

Michigan Structure Inspection Manual (MiSIM)

Chapter 5

Routine and Condition Based In-Depth Inspection

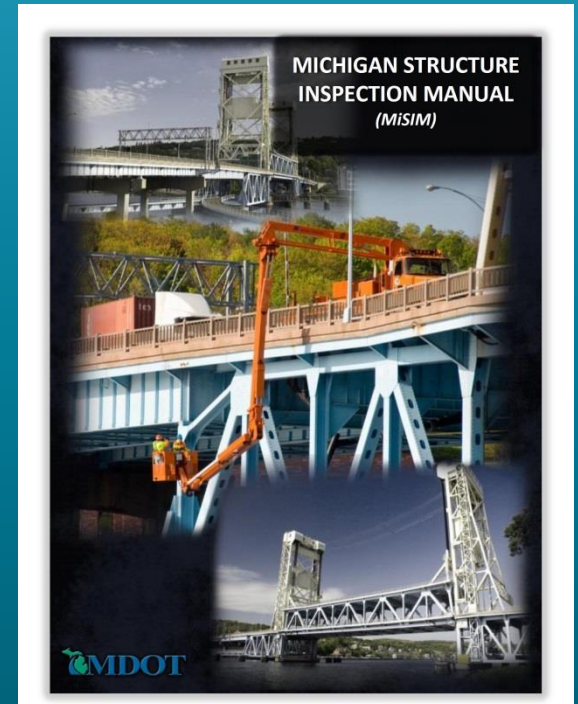


Presented by: Great Lakes Engineering Group

MiSIM Chapter 5

● Purpose

- National Bridge Inspection Standards (NBIS) require outlined procedures for initial and routine bridge safety inspections
- Chapter 5 describes the minimum inspection procedures that must be followed



Types of Inspection

● Initial Inspection

- First NBI inspection after a structure is built (or after extensive rehab has been performed)
- Perform inspection within 90 days, preferably while traffic control is still in place
- Some activities unique to an initial inspection:
 - Collection of SI&A data
 - Load rating
 - Stream bed cross sections
 - Scour evaluation
 - Identify other inspection needs (underwater, fracture critical, etc.)
 - Establish a bridge file

Types of Inspection

Routine NBI Inspection

- Applies to structures over 20' long that are in National Bridge Inventory
- Performed every 24 months or less
- Ratings given from 9 (new) to 0 (failed)

MICHIGAN DEPARTMENT OF TRANSPORTATION				
BRIDGE SAFETY INSPECTION REPORT				
STR	Facility	Latitude / Longitude	MDOT Structure ID	Structure Condition Good Condition(7)
	Feature	Length / Width	Owner	
	Location	Built / Recon. / Paint / Ovly.	TSC	Operational Status A Open, no restriction(A)
	Region / County	Material / Design	Last NBI Inspection	Scour Evaluation
NBI INSPECTION				P1GZ
Inspector Name	Agency / Company Name	Insp. Freq.	Insp. Date	
		24		
GENERAL NOTES				
DECK				
		10/11	10/13	10/15
1. Surface (SIA-58A)		7	7	7
				Concrete surface has a few transverse and longitudinal cracks. (10/15) Concrete surface has transverse cracks in spans 3s and 4s spaced every 6 feet. Few longitudinal cracks in spans 1s-4s. (10/13) Concrete surface has transverse cracks in spans 3s and 4s spaced every 6 feet. Few longitudinal cracks in spans 1s-4s. (10/11)
2. Expansion Joints		7	7	7
				There are six strip seal expansion joints, all are partially filled with debris. No signs of leakage. (10/15) There are 6 strip seal expansion joints, all are filled with debris. No signs of leakage. (10/13) There are 6 strip seal expansion joints, all are filled with debris. No signs of leakage. (10/11)
3. Other Joints		6	6	6
				North end joint has 4 ft of missing HPR seal. There is a bituminous filled spill at the east and west end of the north joint (2sft). South end joint is missing HPR along 50% of joint length. Minor leakage observed below. (10/15) North end joint has 2 ft of missing hot poured rubber seal. There is a bituminous filled spill at the west end of the north joint (2sft) with a crushed area adjacent in the approach. South end joint is missing HPR along 50% of joint length. Minor leakage observed below. (10/13) North end joint has 2 ft of missing hot poured rubber seal. There is a bituminous filled spill at the west end of the north joint (2sft). South end joint is missing HPR along 40% of joint length. Minor leakage observed below. (10/11)
4. Railings		6	5	5
				Concrete parapet with two-tube rail. Typical map cracking observed in span 4s-7s. Minor vertical and longitudinal cracks with leaching in the concrete parapet end posts. Open horizontal crack (1/8 inch wide) in the top of the west railing in span 4s-6s. 4 sft spill at base of light standard 2s, west rail. Minor impact damage at the west rail, span 3s. (10/15) Concrete parapet with 2 tube rail. Typical map cracking observed throughout. Minor vertical and longitudinal cracks with leaching in the concrete parapet end posts. Open horizontal crack (1/8 inch wide) in the top of the west railing, full length. Deteriorated/scaled area at base of light standard 2s, west rail. Impact damage at the west rail, span 3s. (10/13) Concrete parapet with 2 tube rail. Typical map cracking observed throughout. Minor vertical and longitudinal cracks with leaching in the concrete parapet end posts. Open horizontal crack (1/8 inch wide) in the top of the west railing, full length. (10/11)
5. Sidewalks or Curbs		7	6	6
				Concrete sidewalks on both sides. Spalls in sidewalk curbs in span 6s (5 sft at west side, 3s sft at east). 1 sft spill in east sidewalk curb at joint 5s. Horizontal cracks in curb faces typical. Map cracking along both sidewalk fascias. (10/15) Concrete sidewalks on both sides. Horizontal cracks in curb faces typical. Spalls at the east curb (2 sft) at joint 6s and joint 5s (1 sft). The west curb has a spill at joint 6s (1 sft). Map cracking along both sidewalk fascias. Debris and dirt covered areas along west sidewalk. (10/13) Concrete sidewalks on both sides. Horizontal cracks in curb faces typical. Spalls at the east curb (2 sft) at joint 6s and joint 5s (1 sft). The west curb has a spill at joint 6s (1 sft). (10/11)
6. Deck Bottom Surface (SIA-58B)		8	8	8
				Metal stay-in-place forms. Good condition. (10/15) Metal stay-in-place forms. Good condition. (10/13) Metal stay-in-place forms. Good condition. (10/11)
Form P2502		Printed on 03/16/2016		Page 1 of 4

Types of Inspection

● Element Level Inspection

- Identifies bridge elements and quantifies deterioration
- Condition state ratings given to each element from 1 (good) to 4 (severe)
- Types of deterioration are quantified (cracking, spalling, corrosion, etc.)
- Refer to Michigan Bridge Element Inspection Manual (March 2015)

Michigan Bridge Element Inspection Manual

DECK (sq. ft.)

Description: This element defines all bridge decks regardless of the wearing surface or protection systems used. Decks carry traffic and transfer loads to the superstructure.

No.	Name	CS Table	Description
800	Reinforced Concrete Black Bars	1	Reinforced concrete bridge decks constructed with uncoated "black" reinforcement.
813	Reinforced Concrete Slag Aggregate	1	Reinforced concrete bridge decks containing slag aggregate regardless of the reinforcement type.
801	Reinforced Concrete Stainless Bars	1	Reinforced concrete bridge decks constructed with stainless steel, stainless clad, or MMFX reinforcement.
802	Reinforced Concrete Nonmetallic Bars	1	Reinforced concrete bridge decks constructed with nonmetallic reinforcement, such as fiberglass, aramid or carbon composite reinforcement.
803	Reinforced Concrete Coated Bars	1	Reinforced concrete bridge decks constructed with epoxy coated or galvanized reinforcement.
804	Precast Reinforced Concrete	1	Reinforced concrete bridge decks precast using conventional reinforcement and then post-tensioned.
13	Prestressed Concrete	2	Prestressed concrete bridge decks.
28	Steel with Open Grid	3	All open grid steel decks with no fill.
29	Steel with Concrete Filled Grid	3	Steel bridge decks with concrete fill either in all of the openings or within the wheel tracks.
30	Steel - Corrugated/ Orthotropic/Etc.	3	Corrugated metal filled with portland cement, asphaltic concrete or other riding surfaces and Orthotropic steel. Materials added for riding surface are not part of the element condition.

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Michigan Bridge Element Inspection Manual

CS TABLE 1 – REINFORCED CONCRETE

Defect	Condition State 1	Condition State 2	Condition State 3	Condition State 4
	GOOD	FAIR	POOR	SEVERE
Spalls/ Delaminations/ Patch Areas (1080)	None.	Delaminated. Spall 1 in. or less deep or less than 6 in. diameter. Patched area is sound.	Spall greater than 1 in. deep or greater than 6 in. diameter. Patched area is unsound or showing distress. Does not warrant structural review.	The condition warrants a structural review to determine the effect on strength or serviceability of the element or bridge; OR a structural review has been completed and the defects impact strength or serviceability of the element or bridge.
Exposed Rebar (1090)	None.	Present without section loss.	Present with section loss that does not warrant structural review.	
Efflorescence / Rust Staining (1120)	None.	Surface white without build-up or leaching without rust staining.	Heavy build-up with rust staining.	
Cracking ⁽¹⁾ Reinforced Concrete and Other (1130)	Insignificant cracks or moderate-width cracks that have been sealed.	Unsealed moderate-width cracks or unsealed moderate pattern (map) cracking.	Wide cracks or heavy pattern (map) cracking.	
Abrasion /Wear (1190)	No Abrasion of wearing	Abrasion or wearing has exposed coarse aggregate	Coarse aggregate is loose or has popped out of the concrete matrix due to abrasion or wear.	
Distortion – Culvert (1900)	None.	Distortion not requiring mitigation or mitigated distortion.	Distortion that requires mitigation but does not require structural review.	
Settlement – Substructure Elements (4000)	None.	Exists within tolerable limits or arrested with effective actions taken to mitigate.	Exceeds tolerable limits but does not warrant structural review.	

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Types of Inspection

● Element Level Inspection

- Applies to all NBI structures on National Highway System (NHS)
- Condition state ratings (1-4) given to bridge elements
- MDOT requires element level inspection for additional structures:
 - MDOT owned pedestrian bridges
 - Railroad bridges where MDOT is responsible for superstructure maintenance
 - Structures with 10' to 19' span lengths
 - Plaza structures
- Local Agencies
 - Element level inspection required only on NHS routes



Bridge Owner Responsibilities

- Request access to MiBRIDGE
- Review structure inventory, previous inspections, future inspection dates
- Assign reports to inspection team leaders as needed
 - Assign inspections 30 days before they are due
 - Identify structures that require Element Level inspection
- Verify that inspection data is complete for each structure
 - Routine/element level inspection reports, load rating assumption and summary forms, scour action plans, etc.
- Review, respond, and act upon Requests for Action (RFAs)
- Maintain up-to-date bridge files
 - Include inspector credentials and QC plan
 - Refer to MiSIM Chapter 4 for bridge file requirements
- Bridge owner is ultimately responsible for ensuring compliance with federal and state laws

Team Leader Responsibilities

- Perform inspection in accordance with BIRM, MBE, and MDOT policies
- Maintain QTL status by attending MDOT approved continuing education
 - 24 hours of continuing education required every 5 years
- Watch for MDOT bridge advisories and inspection manual updates through MDOT Bridge Operations website
- Attendance at inspection alignment meetings and workshops is encouraged

MiSIM Chapter 5

- Remainder of Chapter 5 discusses individual bridge items and their associated inspection procedures

- Organization

- Item description
- Routine NBI inspection
- Element level inspection
- Work recommendations
- Request for action
- In-depth inspection

MICHIGAN STRUCTURE INSPECTION MANUAL
BRIDGE INSPECTION
CHAPTER 5
ROUTINE and CONDITION BASED IN-DEPTH INSPECTION

5.01 Purpose

The National Bridge Inspection Standards (NBIS) require each state to have outlined procedures for initial and routine bridge safety inspections. This chapter describes the minimum inspection procedures that must be adhered to once a bridge is opened to the public for routine inspections. Bridge owners and inspection team leaders should periodically review the MDOT Bridge Operations web page for advisories, manual updates, and additional information affecting Michigan's Bridge Inspection Program. The requirements of the Federal Highway Administration (FHWA) [Bridge Inspectors Reference Manual](#) (BIRM), AASHTO Manual for Bridge Evaluation (MBE), and those specified herein shall be adhered to by all involved in the inspection and condition rating of Michigan's bridge inventory.

5.02 Routine Inspection Types

A routine inspection is defined by NBIS as a regularly scheduled inspection consisting of observations and/or measurements needed to determine the physical and functional condition of the bridge, to identify any changes from initial or previously recorded conditions, and to ensure that the structure continues to satisfy present service requirements. All elements of the bridge must be visually inspected at a distance that is close enough to determine to overall condition and to detect deficiencies. When portions of primary members are not visible from the ground or water surface then specialized equipment such as a platform bucket truck, or under-bridge inspection unit should be used to gain visual access to the elements (see Figure 5.02.01).




Figure 5.02.01 Utilization of an Under-Bridge Inspection Unit during Routine Inspection

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● Bridge Item

- Surface (BSIR #1, SIA Item 58A)
- Expansion Joints (BSIR #2)
- Other Joints (BSIR #3)
- Railings (BSIR #4)
- Sidewalks or Curbs (BSIR #5)
- Deck Bottom Surface (BSIR #6)
- Deck (BSIR #7, SIA Item 58)
- Drainage (BSIR #8)
- Stringer (BSIR #9, SIA Item 59)
- Paint (BSIR #10, SIA Item 59A)
- Section Loss Under Joints (BSIR #11)
- Bearings (BSIR #12)
- Abutments (BSIR #13, SIA Item 60)
- Piers (BSIR #14, SIA Item 60)
- Slope Protection (BSIR #15)
- Approach (BSIR #16)
- Approach Shoulders and Sidewalks (BSIR #17)
- Approach Slopes (BSIR #18)
- Utilities (BSIR #19)
- Channel (BSIR #20, SIA Item 61)
- Drainage Culverts (BSIR #21)

● Topics Covered for Each Item

- Item Description
- Routine NBI Inspection
- Element Level Inspection
- Work Recommendations
- Request for Action
- In-Depth Inspection

MiSIM Chapter 5 - Deck

- Use Deck (BSIR #7, SIA Item 58) as example

- MiSIM Chapter 5

- Item description
- Routine NBI inspection
- Element level inspection
- Work recommendations
- Request for action
- In-depth inspection

- NBI Rating Exercise

- Element Level Exercise

- RFA Considerations

- In-Depth Inspection Needs



MiSIM Chapter 5 - Deck

● Item Description

- 3D in nature – assess defects in top, bottom, and fascia surfaces
- Does not take into account wearing surfaces, joints, curbs, sidewalks, parapets, railings, or scuppers.

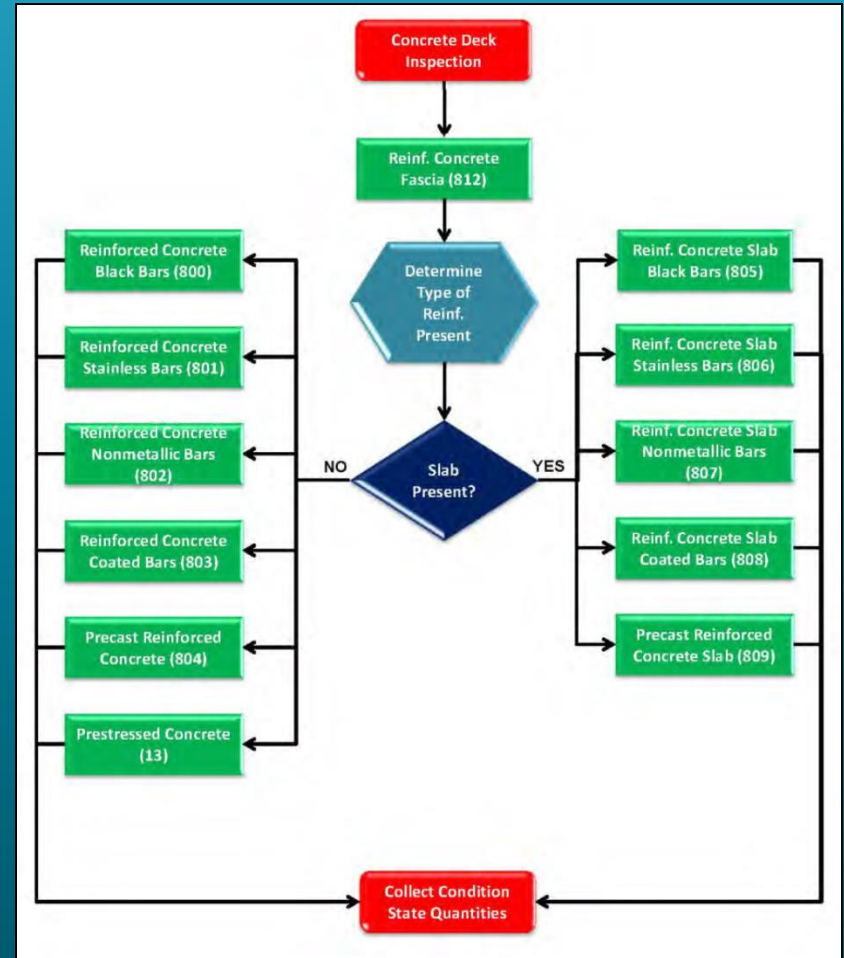
● Routine NBI Inspection

- Inspect all deck surfaces for cracking, delamination, spalling, scaling, and patches. Document type of deterioration, location, and size.
- If present, inspect stay-in-place forms for corrosion and other deterioration. Document extent of deterioration, location, and size.
- Identify areas of false decking along deck bottom.
- Ensure posting signs (if necessary) are in place and accurate.

MiSIM Chapter 5 - Deck

● Element Level Inspection

- Assessment of deck top, bottom, and fascia surfaces
- Helpful to visualize a 1' x 1' grid placed along the surfaces
- When multiple types of deterioration exist in the same vicinity, use the worst condition state of the defects observed
- Refer to Michigan Bridge Element Inspection Manual



Michigan Bridge Element Inspection Manual
Figure 5.11.03 Concrete Deck Element Collection Process

MiSIM Chapter 5 - Deck

Work Recommendations

- Provide applicable work recommendations to address deficiencies in deck surface, bottom, and fascias
- Overall condition of deck should be considered before making recommendations (for example, don't call for healer sealer on a deck in poor condition)

Concrete (Item 58 & 58B ≥ 5)		
Recommendation	Defects	Additional Information
Crack Chasing (Penetrating Sealer)	Cracking, limited, spaced 2' apart or greater	Limited to agencies with direct maintenance forces
Healer Sealer Floodcoat	Cracking, significant, many spaced 2' or less	Generally effective for approximately 6 to 10 years
Thin Overlay Floodcoat	Cracking, significant, many spaced 2' or Less	Generally effective for more than 10 years
Deck Patching	Spalling, greater than 1" deep or 6" diameter	Improves Item 58, 58B, and element ratings
Thin Overlay (Item 58 ≥ 5)		
Recommendation	Defects	Additional Information
Crack Chasing (Penetrating Sealer)	Cracking, limited, spaced at 10' or greater	Limited to agencies with direct maintenance forces
Overlay Patching	Failed effectiveness, 5% or less of the total area	Limited to agencies with direct maintenance forces
Remove and Replace	Failed effectiveness, 5% or more of the total area	Improves Item 58, 58B, and element ratings
Hot Mix Asphalt (Item 58 ≥ 5)		
Recommendation	Defects	Additional Information
Hot Pour Rubber or Overband Crack Seal	Cracking, spaced at 50' or greater	Generally effective for less than 5 years
Hot Mix Asphalt Patching	Spalling, does not extend to structural deck	Improves Item 58B and element ratings
Timber (Item 58 ≥ 5)		
Recommendation	Defects	Additional Information
Water Repellent Treatment	Decay, affects less than 10% or less of the member	Preserves condition to protect deck
Replace Planks	Damage, missing running planks	Improves Item 58B and element ratings

Michigan Bridge Element Inspection Manual
Table 5.05.06 Work Recommendations for Common Bridge Deck Wearing Surfaces

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Request For Action

- An RFA shall be submitted when:
 - Condition of deck poses a hazard to motorists
 - Detailed inspection is required
 - Any issue requiring immediate attention

Request for Action	Concrete	Thin Overlay	Hot Mix Asphalt	Timber
In-Depth Inspection	X	X	X	X
Cracking Caused by Reduced Superstructure Capacity	X	X	X	X
Verification of Acceptable Skid Resistance	X	X		
Severe Deterioration resulting in unsafe ride quality conditions	X	X	X	X
Spalling Exposing Prestressed Superstructure Elements			X	
Severe Surface Rutting Inhibiting Drainage			X	

Michigan Bridge Element Inspection Manual
Table 5.05.07 RFA Examples for Common Bridge Deck Wearing Surfaces

MiSIM Chapter 5 - Deck

- In-Depth Inspection

- Shall be performed as needed
- Hands-on inspection should be completed when NBI deck rating is 6 or less
- Detailed inspection suggested when NBI deck rating is 4 or less
- Detailed inspection required for decks when any Element Level Inspection quantity reaches condition state 4

NBI Rating (Item 58)	Schedule Initial In-depth Within	In-Depth Frequency	Applicable Deck Materials		
6	24 Months	As-Needed	Concrete	Steel	Timber
4	12 Months	48 Months	Concrete	Steel	Timber

Michigan Bridge Element Inspection Manual

Table 5.11.05 Recommended Condition Based In-Depth Inspection Guideline for Decks or Slabs

Example Rating Exercise – Deck

- NBI Rating

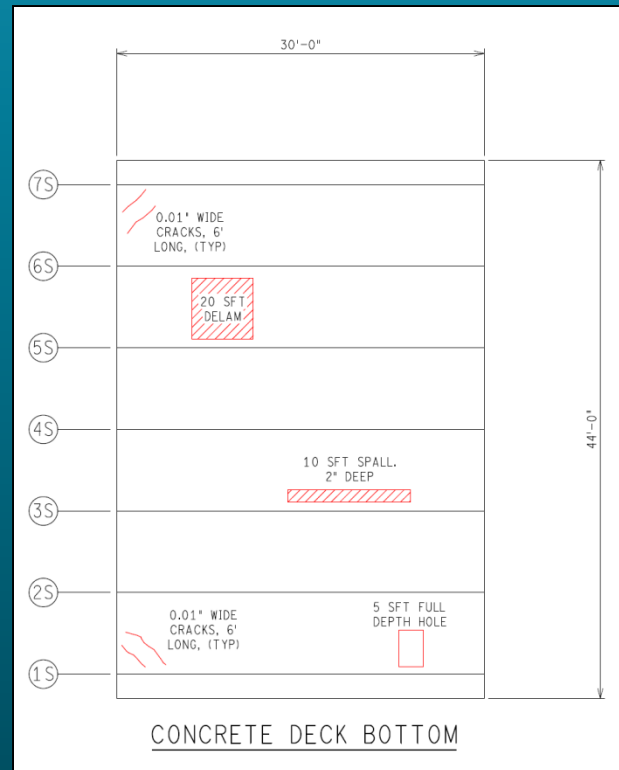
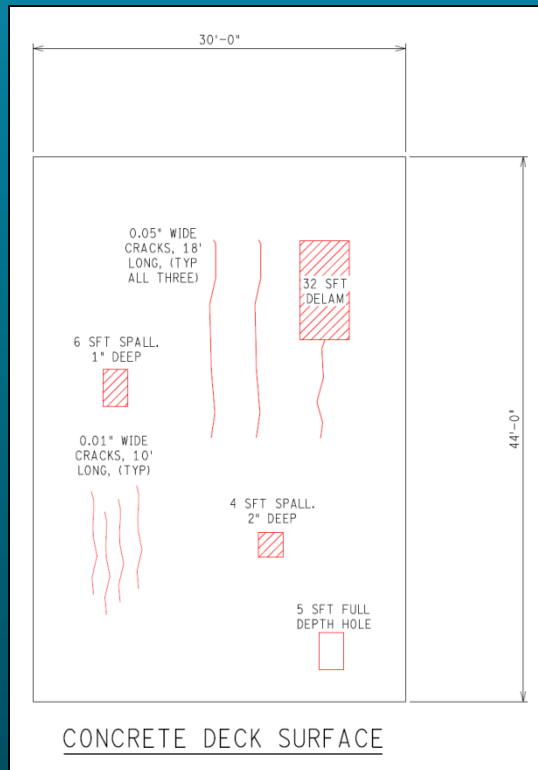
- Rate 9 (new) through 0 (failed) based on overall condition of item

- Element Level Ratings

- Quantify deterioration in bridge elements and categorize into four condition states

NBI Rating Exercise – Deck

- Cracks, delamination, spalls, full depth hole in wheel line
- Deck fascia's have no defects
- There is no wearing surface
- Deck NBI Rating = ?



Element Level Exercise - Deck

- Identify bridge deck elements
 - 803 – Reinforced Concrete Coated Bars (assume epoxy coated bars)
 - 810 – Reinforced Concrete Deck Top Surface
 - 811 – Reinforced Concrete Deck Bottom Surface
 - 812 – Reinforced Concrete Fascia
 - No wearing surface

Michigan Bridge Element Inspection Manual

DECK (sq. ft.)

Description: This element defines all bridge decks regardless of the wearing surface or protection systems used. Decks carry traffic and transfer loads to the superstructure.

No.	Name	CS Table	Description
800	Reinforced Concrete Black Bars	1	Reinforced concrete bridge decks constructed with uncoated "black" reinforcement.
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30	Steel - Corrugated/Orthotropic/Etc.	3	Corrugated metal filled with portland cement, asphaltic concrete or other riding surfaces and Orthotropic steel. Materials added for riding surface are not part of the element condition.

DECK TOP SURFACE (sq. ft.)

Description: These elements define the top surfaces of bridge decks.

No.	Name	CS Table	Description
810	Reinforced Concrete Deck Top Surface	1	Top surface of reinforced concrete deck, slab, or top flange elements that do not have a wearing surface.

Quantity Calculation: Equal to the reinforced concrete deck, slab, or top flange elements.

Element Commentary: The surface evaluation is two dimensional in nature with the defects observed on the top surface. When a wearing surface is present that covers the entire top surface, only the appropriate wearing surface element is recorded and ADE 810 is not used.

DECK BOTTOM SURFACE (sq. ft.)

Description: These elements define the bottom surfaces of bridge decks.

No.	Name	CS Table	Description
811	Reinforced Concrete Deck Bottom Surface	1	Bottom surface of reinforced concrete deck, slab, or top flange elements.

Quantity Calculation: Equal to the reinforced concrete deck, slab or top flange elements.

Element Commentary: The surface evaluation is two dimensional in nature with the defects observed on bottom surface. When stay-in-place forms are present, use element 822 in lieu of Element 811, Reinforced Concrete Bottom Surface. When False Decking or Maintenance Sheeting is in place, use Element 811 for Reinforced Concrete Bottom Surface and the appropriate False Decking/Sheeting Item.

FASCIA (ft.)

Description: This element defines the condition of the fascia of bridge decks.

No.	Name	CS Table	Description
812	Reinforced Concrete Fascia	1	Element to monitor the condition of the bridge fascia of reinforced concrete decks.

Quantity Calculation: The quantity for the element is measured along the length of the deck fascia and may include either the edge of a brush block or the edge of the structural deck.

Element Commentary: Reinforced concrete fascia are susceptible to deterioration and spalling similar to any concrete element. However, installation of false decking to contain spalls may not be applicable to this section of the deck. Additionally, the fascia is integral to the connection of the bridge barrier to the structural deck. This element is inspected to identify maintenance needs for scaling or patching and to monitor the connection of the bridge barrier to the structural deck. As such, this element would include the structural deck that extends beyond the fascia beam as well as any deck appurtenances (such as a sidewalk fascia or barrier brush block) that extend beyond the structural deck.

Element Level Exercise – Deck Surface

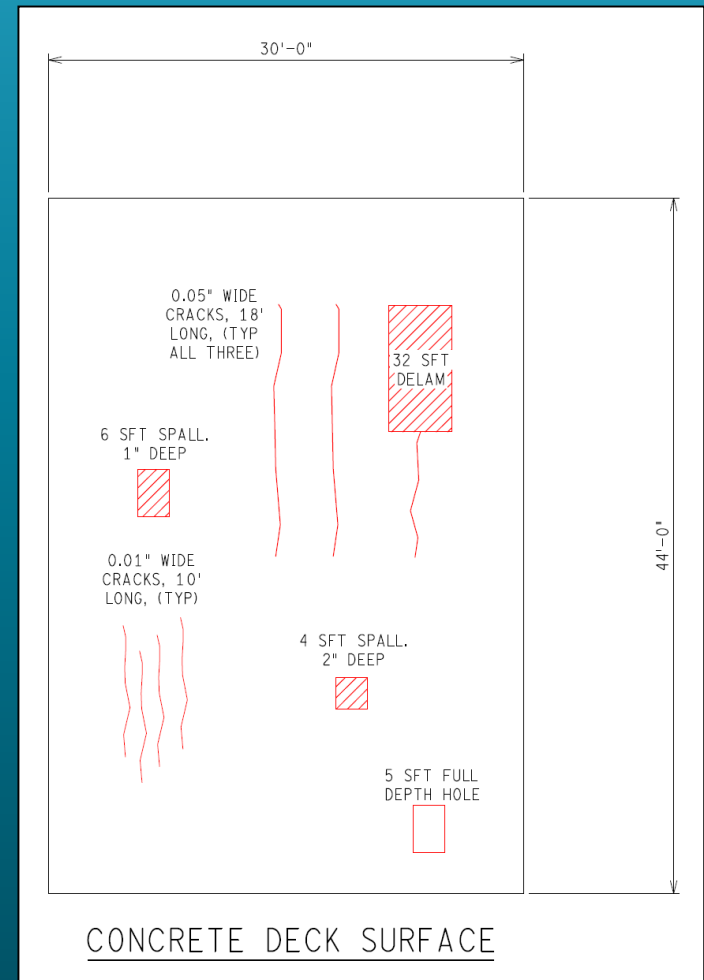
- Determine defect type and quantity in deck surface
- Use manual to find condition state

Michigan Bridge Element Inspection Manual

CS TABLE 1 – REINFORCED CONCRETE

Defect	Condition State 1	Condition State 2	Condition State 3	Condition State 4
	GOOD	FAIR	POOR	SEVERE
Spalls/ Delaminations/ Patch Areas (1080)	None.	Delaminated. Spall 1 in. or less deep or less than 6 in. diameter. Patched area is sound.	Spall greater than 1 in. deep or greater than 6 in. diameter. Patched area is unsound or showing distress. Does not warrant structural review.	
Exposed Rebar (1090)	None.	Present without section loss.	Present with section loss that does not warrant structural review.	The condition warrants a structural review to determine the effect on strength or serviceability of the element or bridge; OR a structural review has been completed and the defects impact strength or serviceability of the element or bridge.
Efflorescence / Rust Staining (1120)	None.	Surface white without build-up or leaching without rust staining.	Heavy build-up with rust staining.	
Cracking ⁽¹⁾ Reinforced Concrete and Other (1130)	Insignificant cracks or moderate-width cracks that have been sealed.	Unsealed moderate-width cracks or unsealed moderate pattern (map) cracking.	Wide cracks or heavy pattern (map) cracking.	
Abrasion /Wear (1190)	No Abrasion of wearing	Abrasion or wearing has exposed coarse aggregate	Coarse aggregate is loose or has popped out of the concrete matrix due to abrasion or wear.	
Distortion – Culvert (1900)	None.	Distortion not requiring mitigation or mitigated distortion.	Distortion that requires mitigation but does not require structural review.	
Settlement – Substructure Elements (4000)	None.	Exists within tolerable limits or arrested with effective actions taken to mitigate.	Exceeds tolerable limits but does not warrant structural review.	

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Defect Type	Quantity	Condition State
Cracks (0.01" wide)	40 SFT	?
Cracks (0.05" wide)	54 SFT	?
Delamination	32 SFT	?
Spall, 1" deep	6 SFT	?
Spall, 2" deep	4 SFT	?
Full depth hole	5 SFT	?

Element Level Exercise – Deck Surface

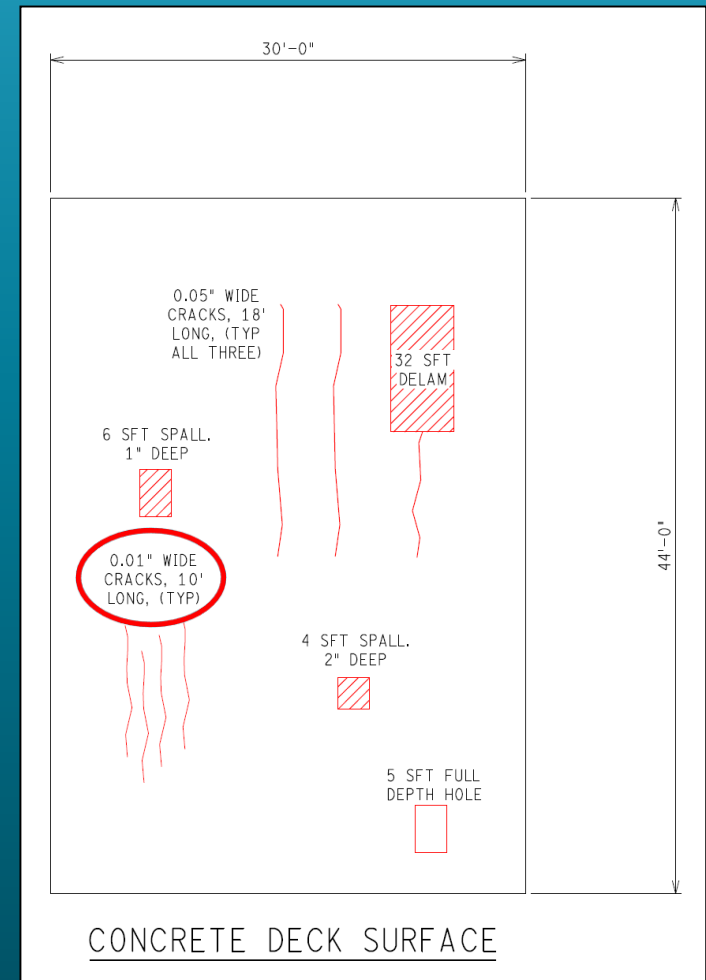
- Determine defect type and quantity in deck surface
- Use manual to find condition state

Michigan Bridge Element Inspection Manual

CS TABLE 1 – REINFORCED CONCRETE

Defect	Condition State 1 GOOD	Condition State 2 FAIR	Condition State 3 POOR	Condition State 4 SEVERE
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Full depth hole	5 SFT	

Element Level Exercise – Deck Surface

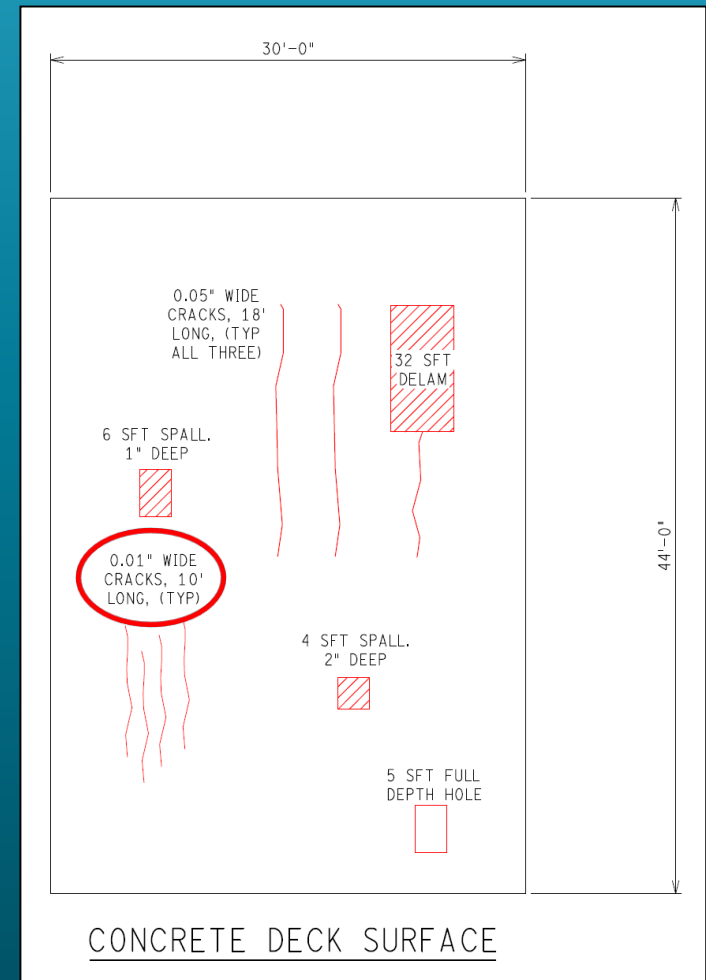
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Michigan Bridge Element Inspection Manual

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Defect Type	Quantity	Condition State
Cracks (0.01" wide)	40 SFT	1
Cracks (0.05" wide)	54 SFT	
Delamination	32 SFT	
Spall, 1" deep	6 SFT	
Spall, 2" deep	4 SFT	
Full depth hole	5 SFT	

Element Level Exercise – Deck Surface

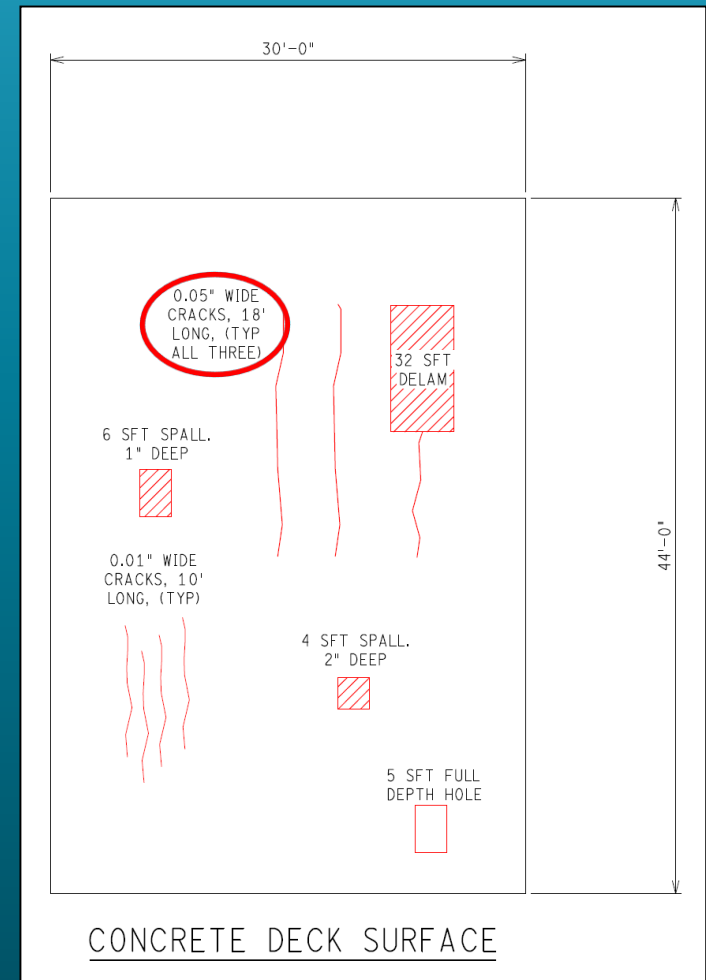
- Determine defect type and quantity in deck surface
- Use manual to find condition state

Michigan Bridge Element Inspection Manual

CS TABLE 1 – REINFORCED CONCRETE

Defect	Condition State 1 GOOD	Condition State 2 FAIR	Condition State 3 POOR	Condition State 4 SEVERE
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Exposed Rebar (1090)	None.	Present without section loss.	Present with section loss that does not warrant structural review.	The condition warrants a structural review to determine the effect on strength or serviceability of the element or bridge; OR a structural review has been completed and the defects impact strength or serviceability of the element or bridge.
Efflorescence / Rust Staining (1120)	None.	Surface white without build-up or leaching without rust staining.	Heavy build-up with rust staining.	
Cracking ⁽¹⁾ Reinforced Concrete and Other (1130)	Insignificant cracks or moderate-width cracks that have been sealed.	Unsealed moderate-width cracks or unsealed moderate pattern (map) cracking.	Wide cracks or heavy pattern (map) cracking.	
Abrasion /Wear (1190)	No Abrasion of wearing	Abrasion or wearing has exposed coarse aggregate	Coarse aggregate is loose or has popped out of the concrete matrix due to abrasion or wear.	
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Element Level Exercise – Deck Surface

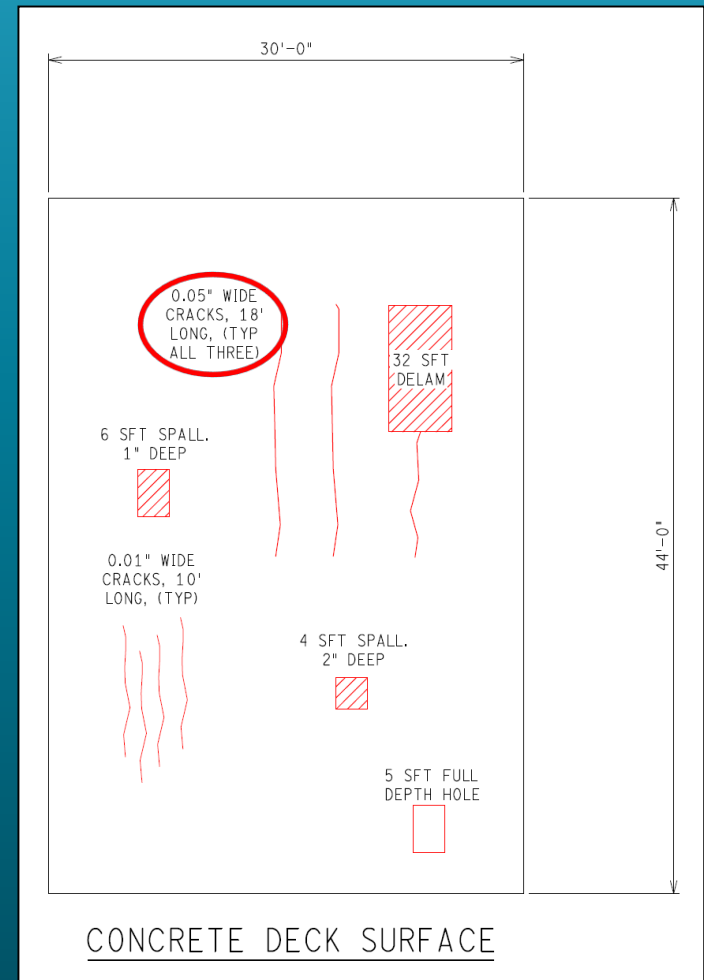
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Element Level Exercise – Deck Surface

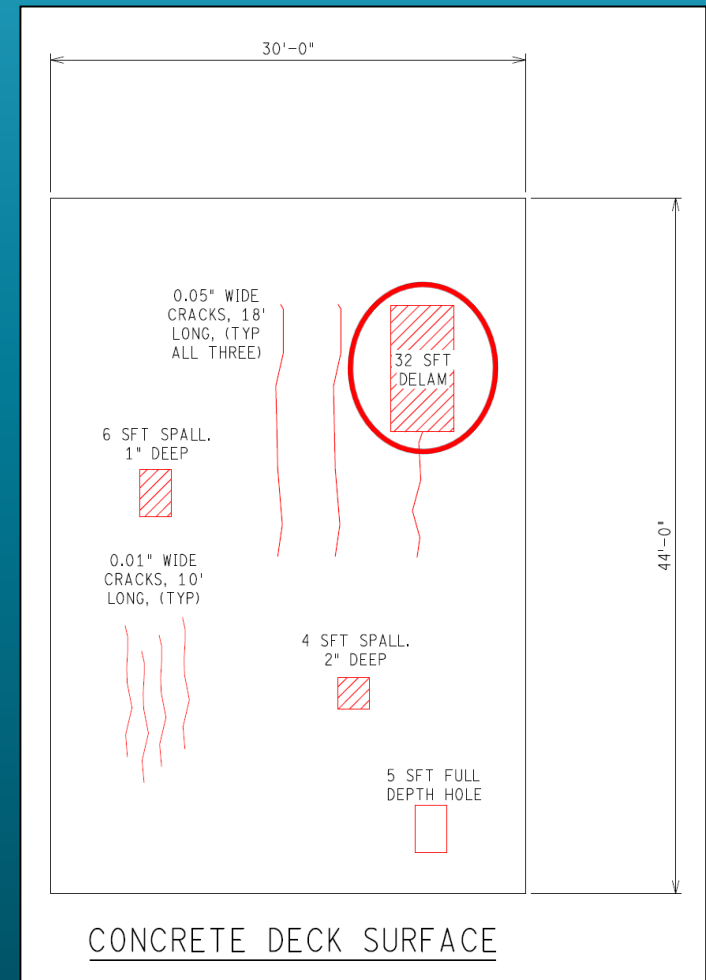
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Michigan Bridge Element Inspection Manual

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Element Level Exercise – Deck Surface

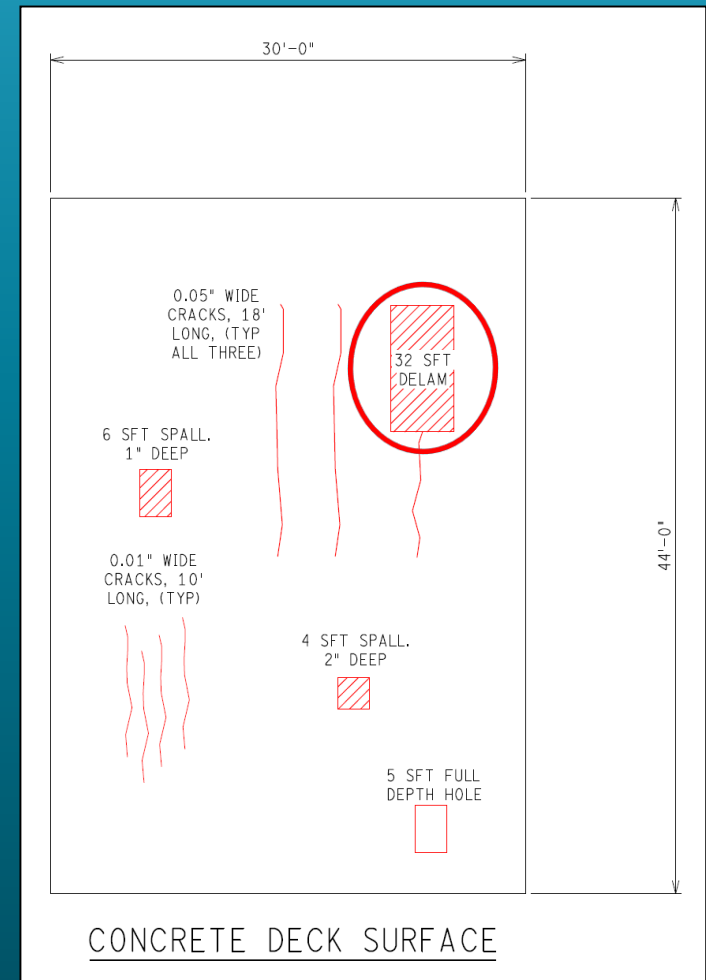
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Spall, 2" deep	4 SFT	
Full depth hole	5 SFT	

Element Level Exercise – Deck Surface

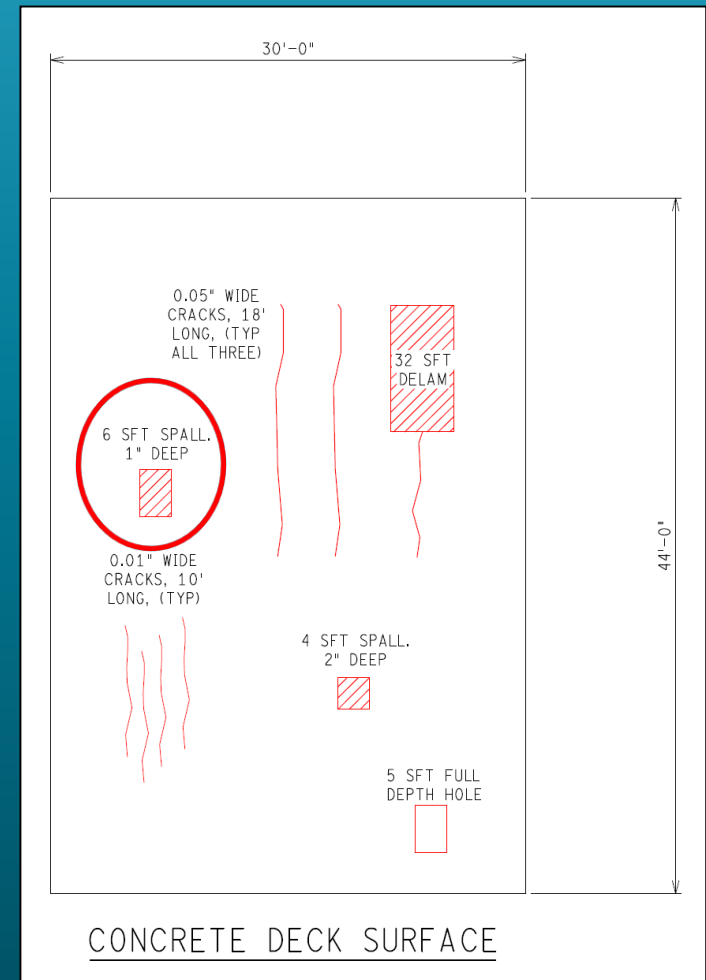
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Michigan Bridge Element Inspection Manual

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Spall, 2" deep	4 SFT	
Full depth hole	5 SFT	

Element Level Exercise – Deck Surface

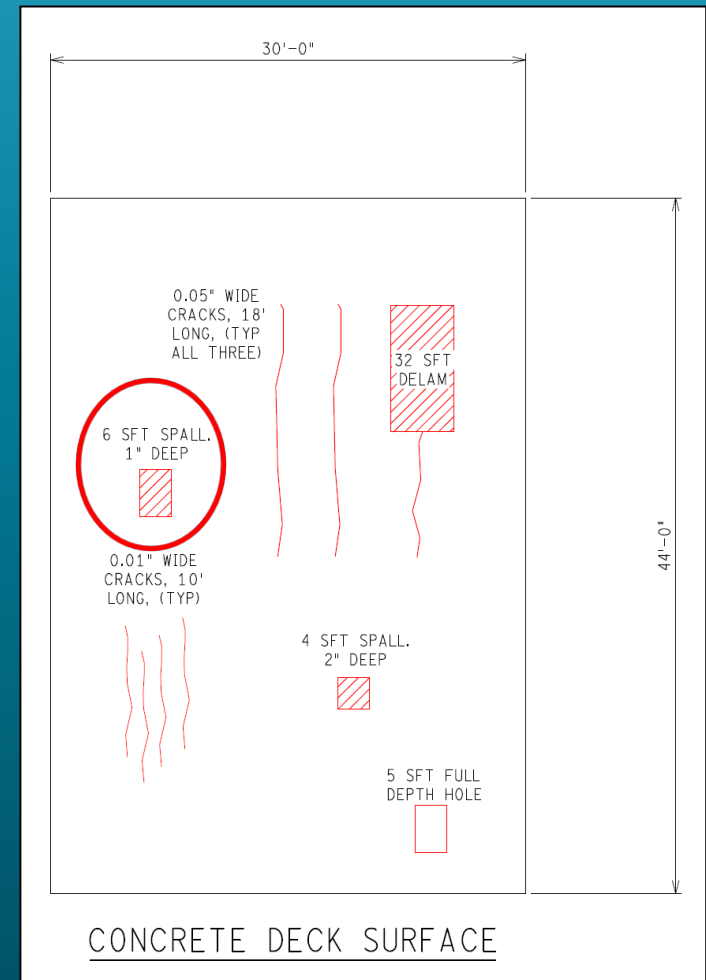
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Delamination	32 SFT	2
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Spall, 2" deep	4 SFT	
Full depth hole	5 SFT	

Element Level Exercise – Deck Surface

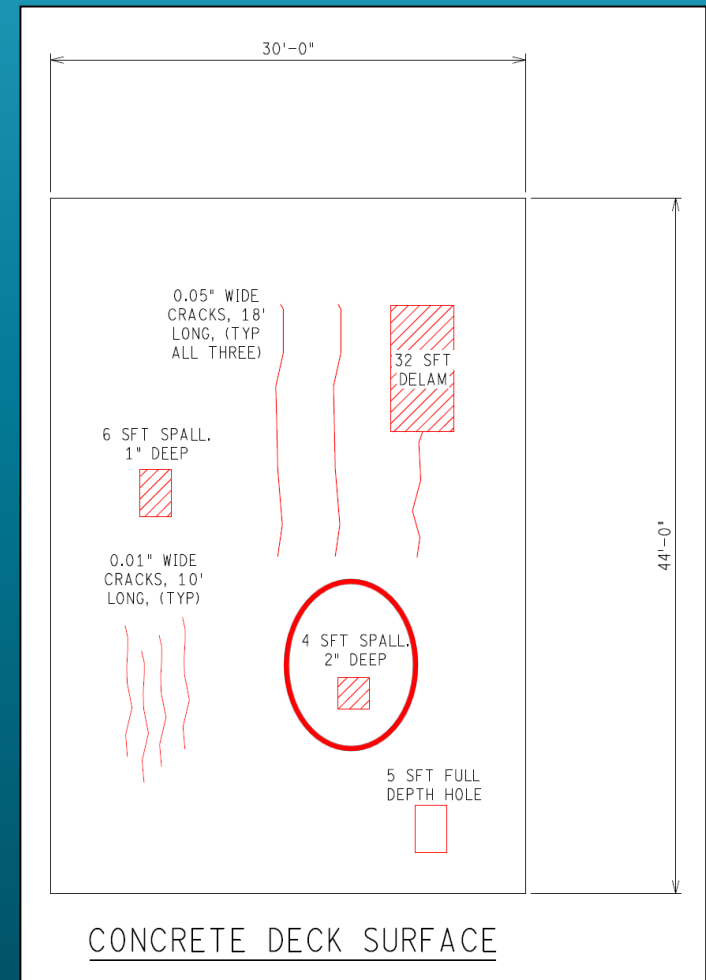
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Delamination	32 SFT	2
Spall, 1" deep	6 SFT	2
Spall, 2" deep	4 SFT	?
Full depth hole	5 SFT	

Element Level Exercise – Deck Surface

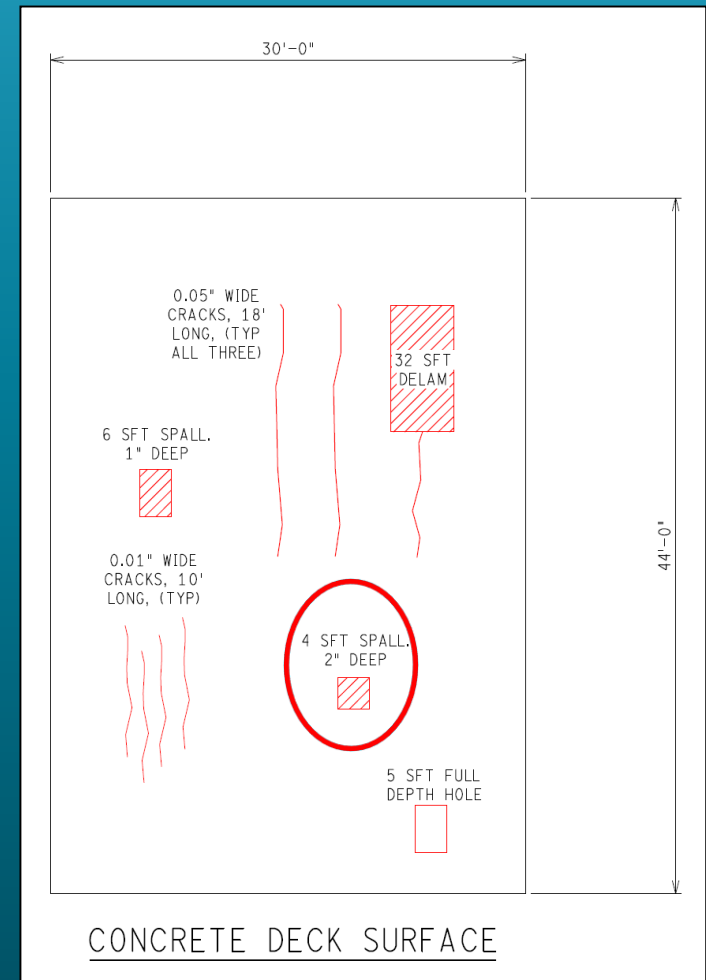
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Spall, 2" deep	4 SFT	3
Full depth hole	5 SFT	

Element Level Exercise – Deck Surface

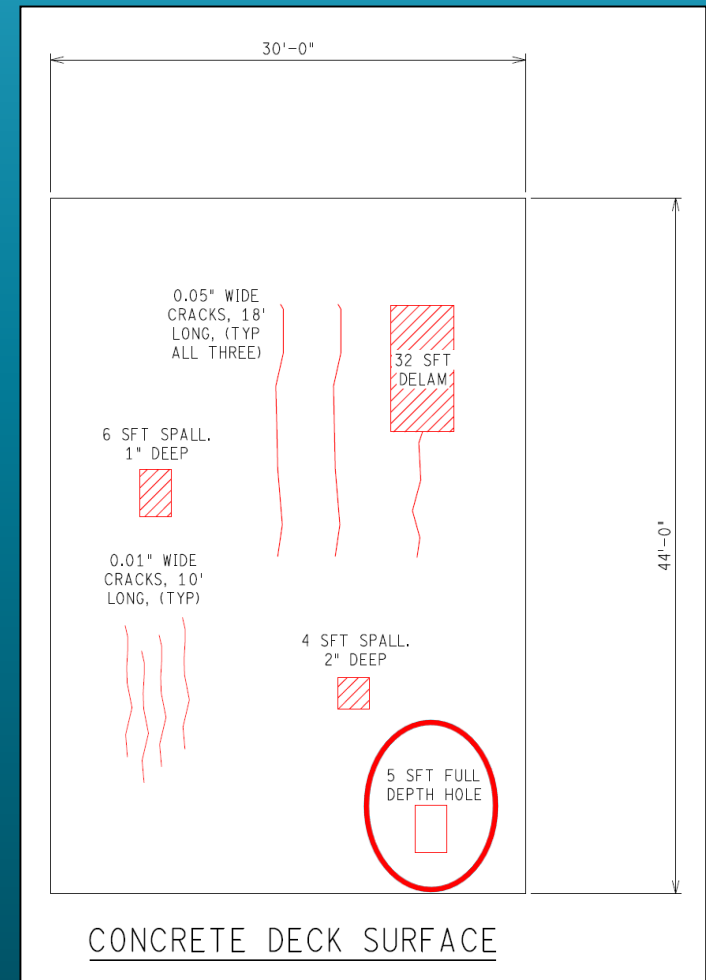
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Cracks (0.05" wide)	54 SFT	2
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Spall, 1" deep	6 SFT	2
Spall, 2" deep	4 SFT	3
Full depth hole	5 SFT	?

Element Level Exercise – Deck Surface

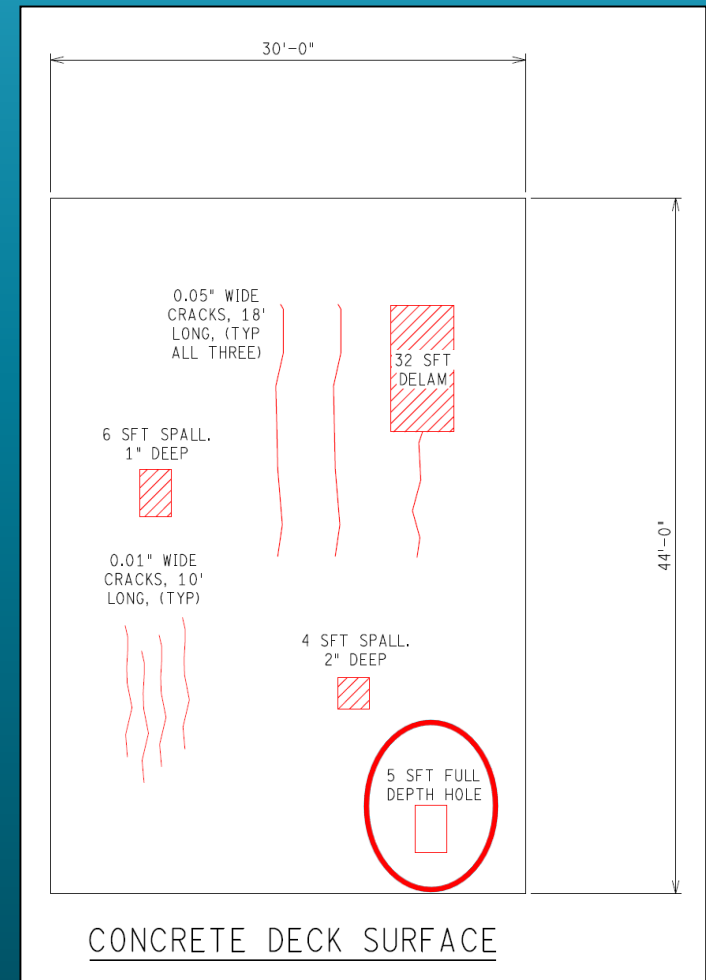
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Delamination	32 SFT	2
Spall, 1" deep	6 SFT	2
Spall, 2" deep	4 SFT	3
Full depth hole	5 SFT	4


Element Level Exercise – Deck Surface

- Total area = 44' x 30' = 1320 SFT

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Cracks (0.05" wide)	54 SFT	2
Delamination	32 SFT	2
Spall, 1" deep	6 SFT	2
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Full depth hole	5 SFT	4

MICHIGAN DEPARTMENT OF TRANSPORTATION

STR SAFETY INSPECTION REPORT - AASHTO ELEMENTS

STR	Latitude / Longitude	MDOT Structure ID	Structure Condition
Facility			
Feature	Length / Width	Owner	
Location	Built / Recon. / Paint / Ovly.	TSC	Operational Status
Region / County	Material / Design	Last NBI Inspection	Scour Evaluation

BRIDGE
 POST-TENSIONING
 XX TON
 DE WALT BRIDGE

NBI INSPECTION 6Q8D

Inspector Name	Agency / Company Name	Insp. Freq.	Insp. Date

AASHTO ELEMENTS (English Units)

Element Number	Element Name	Total Quantity	Unit	Good CS1	Fair CS2	Poor CS3	Severe CS4
Decks/Slabs							
803	Conc Deck - Coated Bars	1320	sq.ft	1189 90%	112 8%	14 1%	5 0%
810	Conc Deck - Top Surface	1320	sq.ft	1219 92%	92 7%	4 0%	5 0%
811	Conc Deck - Btm Surface	1320	sq.ft	1285 97%	20 2%	10 1%	5 0%
812	Reinf Conc Fascia	60	ft	60 100%	0 0%	0 0%	0 0%

Element Level Exercise – Deck Bottom

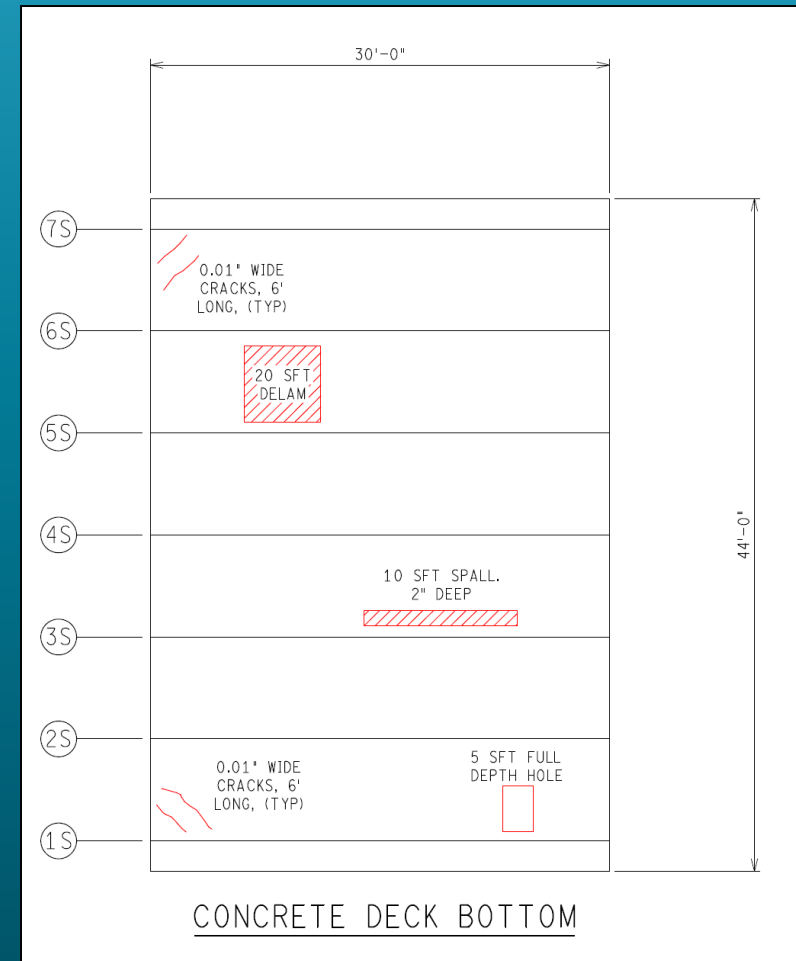
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Defect Type	Quantity	Condition State
Cracks (0.01" wide)	24 SFT	?
Delamination	20 SFT	?
Spall, 2" deep	10 SFT	?
Full depth hole	5 SFT	?

Element Level Exercise – Deck Bottom

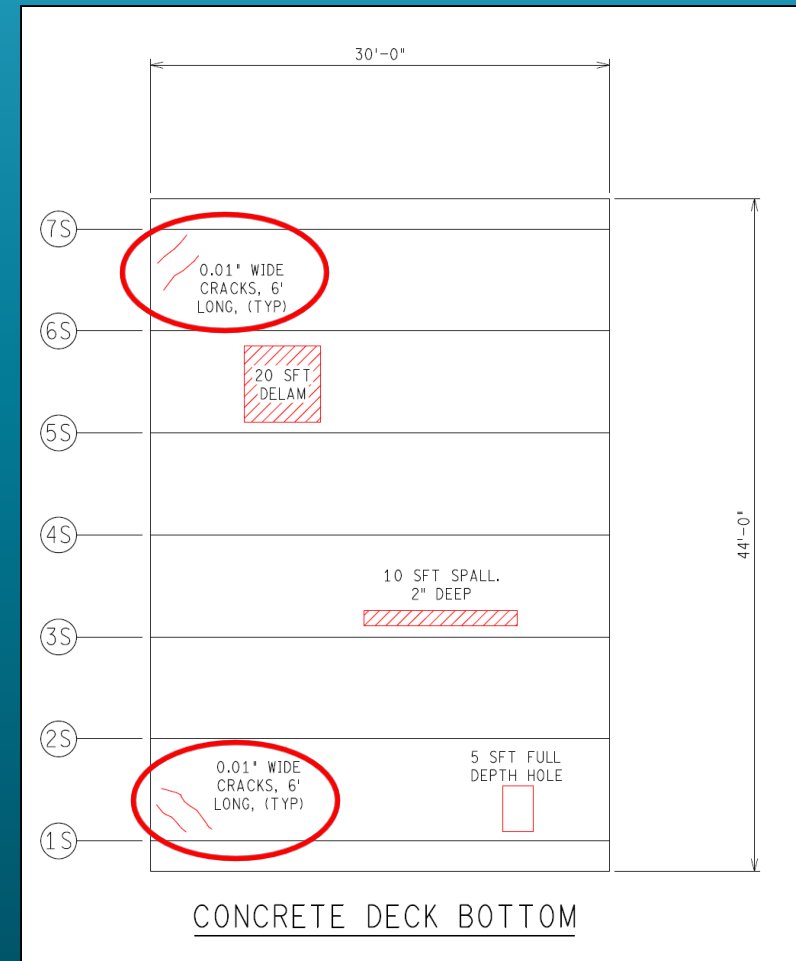
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Cracking ⁽¹⁾ Reinforced Concrete and Other (1130)	Insignificant cracks or moderate-width cracks that have been sealed.	Unsealed moderate-width cracks or unsealed moderate pattern (map) cracking.	Wide cracks or heavy pattern (map) cracking.	
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Settlement – Substructure Elements (4000)	None.	Exists within tolerable limits or arrested with effective actions taken to mitigate.	Exceeds tolerable limits but does not warrant structural review.	

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Defect Type	Quantity	Condition State
Cracks (0.01" wide)	24 SFT	?
Delamination	20 SFT	
Spall, 2" deep	10 SFT	
Full depth hole	5 SFT	

Element Level Exercise – Deck Bottom

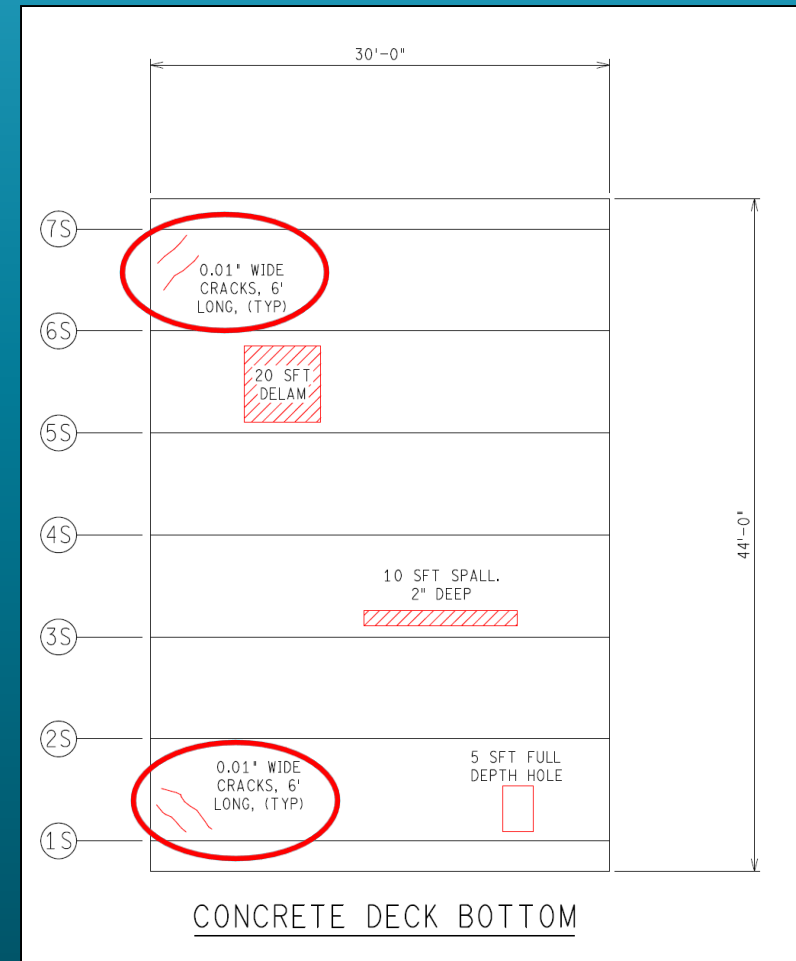
- Determine defect type and quantity in deck bottom
- Use manual to find condition state

Michigan Bridge Element Inspection Manual

CS TABLE 1 – REINFORCED CONCRETE

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Full depth hole	5 SFT	

Element Level Exercise – Deck Bottom

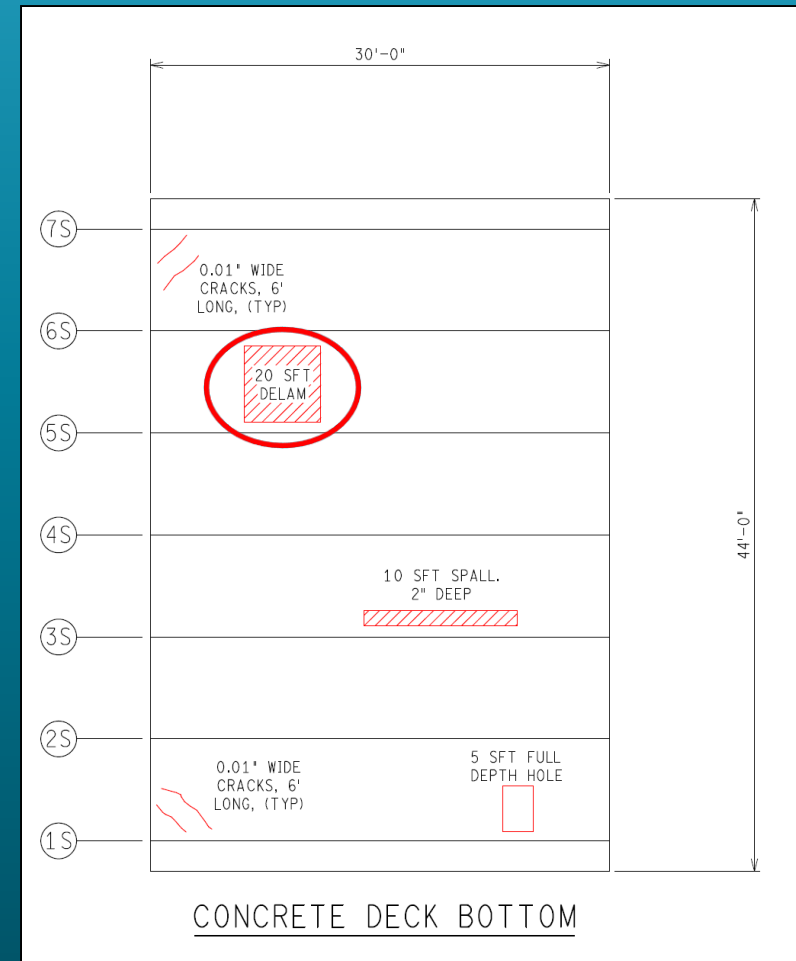
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Michigan Bridge Element Inspection Manual

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Element Level Exercise – Deck Bottom

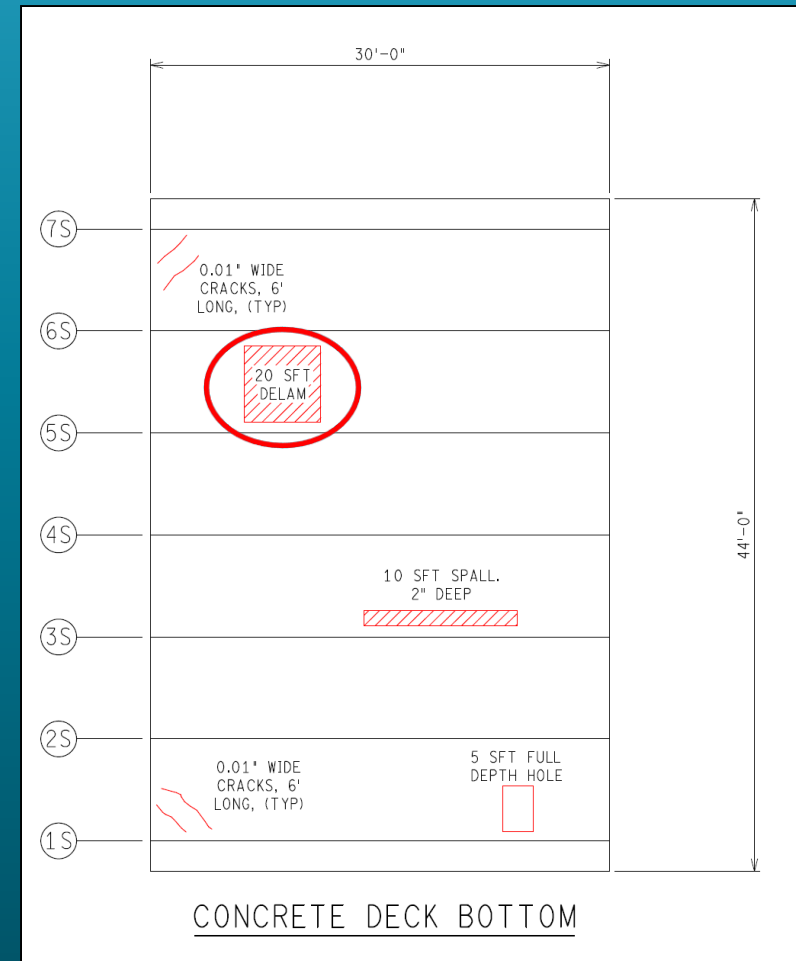
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Michigan Bridge Element Inspection Manual

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Delamination	20 SFT	2
Spall, 2" deep	10 SFT	
Full depth hole	5 SFT	

Element Level Exercise – Deck Bottom

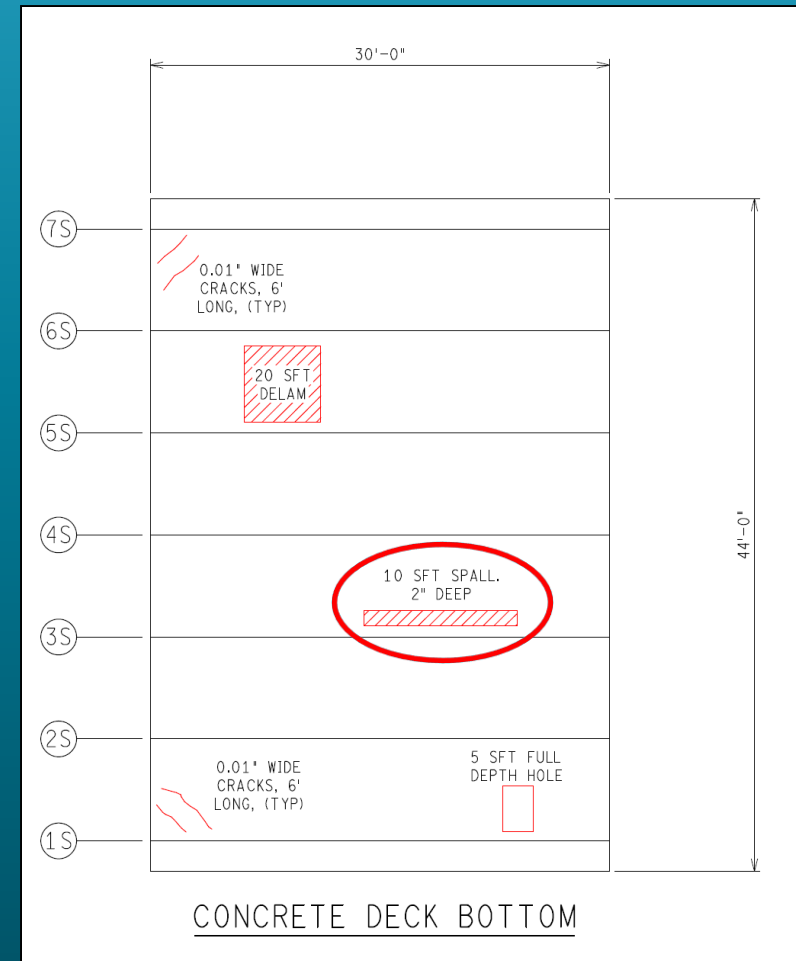
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Michigan Bridge Element Inspection Manual

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Full depth hole	5 SFT	

Element Level Exercise – Deck Bottom

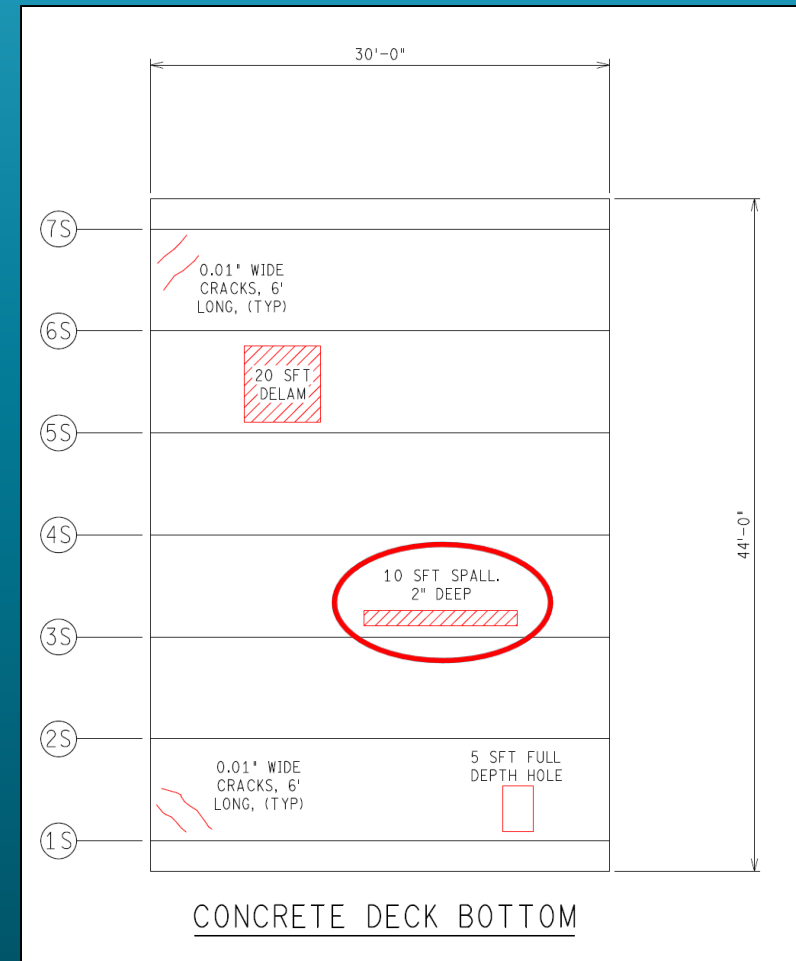
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Michigan Bridge Element Inspection Manual

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Defect Type	Quantity	Condition State
Cracks (0.01" wide)	24 SFT	1
Delamination	20 SFT	2
Spall, 2" deep	10 SFT	3
Full depth hole	5 SFT	

Element Level Exercise – Deck Bottom

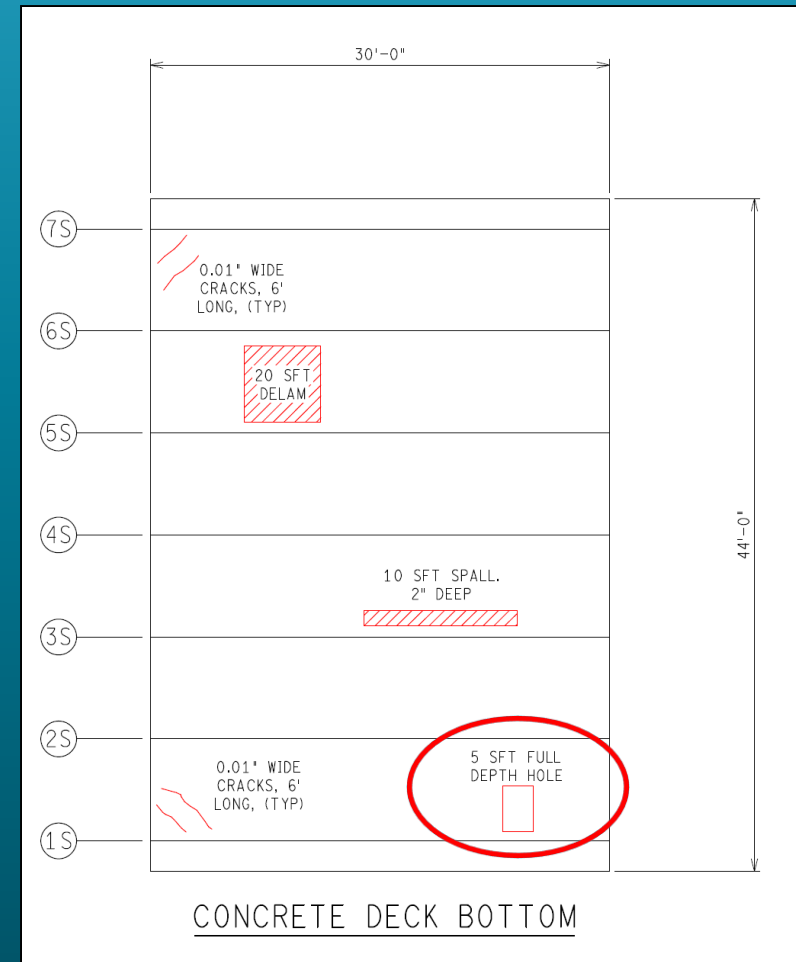
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Michigan Bridge Element Inspection Manual

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Defect Type	Quantity	Condition State
Cracks (0.01" wide)	24 SFT	1
Delamination	20 SFT	2
Spall, 2" deep	10 SFT	3
Full depth hole	5 SFT	?

Element Level Exercise – Deck Bottom

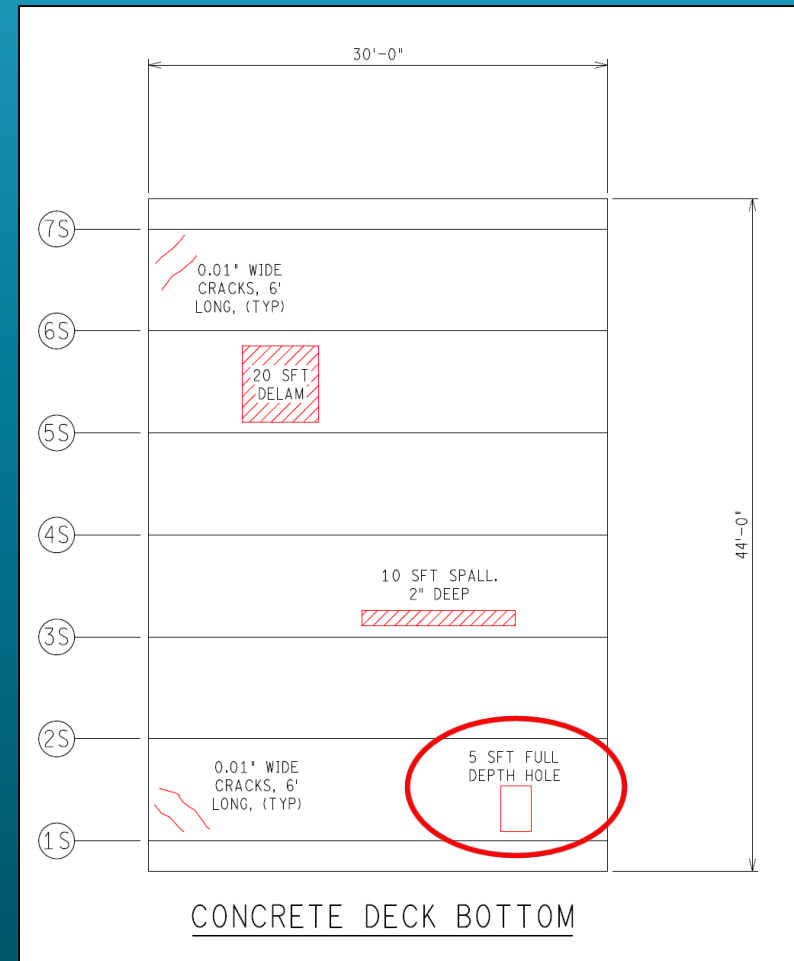
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Michigan Bridge Element Inspection Manual

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Defect Type	Quantity	Condition State
Cracks (0.01" wide)	24 SFT	1
Delamination	20 SFT	2
Spall, 2" deep	10 SFT	3
Full depth hole	5 SFT	4

Element Level Exercise – Deck Bottom


- Total area = 44' x 30' = 1320 SFT


Defect Type	Quantity	Condition State
Cracks (0.01" wide)	24 SFT	1
Delamination	20 SFT	2
Spall, 2" deep	10 SFT	3
Full depth hole	5 SFT	4

MICHIGAN DEPARTMENT OF TRANSPORTATION

STR SAFETY INSPECTION REPORT - AASHTO ELEMENTS

Facility	Latitude / Longitude	MDOT Structure ID	Structure Condition
Feature	Length / Width	Owner	
Location	Built / Recon. / Paint / Ovly.	TSC	Operational Status
Region / County	Material / Design	Last NBI Inspection	Scour Evaluation





NBI INSPECTION 6Q8D

Inspector Name	Agency / Company Name	Insp. Freq.	Insp. Date

AASHTO ELEMENTS (English Units)

Element Number	Element Name	Total Quantity	Unit	Good CS1	Fair CS2	Poor CS3	Severe CS4
Decks/Slabs							
803	Conc Deck - Coated Bars	1320	sq.ft	1189 90%	112 8%	14 1%	5 0%
810	Conc Deck - Top Surface	1320	sq.ft	1219 92%	92 7%	4 0%	5 0%
811	Conc Deck - Btm Surface	1320	sq.ft	1285 97%	20 2%	10 1%	5 0%
812	Reinf Conc Fascia	60	ft	60 100%	0 0%	0 0%	0 0%

Element Level Exercise – Deck

- Combine deck top, bottom, and fascias to get total deck

810 – CONCRETE DECK TOP SURFACE

Defect Type	Quantity	Condition State
Cracks (0.01" wide)	40 SFT	1
Cracks (0.05" wide)	54 SFT	2
Delamination	32 SFT	2
Spall, 1" deep	6 SFT	2
Spall, 2" deep	4 SFT	3
Full depth hole	5 SFT	4

811 – CONCRETE DECK BOTTOM SURFACE

Defect Type	Quantity	Condition State
Cracks (0.01" wide)	24 SFT	1
Delamination	20 SFT	2
Spall, 2" deep	10 SFT	3
Full depth hole	5 SFT	4

812 – REINF CONCRETE FASCIA

Defect Type	Quantity	Condition State
None	0	-

MICHIGAN DEPARTMENT OF TRANSPORTATION							
STR SAFETY INSPECTION REPORT - AASHTO ELEMENTS							
Facility	Latitude / Longitude	MDOT Structure ID	Structure Condition				
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NBI INSPECTION							6Q8D
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812	Reinf Conc Fascia	60	ft	60 100%	0 0%	0 0%	0 0%

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Element Level Exercise - Deck

- Elements included in example:
 - 803 – Reinforced Concrete Coated Bars
 - 810 – Reinforced Concrete Deck Top Surface
 - 811 – Reinforced Concrete Deck Bottom Surface
 - 812 – Reinforced Concrete Fascia
- Other elements to consider when evaluating the deck:
 - Slab or Top Flange
 - Sidewalk
 - Wearing Surfaces
 - False Decking, Maintenance Sheeting, Stay-In-Place Forms
 - Joints
 - Approach Slab
 - Bridge Railing

Element Level Exercise - Deck

Summary

- Identified bridge deck elements
- Quantified each element
- Identified deterioration within each element
- Determined condition state based on type/severity of deterioration
- Entered data into MiBRIDGE

Michigan Bridge Element Inspection Manual

DECK (sq. ft.)

Description: This element defines all bridge decks regardless of the wearing surface or protection systems used. Decks carry traffic and transfer loads to the superstructure.

No.	Name	CS Table	Description
800	Reinforced Concrete Black Bars	1	Reinforced concrete bridge decks constructed with uncoated "black" reinforcement.
813	Reinforced Concrete Slag Aggregate	1	Reinforced concrete bridge decks containing slag aggregate regardless of the reinforcement type.
801	Reinforced Concrete Stainless Bars	1	Reinforced concrete bridge decks constructed with stainless steel, stainless clad, or MMFX reinforcement.
802	Reinforced Concrete Nonmetallic Bars	1	Reinforced concrete bridge decks constructed with nonmetallic reinforcement, such as fiberglass, aramid or carbon composite reinforcement.
803	Reinforced Concrete Coated Bars	1	Reinforced concrete bridge decks constructed with epoxy coated or galvanized reinforcement.
804	Precast Reinforced Concrete	1	Reinforced concrete bridge decks precast using conventional reinforcement and then post-tensioned.
13	Prestressed Concrete	2	Prestressed concrete bridge decks.
28	Steel with Open Grid	3	All open grid steel decks with no fill.
29	Steel with Concrete Filled Grid	3	Steel bridge decks with concrete fill either in all of the openings or within the wheel tracks.
30	Steel - Corrugated/ Orthotropic/Etc.	3	Corrugated metal filled with portland cement, asphaltic concrete or other riding surfaces and Orthotropic steel. Materials added for riding surface are not part of the element condition.

Michigan Bridge Element Inspection Manual

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RFA Considerations

- Request For Action

- An RFA shall be submitted when:
 - Condition of deck poses a hazard to motorists
 - Detailed inspection is required
 - Any issue requiring immediate attention

- Any reason to issue an RFA for the deck in our example?

Request for Action	Concrete	Thin Overlay	Hot Mix Asphalt	Timber
In-Depth Inspection	X	X	X	X
Cracking Caused by Reduced Superstructure Capacity	X	X	X	X
Verification of Acceptable Skid Resistance	X	X		
Severe Deterioration resulting in unsafe ride quality conditions	X	X	X	X
Spalling Exposing Prestressed Superstructure Elements			X	
Severe Surface Rutting Inhibiting Drainage			X	

Michigan Bridge Element Inspection Manual
Table 5.05.07 RFA Examples for Common Bridge Deck Wearing Surfaces

In-Depth Inspection Needs

- In-Depth Inspection
 - Shall be performed as needed
 - Hands-on inspection should be completed when NBI deck rating is 6 or less
 - Detailed inspection suggested when NBI deck rating is 4 or less
 - Detailed inspection required for decks when any Element Level Inspection quantity reaches condition state 4
- Any need for an in-depth inspection for the deck in our example?


NBI Rating (Item 58)	Schedule Initial In-depth Within	In-Depth Frequency	Applicable Deck Materials		
6	24 Months	As-Needed	Concrete	Steel	Timber
4	12 Months	48 Months	Concrete	Steel	Timber

Michigan Bridge Element Inspection Manual

Table 5.11.05 Recommended Condition Based In-Depth Inspection Guideline for Decks or Slabs


Recent RFA – Full Depth Deck Failure

MICHIGAN DEPARTMENT OF TRANSPORTATION

STR 11716	REQUEST FOR ACTION			B01-82194
Facility I-75	Latitude / Longitude 42.283 / -83.148	MDOT Structure ID 82182194000B010	Structure Condition Poor Condition(4)	
Feature ROUGE R, DEARBORN ST & RR	Length / Width 8,627 / 132.4	Owner MDOT - Big Bridge		
Location IN DETROIT	Built / Recon. / Paint / Ovly. 1967 / 1989 / 2003 / 1989	TSC Detroit(7E)	Operational Status A Open, no restriction(A)	
Region / County Metro(7) / Wayne(82)	Material / Design 4 Steel Continuous / 02 Stringer/Girder	Last NBI Inspection 05/27/2015 / V4Z4	Scour Evaluation 8 Stable Above Footing	



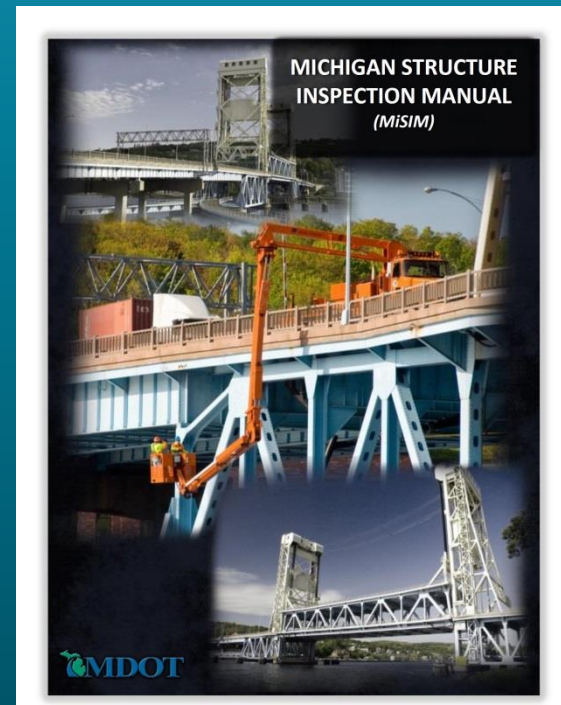
Recent RFA – Full Depth Deck Failure

MICHIGAN DEPARTMENT OF TRANSPORTATION				
STR 11716	REQUEST FOR ACTION			B01-82194
Facility	Latitude / Longitude	MDOT Structure ID	Structure Condition	
I-75	42.283 / -83.148	82182194000B010	Poor Condition(4)	
Feature	Length / Width	Owner		
ROUGE R,DEARBORN ST & RR	8,627 / 132.4	MDOT - Big Bridge		
Location	Built / Recon. / Paint / Ovly.	TSC	Operational Status	
IN DETROIT	1967 / 1989 / 2003 / 1989	Detroit(7E)	A Open, no restriction(A)	
Region / County	Material / Design	Last NBI Inspection	Scour Evaluation	
Metro(7) / Wayne(82)	4 Steel Continuous / 02 Stringer/Girder	05/27/2015 / V4Z4	8 Stable Above Footing	
REQUEST FOR ACTION				11716-01162016
Submitted By	Agency / Company Name	RFA#	RFA Date	
Andrew Bouvy	Bridge Field Services	11716-01162016	01/16/2016	
Problems/Comments				
RFA entered to document critical finding. (Andrew Bouvy 01/18/2016)				
IMMEDIATE ACTION				
Recommended Action	Requested By	Completed By	Completed Date	
Close Lane	Andrew Bouvy	Wayne County Maint.	01/16/2016	
Comments				
Full depth deck failure in Northbound center lane required three lanes to be closed for approximately 24 hours. Notification provided by Matt Chynoweth on 1/17/2016. (Andrew Bouvy 01/18/2016)				
Date Traffic Restored / Signs Installed	Traffic Restoration / Sign Installation Comments			
01/17/2016	Deck patching completed in approximately 24 hours.			
INTERMEDIATE ACTION				
FINAL ACTION COMPLETED				
Comment				RFA Complete
Patching is complete and all lanes have been reopened. (Andrew Bouvy 01/18/2016)				Yes
RFA COMMITTEE				
Review Required	Committee Review Date	Estimated Repair Date		
Yes				

MiSIM Chapter 5

● Summary

- Types of inspection – Routine and Condition-based
- Owner and Inspection Team Leader responsibilities
- Bridge elements
 - Item description
 - Routine NBI inspection
 - Element level inspection
 - Work recommendations
 - Request for action
 - In-depth inspection



Questions

