placement at the specified frequency, field cured under conditions comparable to the in-place concrete, and tested in accordance with AASHTO T 22. Test beams for the concrete of both lifts shall be fabricated at the time of placement at the same locations of placement, field cured under conditions comparable to the in-place concrete, and tested in accordance with AASHTO T97.

METHOD OF MEASUREMENT

This work will be measured for payment in accordance with Article 420.19 of the Standard Specifications.

BASIS OF PAYMENT

This work will be paid for at the contract unit price per square yard for COMPOSITE PORTLAND CEMENT CONCRETE PAVEMENT (JOINTED), of the total thickness specified.

Pavement fabric will be paid for at the contract unit price per square yard for PAVEMENT FABRIC.

When the contract requires the Contractor to furnish a profilograph, the work will be paid for according to Article 407.12.

Protective coat will be paid for at the contract unit price per square yard for PROTECTIVE COAT.

Removing and replacing curing and protective cover, when required, will be paid for according to Article 109.04.

Test strips will be evaluated for payment at the contract unit price per each for CONSTRUCTING COMPOSITE CONCRETE TEST STRIP, according to the following.

(a) If the initial composite concrete test strip is determined to be acceptable, the pavement and test strip will be paid at the contract unit prices.
(b) If the initial composite concrete test strip is placed on-site and determined to be unacceptable to remain in place by the Engineer, the initial pavement and test strip will not be paid for and shall be removed at the Contractor's expense.
(c) If the Contractor requests and is granted approval for a concrete mix design other than the initially approved concrete mix designs or equipment for paving is modified for any reason, the Contractor shall construct a test strip for the new mix design or modified paving train at no additional cost to the Tollway.