HIGH PERFORMANCE CONCRETE QUESTIONNAIRE

Version: 7-15-03

State: South Dakota

1. Which of the following changes have been made to your concrete specifications in the last 10 years?

Check those that apply:

	Changes Made in Last 10 Years	Included in Current Specifications
Use HPC-low permeability concrete	✓	
Use HPC-high strength concrete	✓	
Allow admixtures		✓
Concrete strengths		✓
Bridge deck curing		✓
Deck finishing requirements		✓
Limit cement/alkali content		✓
Testing and acceptance requirements		✓
Heat of Hydration required for cement		
Chloride testing of hardened concrete		
Lightweight concrete		
Self-consolidating concrete (SCC) in use		
Flowing concrete in use		
Epoxy coated reinforcing steel used		✓
Stainless Steel reinforcing steel used	✓	
Stainless clad reinforcing steel used	✓	
Specify air void parameters (spacing factor and/or specific surface)		

2. Current Concrete Specifications:

Class of Concrete	Air Content %	Max. W/C Ratio	Slump (in.)	Cement Type	Min. Cement Content (lb/cy)	Max. Cement Content (lb/cy)	Maximum Aggregate Size (in.)
Prestressed	6 ± 1.5	(1)	5 max.	(1)	(1)	(1)	1.0
Decks	6.5 ± 1.0	0.45	1-3.5	II	650	800	1.0
Parapets	6.5 ± 1.0	0.45	1-3.5	II	650	800	1.0
Substr./General	6.5 +1.0 −1.5	0.45	1-4.5	II	650	800	1.0
Paving	6.5 +1.0 −1.5	(1)	1-3	II	(1)	(1)	1.0
Latex Hydraulic Cement Concrete	5.0 ± 1.0	0.40	4-8	I	682	682	0.5
Silica Fume Concrete							

Highest compressive strength used for prestressed concrete girders: 9,900 psi
Compressive concrete strength used for decks: 4,500 psi

3. All states have experienced some of the below concrete distresses. To what extent has your State experienced these (Rank from 1 to 5 with 1=rare and 5=often):

Type of Distress	1	2	3	4	5
Corrosion of Reinforcing Steel			✓		
Sulfate Attack		✓			
Alkali-silica Reactivity			✓		
Freezing and Thawing				✓	
Cracking (girders, substructure, pvmt)				✓	
Deck Cracking (Early age < 5 years)					✓
Overload	✓				
Poor Construction Quality			✓		

4. Construction Requirements:
Workability Requirements:

ADMIXTURES AND SLAG USAGE					
ADMIXTURE/SLAG	Non-Aggressive Environment		Aggressive Environment		ELEMENTS WHERE USED
	YES	NO	YES	NO	All, D, G, P, F, CP, DS*
Air-Entraining	✓		✓		Required - All
Retarding	✓		✓		Allowed - All
Accelerating	✓		✓		Allowed - All
Water Reducing (Normal)	✓		✓		Allowed - All Required - DS
Water Reducing (High Range)	✓		✓		Allowed - All
Water Reducer + Retarder	✓		✓		Allowed - All
Water Reducer + Accelerator	✓		✓		Allowed - All
Viscosity Modifying Admixture	✓		✓		May Be Allowed - All
Silica Fume	✓		✓		Allowed - G
Fly Ash, Class F	✓		✓		Allowed - All, Required - D
Fly Ash, Class C		✓		✓	
Fly Ash, Class N		✓		✓	
Metakaolin		✓		✓	
Rice Hull Ash		✓		✓	
Other Ash Materials		✓		✓	

Bark Ash		✓		✓	
Bottom Ash		✓		✓	
Pet Coke Ash		✓		✓	
Slag		✓		✓	
Latex	✓		✓		Sometimes Required Deck Overlays
Corrosion Inhibitors	✓		✓		May Be Allowed - All

*Key: Deck(D); Girder(G); Pier(P); Footing(F); Concrete Pile(CP); Drilled Shaft(DS)

ADMIXTURE TYPE & SLAG	RANGE % (Wt. Of Cement Replaced)
Fly Ash	20 %
Slag	N/A
Silica Fume	N/A
Metakaolin	N/A
Rice Hull Ash	N/A
Other Ash Materials	N/A

	Yes	No
Is water allowed to be added at the job site?	✓	
Are air-entraining admixtures allowed to be added at the job site?	✓	
Are accelerators added at the job site? Not normally used.		
Are there any special finishing requirements?	✓	

Explain: Bridge Decks: Required self-propelled rotating cylinder type finish machine; Broom finish followed by transverse metal-tine finish.

Are there any time constraints between finishing and applying curing?	✓	

Explain: (Minimum and Maximum Times) Wet burlap and poly shall be in place within 4-hours after completion of bridge deck finishing.

CURING REQUIREMENTS						
Structural Element	Exist. Spec. Y/N	Curing Comp. Y/N	Fog Mist Y/N	Wet Burlap Duration	ERL LB/SF/HR	Cure Time (Days)
Deck	Y	Y	N	7-Days	N/A	7-Days
SF Overlay	N					
Latex Conc. Overlay	Y	N	N	48-Hours	N/A	96-Hours
Dense Conc. Overlay	Y	N	N	72-Hours	N/A	72-Hours
Paving	Y	Y	N	72-Hours	N/A	72-Hours
Shotcrete	N					
Shotcrete With SF	N					
Massive Element	N					

Key : ERL= Evaporation Rate Limit (LBS/SF/HR)

Any construction requirements for reducing evaporation?

Yes ✓ No _____

Bridge Decks: Curing compound used to retard evaporation prior to placing wet burlap.

How and how often is evaporation rate measured?

5. Has fiber-reinforced concrete been specified for bridge decks or overlays and paving (either steel or plastic fibers)(Indicate R = Regular and E = Experimental.)

Bridge decks: Yes E No _____ Fiber Type Plastic
Overlays: Yes E No _____ Fiber Type Plastic
Paving: Yes E No _____ Fiber Type Plastic

6. Identify concrete cover requirements:

MINIMUM CONCRETE COVER REQUIREMENTS		
STRUCTURAL ELEMENT	COVER (in.)	
	Non-Aggressive Environment	Aggressive Environment
Decks – Top	2.5	2.5
Decks – Bottom	1.0	1.0
Reinforced Concrete Beams	1.5	1.5
Prestressed Concrete Beams - CIP	1.5	1.5
Prestressed Concrete Beams - Precast	1.0	1.0
Substructure – Piers	2.0	2.0
Substructure – Abutments	2.0	2.0
Substructure - Footings	2.0	2.0

REQUIRED REINFORCING STEEL			
STRUCTURAL ELEMENT	TYPE REINFORCING STEEL BS, ECS, GS, SS, SCD, MMFX		
	Non-Aggressive Environment	Aggressive Environment	Experimental Use Only
Decks – Top	ECS	ECS	SS, SCD
Decks – Bottom	ECS	ECS	SS, SCD
Reinforced Concrete Beams	BS	BS	
Prestressed Concrete Beams, CIP	BS	BS	
Prestressed Concrete Beams, Precast	BS	BS	
Substructure – Piers	BS	BS	
Substructure – Abutments	BS	BS	
Substructure - Footings	BS	BS	

Key: BS = Black Reinforcing Steel; ECS = Epoxy Coated Reinforcing Steel; GS = Galvanized Reinforcing Steel; SS = Stainless Reinforcing Steel; SCD = Stainless Clad Reinforcing Steel; MMFX = MMFX Microcomposite Steel Rebar

7. Is there a limit on the percent of alkali allowed in the cement?

Yes ✓ No _____

8. Are aggregates tested for reactivity?

Yes ✓ No _____

How many sources of aggregates? 45

9. Indicate specification permeability requirement limits for: None Specified

Structural Element	Coulombs	
	Non-Aggressive Environment	Aggressive Environment
Bridge Decks		
Prestressed Concrete Members		
Substructure Elements		
Pavements		

10 (a): What QC/QA tests do you specify?

Fresh Concrete		Hardened Concrete	
	Tests		Tests
Slump	✓	Compressive Strength	✓
Spread		Air/Void System	
Unit Weight	✓	Chloride Permeability	
Air Content	✓	Maturity	
Water Content		Freeze/Thaw	
W/CM		Shrinkage	
		ASR	

10 (b): What are your acceptance criteria for cracks?

None specified

10 (c): Do you specify pre-construction mock-ups? If yes, provide details.

Sometimes, for experimental projects.

10 (d): Do you specify design properties at 28 days or 56 days or some other duration?

28 days

10 (e): Do you allow 4x8 cylinders for compressive strength tests?

1. For very high strength concrete.
2. When Shure Cure System is being used for P/S Concrete.

10 (f): What types of end-caps do you specify/allow – Sulfur, Neoprene, Ground Ends?

Neoprene

10 (g): Do you specify match-cured cylinders?

Allow for P/S Concrete girders.

10 (h): How do you enforce/monitor wet-water curing?

Visual inspection

10 (i): Do you require warrantees against defects – e.g. bridge deck cracking?
If yes, provide details. No.

10 (j): What is your experience/evaluation/specification regarding the Microwave Test for w/cm? No experience.

11. How often are the following types of concrete overlays used? (Rank from 1 to 5 with 1=rare and 5=often)

Type of Overlay	1	2	3	4	5	Comment on Performance E, G, or P**
Latex-modified Concrete		✓				G
Silica Fume Concrete	✓					P
Dense Concrete					✓	E
Fly Ash Concrete	✓					(1)
Slag Concrete	✓					
Epoxy (Thin Bonded)	✓					
Polymer (Thin Bonded)	✓					
Other						

**Key: Excellent(E); Good(G); Poor(P) (1) Fly Ash Dense Concrete will be standard bridge deck overlay concrete in future.

12. Rank the need or interest for your State to learn more about the following from 1 to 5 (1=low; 5=very high)

BENEFICIAL ATTRIBUTES	1	2	3	4	5	Overall Ranking (1-11)
Low Permeability (Dense Concrete)			✓			3
High Durability				✓		2
High Corrosion Resistance			✓			8
Alkali-silica Reactivity Resistance			✓			6
Higher Concrete Strengths		✓				13
Highly Flowable Concrete		✓				12
Crack Control					✓	4
Skid Resistance			✓			9
Rideability			✓			10
Toughness of Concrete*		✓				11
Minimum Maintenance			✓			5
Longer Service Life				✓		1
Savings (Life Cycle Costs)				✓		7

*Add fibers: steel, glass, plastic, polypropolene, etc.

13. Who at State and Division levels i.e., Materials, Construction, Pavement, Research, Structures, would be involved in examining concrete specifications and procedures and learning about High Performance Concrete?

Check those that apply:
Materials ✓
Construction ✓
Pavement
Structures ✓
Research ✓

14. Have you considered adopting/implementing the following SHRP products?

2005 A Guide to Determining the Optimal Gradation of Concrete Aggregates?

Yes ✓ No ____ Unknown ____ Implemented ____

2014 Specifications for High Performance Concrete?

Yes ✓ No ____ Unknown ____ Implemented ____

2017 Designing ASR-Safe concrete Mix?

Yes ____ No ✓ Unknown ____ Implemented ____

2036 Manual for Bridge Rehabilitation and Protection

Yes ____ No ✓ Unknown ____ Implemented ____

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Thank you for completing the questionnaire. A summary of compiled results will be made available upon completion.