New Concrete Surface Finish Policy & Evaluation of Concrete Cracks

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Presentation Topic Overview

- **New Concrete Surface Finish Policy:**

  A new policy has been implemented that reduces the use of coatings, textures, stains and tints. The general provisions of, and reasons for, the new policy will be discussed

- **Evaluation of Concrete Cracks**

  The Engineer of Record's (EOR) role in the concrete crack evaluation process will be reviewed

New Concrete Surface Finish Policy

- **The new policy was developed by the Concrete Surface Finish Task Team whose members are:**
  - Mike Bergin (State Structural Materials Engineer)
  - Jeff Cicerello (District 5 Senior Structures Design Engineer)
  - Richard Kerr (Bridge Management Inspection Engineer)
  - Fred Ochoa (District 4 Structures Design Engineer),
  - Steven Plotkin (State Construction Structures Engineer)
  - Jeff Pouliotte (State Structures Maintenance Engineer)
  - Robert Robertson (State Structures Design Engineer)
  - Paul Vinik (State Structural Material Systems Engineer)

New Concrete Surface Finish Policy

- **Previous policy was somewhat vague but was widely interpreted for at least 30 years as <u>requiring</u> almost all bridges to be coated with Class 5 finish - <u>Default policy: almost always coat</u>**
- **The new policy is the opposite of the old and prohibits Class 5 finish unless specifically approved by a Department Engineer authorized to do so - <u>Default policy: do not coat unless there is ample justification</u>**
- **Reasons for the Change:**
  - Previously there were no formal policies and the informal guidelines that did exist resulted in widespread inconsistencies and unnecessary expense.
  - Coatings are purely for aesthetic enhancement and provide no significant durability benefit.

New Concrete Surface Finish Policy

- **Reasons for the Change:**
  - ✓ In settings that do not have high aesthetic value, the significant cost of coatings is not justified. The new policy is estimated to save approximately $1 million annually.
  - ✓ Within a few years of construction, traffic railings are marred by black tire marks, scrapes, chips, etc. that largely negate the aesthetic value of the Class 5 finish. Most traffic rail coatings are severely weathered within 10 years resulting in a patchy appearance that includes widespread, unsightly black mildew stains. This condition can be even more unsightly than an uncoated railing of the same age.
  - ✓ Roadway barriers are rarely coated so the current policy of always coating bridge barriers results in an inconsistent policy that has minimal visual benefit especially when short lengths of coated bridge median traffic railings exist within long stretches of uncoated roadway median barriers.

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New Concrete Surface Finish Policy

- **Reasons for the Change:**
  - ✓ Almost all bridge traffic railings are slip formed and as part of the routine slip forming process, railing surfaces are pointed and patched as placement progresses. This results in an aesthetically pleasing uniform surface color and texture, so the only use for a coating is to provide a different color.
  - ✓ Rural bridges are usually isolated from other bridges and buildings and so their surface color and texture are of less concern particularly since the natural gray color of concrete is neutral. Also, there are far fewer motorists and pedestrians that view these structures on a daily basis so their visual impact is much less significant than are urban bridges, walls, railings and barriers that are in highly populated areas.
  - ✓ The policy of the Department's Maintenance Office is not to clean or recoat structures except in rare instances. After 10 to 20 years of service, an uncoated bridge and a coated bridge look very similar since by then, they are covered with various dark mildew and other unsightly stains.

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New Concrete Surface Finish Policy

These barrier walls were completed recently and they reflect the typical practice of not coating roadway barrier walls but coating bridge barrier walls. This type of bridge/roadway interface is the rule all over the state which begs the question: why coat bridge barrier walls but not roadway barrier walls?

New Concrete Surface Finish Policy

The bridge traffic railing in the left Photo has been in service less than 15 years. The lighter colored sections are the surfaces that remain of the original Class 5 coating. The color of the darker sections is the natural concrete that remains after the coating completely disintegrates. This unsightly "Patchy" appearance, which can start as early as 10 years after service begins, is typical of weathered railings and barriers all over the state. The right Photo shows the other way that the appearance of a coated barrier wall changes within 10 years of being in service. Notice the severe mildew accumulation over what was once a new Class 5 coating.

New Concrete Surface Finish Policy

The left median barrier is on a bridge and was originally coated with Class 5 that has become patchy. The right is the roadway median barrier that was not coated but has a uniform color after 20 years. Which looks better?

New Concrete Surface Finish Policy

This is a recently completed slip formed traffic railing. Notice the smooth uniform texture. The color is also fairly uniform and will improve as the surface weathers.

New Concrete Surface Finish Policy

Before the policy change, this traffic railing would have automatically been coated on all surfaces but in this isolated location only gators and snakes receive the benefit of enhanced aesthetics of coating the outside surface of the railing.

New Concrete Surface Finish Policy

The left bridge received Class 5 coating and the right bridge did not: both are about 30 years old. As you can see, both have a similar appearance and the uncoated bridge may even look a little better.

New Concrete Surface Finish Policy

- **Policy Overview:**
  - All concrete surfaces shall receive a General Concrete Finish (pointing and patching) in accordance with FDOT Standard Specification for Road and Bridge Construction (Specification) 400-15.1 or 521-4 and shall not be coated, textured, tinted or stained except in the case of Special Projects.
  - **Special Project:** a bridge, retaining wall or noise wall that is formally recognized by the Department as requiring enhanced aesthetic treatment because of its close proximity to and/or high visibility from important or popular locations with the following land uses: historical, tourist, commercial, recreational or residential.
  - When a structure is formally designated by the Department as a Special Project in agreement with a local government or other recognized organization's request, the designation must be approved by the District Secretary.

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New Concrete Surface Finish Policy

- **Policy Overview:**
  - If the Department designates a project/structure as Special, the District Design Engineer shall approve the designation.
  - If a local government or other recognized organization requests a Special Project designation and the Department is not in agreement then the Department may agree to designate the project as Special but the Exception Policy must be agreed to in advance by the local government or other recognized organization.
  - **Exception Policy:** A local government or other recognized organization shall formally agree (legal documents must be executed) to reimburse the Department for any added expense of construction as well as the expense of performing any cleaning or maintenance of coatings, textures, tints or stains during the service life of the Project when not considered to be Special by the Department.

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New Concrete Surface Finish Policy

CONCRETE SURFACE FINISH POLICY

Required Concrete Surface Finish Decision Table

TYPE STRUCTURAL COMPONENT		REQUIRED CONCRETE SURFACE FINISH	
		URBAN	RURAL
Non-Special Bridges/Projects	Bridge column, cap, traffic railing, parapet, deck coping and underside	General surface finish or a texture as specified in SSRBC 400-15 (1)	General surface finish or a texture (1)
	Retaining wall	General surface finish or a texture (1)	General surface finish or a texture (1)
	Noise wall	General surface finish or a texture (1)	General surface finish or a texture (1)
Special Bridges /Projects (4)	Inside and top surfaces of bridge and retaining wall traffic railings and parapets	General surface finish (1)	General surface finish (1)
	Bridge column, cap, and back of traffic railing and parapet	Surface finish at the discretion of the EOR with District Design Engineer (DDE) approval	Surface finish at the discretion of the EOR with DDE approval
	Retaining wall	Surface finish at the discretion of the EOR with DDE approval	Surface finish at the discretion of the EOR with DDE approval
	Noise wall	Surface finish at the discretion of the (3) EOR with DDE approval	Surface finish at the discretion of the EOR with DDE approval only after Chief Engineer approval
Roadway barriers – all surfaces		General surface finish (1) (2)	General surface finish (1) (2)

(1) Exceptions allowing the use of coatings, tints or stains require approval of the Chief Engineer

(2) Coatings, tints or stains may be applied to roadway barriers in order to be compatible with Special Bridge treatments or corridor uniformity when warranted and approved by the DDE

(3) To enhance visual uniformity and at the discretion of the DDE, coatings, tints or stains may be applied to retaining walls and bridges that are in the visual proximity of noise walls that are coated, tinted or stained

(4) Bridges/Projects may only be designated as Special by the District Secretary or DDE depending on the situation

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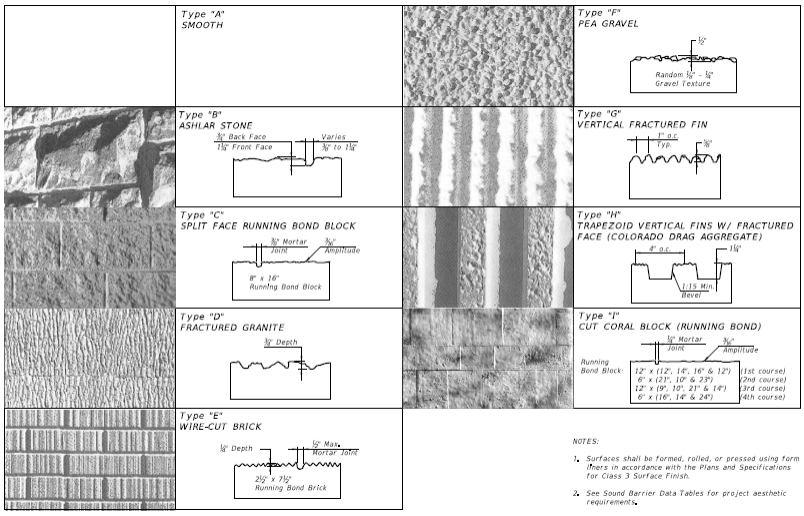

Design Standard Index 5200

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New Concrete Surface Finish Policy

- **Specification Revisions Resulting from the New Policy**
  - ✓ 400-15 will be require patching mortar to be one the following:
    - Mortar made from the same concrete mix as was the concrete being patched but without large aggregates
    - Mortar that is a blend of white cement and gray cement which must match the color of the concrete being patched.
  - ✓ The proportions of white and grey cement will require a trial and error process

Evaluation of Concrete Cracks

- **What are the steps of the crack evaluation process and which ones require EOR input?**
  - ✓ A Construction Engineering and Inspection (CEI) representative, usually a construction inspector, must view the concrete surfaces of each bridge component (footing, column, cap, beam, deck) at least 3 times during construction as follows:
    1) Soon after forms are removed
    2) After full dead loads have been applied but before use by full unrestricted traffic
    3) Shortly after use by full unrestricted traffic

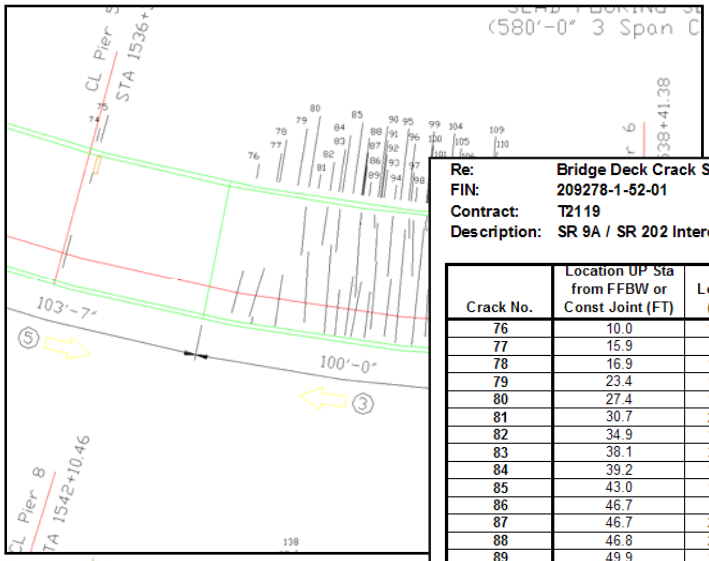
Evaluation of Concrete Cracks

So what concrete cracks have we seen?

Evaluation of Concrete Cracks

- ✓ Gather and record data for each crack including length, width, depth, termination points, and location relative to a reference point
- ✓ Develop a crack map to scale that shows the face of the concrete component containing the crack with the crack drawn in its correct position relative to a reference point along with its length and approximate alignment

Evaluation of Concrete Cracks



Re: Bridge Deck Crack Survey (720707)
FIN: 209278-1-52-01
Contract: T2119
Description: SR 9A / SR 202 Interchange

Crack No.	Location UP Sta from FFBW or Const Joint (FT)	Length (FT)	Avg Width
76	10.0	15.5	0.003
77	15.9	2.6	0.003
78	16.9	18.0	0.002
79	23.4	18.4	0.004
80	27.4	17.0	0.005
81	30.7	25.1	0.003
82	34.9	13.7	0.002
83	38.1	31.1	0.005
84	39.2	15.1	0.003
85	43.0	16.1	0.003
86	46.7	4.2	0.003
87	46.7	26.4	0.004
88	46.8	21.0	0.002
89	49.9	19.5	0.003
90	51.5	5.0	0.003

Evaluation of Concrete Cracks

Rule of Thumb (Rough Estimate) Relating Concrete Crack Width to Depth for Nonstructural Cracks

Average Crack Width (1/1000 inch or mils)	Approximate Crack Depth (inch)
4 mils	1/2 inch
8	1
12	1-1/2
16	2
20	2-1/2

Note: The depth of cracks greater than 20 mils is very variable in comparison to crack width which is why the table stops at 20 mils and these cracks are more likely to be structural.

Evaluation of Concrete Cracks

- Determine if the crack is structural or nonstructural and if possible determine the cause: EOR and possibly FDOT engineers (Materials, Maintenance, etc.) must be consulted

400-21.3 Classification of Cracks: The Engineer will classify cracks as either nonstructural or structural and determine the cause. In general, nonstructural cracks are cracks 1/2 inch or less deep from the surface of the concrete; however, the Engineer may determine that a crack greater than 1/2 inch deep is nonstructural. In general, structural cracks are cracks that extend deeper than 1/2 inch. A crack that is fully or partially underwater at any time during its service life will be classified as a structural crack unless the environment note on the General Notes sheet in the Plans categorizes the substructure as slightly aggressive, in which case, the nonstructural crack criteria may apply as determined by the Engineer.

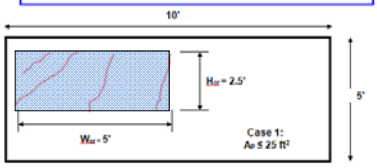
Evaluation of Concrete Cracks

- For nonstructural cracks, the CEI Engineer will use the crack map to establish the parameters needed for input to the table in Construction Specification 400-21 that establishes how cracks will be corrected
- Parameters include:
  - Elevation Range – Plans
  - Crack width Range – Crack Map
  - Crack Significance or Severity – Calculated by CEI Engineer
  - Environmental Category or classification –Plans

E cks

FOOTINGS, COLUMNS, CAPS, ETC.

NOTE: LOT size may never exceed the area of a single component face

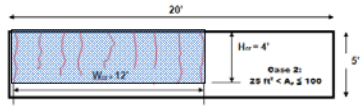


Vertical Face of a Footing, Column or Cap

Lot Size Determination for Case 1: $A_P \leq 25$ ft²

$A_P = H_{cr} \times W_{cr}$ = 2.5' X 5' = 12.5 ft² < 25 ft²,

Therefore, A_L = 25 ft²



Vertical Face of a Footing, Column or Cap

Lot Size Determination for Case 2: 25 ft² < $A_P \leq$ 100 ft²

$A_P = H_{cr} \times W_{cr}$ = 4' X 12' = 48 ft² < 100 ft²,

Therefore, A_L = 48 ft²

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Evaluation of Concrete Cracks

Table 2
DISPOSITION OF CRACKED CONCRETE BRIDGE DECKS
[see separate Key of Abbreviations and Footnotes for Tables 1 and 2]

Elev. Range	Crack Width Range (inch) (2)	Cracking Significance Range per LOT (1)											
		Isolated less than 0.005%			Occasional 0.005% to<0.017%			Moderate 0.017% to<0.029%			Severe 0.029% or gtr.		
		Environment Category											
	x = crack width	SA	MA	EA	SA	MA	EA	SA	MA	EA	SA	MA	EA
Elevation: 12 feet or Less AMHW	x ≤ 0.004	NT	NT	NT	NT	NT	NT	NT	NT	NT			
	0.004< x ≤ 0.008	NT	NT	EI/M	NT	NT	EI/M	EI/M	EI/M	EI/M			
	0.008< x ≤ 0.012	NT	NT	EI/M	NT	EI/M	EI/M	EI/M	EI/M				
	0.012< x ≤ 0.016	NT	NT	EI/M	NT	EI/M							
	0.016< x ≤ 0.020	EI/M	EI/M	EI	EI								
	0.020< x ≤ 0.024	EI/M	EI	EI		Investigate to Determine Appropriate Repair or Rejection					Reject and Replace		
	0.024< x ≤ 0.028	EI/M	EI										
	x > 0.028												
Elevation: Over Land or More Than 12 feet AMHW	Crack Width	SA	MA	EA	SA	MA	EA	SA	MA	EA	SA	MA	EA
	x ≤ 0.004	NT	NT	NT	NT	NT	NT	NT	NT	NT			
	0.004< x ≤ 0.008	NT	NT	NT	NT	NT	EI/M	NT	EI/M	EI/M			
	0.008< x ≤ 0.012	NT	NT	EI/M	NT	NT	EI/M	EI/M	EI/M				
	0.012< x ≤ 0.016	NT	NT	EI/M	NT	EI/M							
	0.016< x ≤ 0.020	NT	EI/M	EI	EI/M								
	0.020< x ≤ 0.024	NT	EI/M	EI		Investigate to Determine Appropriate Repair or Rejection					Reject and Replace		
	0.024< x ≤ 0.028	NT	EI/M										
	x > 0.028												

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Evaluation of Concrete Cracks

- Once a standard correction is determined from the table in 346-21, if "Investigation to Determine Appropriate Repair or Rejection" or "Reject and Replace" is indicated by the Specification, the EOR and FDOT engineers must be consulted by the CEI Engineer prior to issuing a final decision
- If a crack is structural or falls under the Investigate category in 346-21, the Contractor's EOR must prepare and submit a crack repair proposal to the CEI Engineer
- The CEI Engineer reviews the proposal and transmits copies to the EOR and Department Engineers for their review

Evaluation of Concrete Cracks

- For Category 1 structures, the EOR must review the proposal and indicate approval or disapproval with concurrence of District Structures Design Engineer
- For Category 2, the EOR must receive concurrence from the State Construction Structures Engineer
- There may be one or more cycles of review if the EOR and/or a Department Engineer disagrees with the Contractor's proposal and requests a revision

Evaluation of Concrete Cracks

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