

ASCE/SEI Workshop **“Enhancing Bridge Performance”**

Bridge Deterioration Issues and Performance Measures

Danielle D. Kleinhans, Ph.D., P.E.
Secretary Concrete Bridge Committee

BIRM Types of Deterioration

- ↪ Cracking
- ↪ Scaling
- ↪ Delamination
- ↪ Spalling
- ↪ Chloride Contamination
- ↪ Efflorescence
- ↪ Ettringite formation
- ↪ Honeycombs
- ↪ Pop-outs
- ↪ Wear
- ↪ Collision damage
- ↪ Abrasion
- ↪ Overload damage
- ↪ Reinforcing steel corrosion
- ↪ Prestressed concrete deterioration

Direct Performance Measures

- ↪ Load distribution factors
- ↪ Load impact factors
- ↪ Deflection
- ↪ Strain/Stress



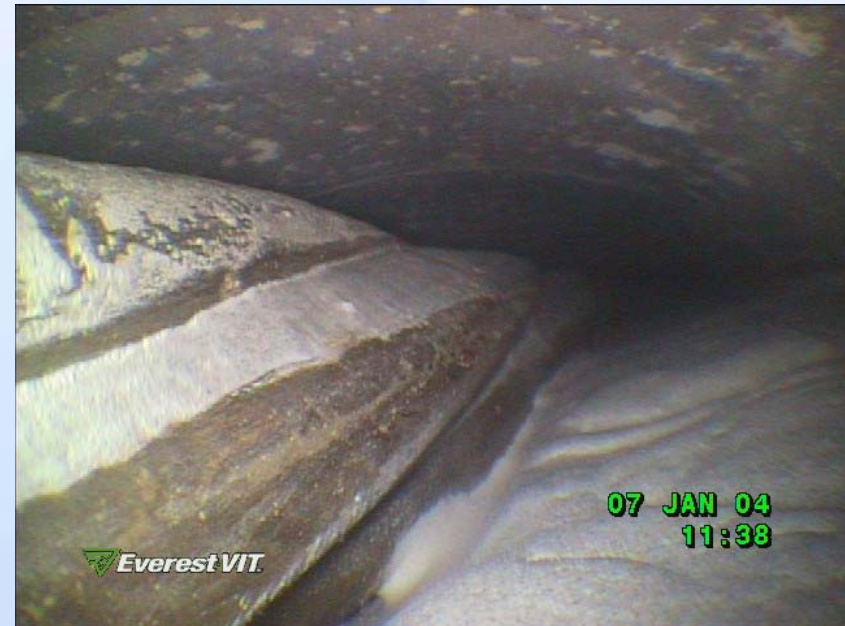
Potential deficiencies

- ↪ Subjective nature of condition ratings
 - Phares et al., 2004
 - 95% of primary element condition ratings for individual bridge components will vary within two rating points of the average
 - 68% will vary within one point

<u>Code</u>	<u>Description</u>
N	NOT APPLICABLE
9	EXCELLENT CONDITION
8	VERY GOOD CONDITION - no problems noted.
7	GOOD CONDITION - some minor problems.
6	SATISFACTORY CONDITION - structural elements show some minor deterioration.
5	FAIR CONDITION - all primary structural elements are sound but may have minor section loss, cracking, spalling, or scour.
4	POOR CONDITION - advanced section loss, deterioration, spalling, or scour.
3	SERIOUS CONDITION - loss of section, deterioration, spalling, or scour have seriously affected primary structural components. Local failures are possible. Fatigue cracks in steel or shear cracks in concrete may be present.
2	CRITICAL CONDITION - advanced deterioration of primary structural elements. Fatigue cracks in steel or shear cracks in concrete may be present or scour may have removed substructure support. Unless closely monitored it may be necessary to close the bridge until corrective action is taken.
1	"IMMINENT" FAILURE CONDITION - major deterioration or section loss present in critical structural components, or obvious vertical or horizontal movement affecting structure stability. Bridge is closed to traffic but corrective action may put bridge back in light service.
0	FAILED CONDITION - out of service; beyond corrective action.

Potential deficiencies

- ↪ Lack of “internal” inspections using NDT
 - Unknown conditions may exist



Potential deficiencies

- ↪ Lack of quantitative data collected
- ↪ Disconnect between inspection information and rating calculations
- ↪ Cause of distress not always assessed correctly
 - Evidenced by repeated failed repairs

Questions?