High Speed Condition Scanning for Bridge Deck Preservation

by

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Outline

• Bridge deck issues
• Scanning technologies
• Comparison studies
• Current agency application
Bridge Decks

- Most expensive bridge element over life cycle
- Life cycle cost can be reduced with well timed preservation treatments
- Need to know deck condition for right treatment at right time
- Need to know which decks to target
Deck Condition Assessment

- Biennial visual inspection
  - Can't see below the surface

- Sounding (chain drag)
  - Slow, subjective, not usable on AC overlays
  - Can only do a few decks each year
Rapid Scanning for Deck Condition

• Ground Penetrating Radar (ASTM D6087)
• Infrared Thermography (ASTM D 4788)
• Application began over 20 years ago
• Several states routinely utilize these methods
ASTM Specifications

Designation: D 6087 – 08
Standard Test Method for Evaluating Asphalt-Covered Concrete Bridge Decks Using Ground Penetrating Radar¹

Designation: D 4788 – 03 (Reapproved 2007)
Standard Test Method for Detecting Delaminations in Bridge Decks Using Infrared Thermography¹
High Speed Deck Scanning

- Survey 10-20 decks/day
- 100% coverage
- Accurate, quantitative results
- Electronic results, CADD compatible
GPR Equipment Setup
Bridge Deck Survey Layout

passing lane

driving lane

shldr

Vehicle/antenna positions
Sample Bridge Deck GPR Data Showing Deterioration

- Bottom of AC
- Top Rebar
- Bottom Rebar
- Deteriorated Areas
Sample Scanning Outputs

concrete deterioration

rebar depth (in)

2  3  4
Infrared Survey Equipment

Infrared & Visual Cameras
Sample Infrared and Visual Data

distance value (ft).

Visual

Infrared
IR Data Showing Delaminations
Final Delamination Map

Distance from W. Abut. (ft)
Evaluations of Scanning Methods

• SHRP2 R06A
  – Compared multiple methods
  – Concluded GPR, IR, most effective

• NIST
  – Looked at GPR vs. corrosion, delamination

• MnDOT
  – Compared quantities for 12 repaired decks
Test Deck - Sabattus River Bridge Deck Before Demolition
GPR Condition Map Showing Locations of Extracted Slabs
Slab Layout in the Lab
GPR vs. Half Cell Potential
Tests on Extracted Deck Slabs

(a) delaminations detected with sounding
(b) Half-cell corrosion potentials
(c) GPR rebar level attenuation
MnDOT Evaluation

- Conducted by an independent consultant
- Looked at 12 repaired decks, all scanned with GPR and 7 also with IR
- GPR/IR results compared to sounding/repair quantities
- Average quantities were within 3.5-4.0%
Example Agency Use of Scanning

- Wisconsin DOT Statewide (>1000 decks)
- MnDOT Metro, D-6, & D-1 (>300 decks)
- Montana DOT Statewide (120 decks this year)
- Michigan DOT SW Region (57 decks this year)
- Kansas DOT (64 decks this year)
Why Implement Scanning?

- Evaluate larger decks, high traffic volumes
  - Not feasible to chain drag
- Safety of personnel – limits exposure
- Better information to decide scope of repair/rehab
- Reduce contingency funds for overruns
- Identify decks that may benefit from early treatment
- Better utilize paving closures for deck preservation
Tappan Zee Bridge
3 miles long, 1.3M sf, ADT = 135,000
Minimize Personnel Exposure

Chain drag

GPR Scanning
Planning and Scoping
NBI Rating vs. Scanning

![Bar Chart: Planning and Scoping NBI Rating vs. Scanning](image)

**NBI Rating**
- 7: 0 decks
- 6: 30 decks
- 5: 15 decks
- 4: 5 decks

**Deck Deterioration from Scanning**
- <5%: 10 decks
- 5%-10%: 15 decks
- 10%-25%: 20 decks
- >25%: 30 decks

**Actions**
- Do Nothing
- Minor Rehab
- Major Rehab
- Replace
Early Intervention for Preservation

Condition

Age (years)

Preservation

Expected

Actual

☆ = Deck scanning
Reduce Overruns with Accurate Repair Quantities
Deck Scanning Summary

• Scanning technology provides accurate evaluations at project and network level
• Comprehensive condition information supports prioritization and scoping of repairs
• Enables early intervention with preservation to extend deck life at limited cost
• Can be applied on a 3-5 year cycle to track deck condition, effectiveness of preservation