

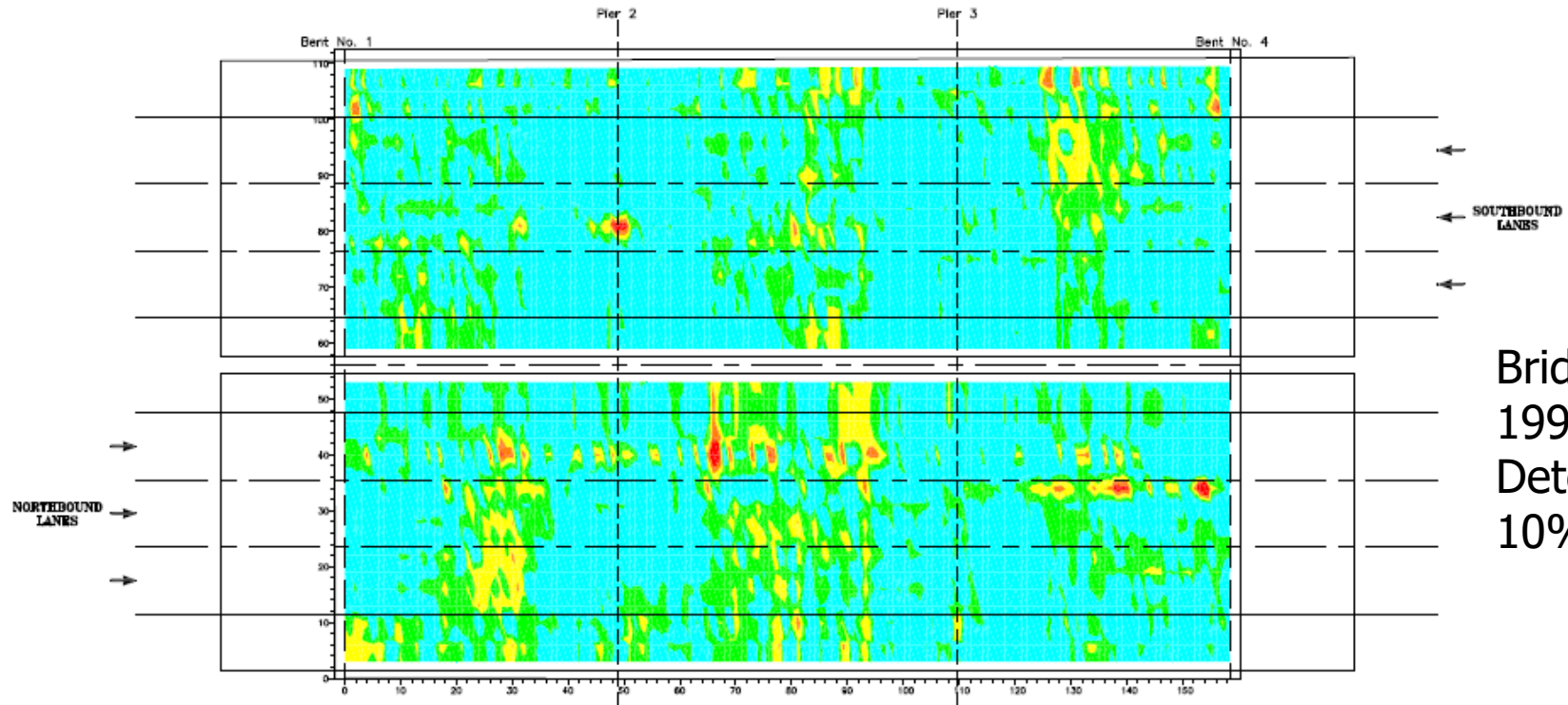
Indiana Department of Transportation

Ground Penetrating Radar Bridge Deck Testing
Randy Strain

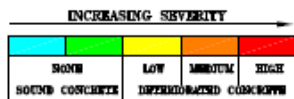
INDOT NDT

- Resource International, Inc. is in the process of completing our first contract of non-destructive bridge deck testing using ground penetrating radar.
- The contract included testing for 230 bridge decks.
- The bridges were selected by the INDOT Bridge Asset Engineers and Bridge Inspection Supervisors.

DETERIORATION MAP
 (12)912-45-02353 B (NBI #33050)
 SR 912 OVER N&S RR
 LAKE COUNTY
 STATE OF INDIANA



Bridge Deck constructed in 1994 25 year old deck
 Deterioration less than 10%



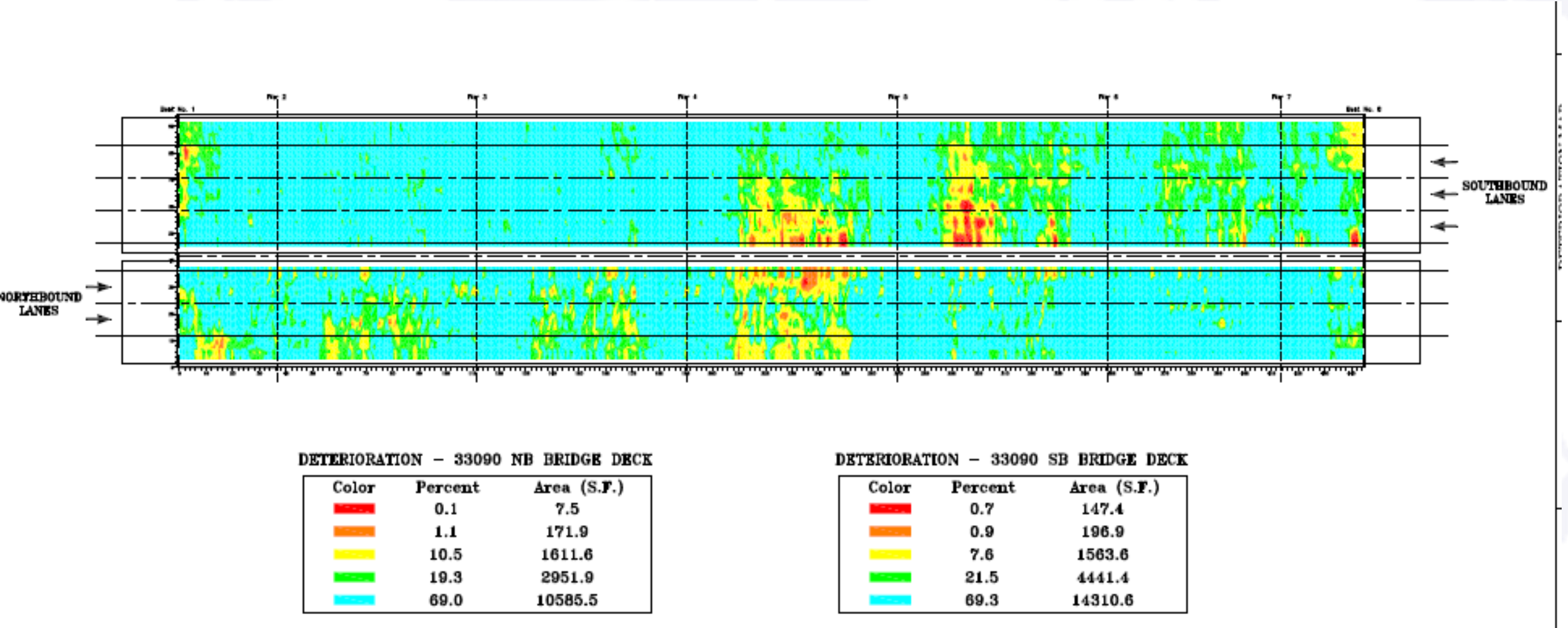
DETERIORATION - 33050 NB BRIDGE DECK

Color	Percent	Area (S.F.)
Red	0.2	15.1
Orange	0.7	58.7
Yellow	7.9	623.4
Green	28.8	2282.8
Cyan	62.4	4944.9

DETERIORATION - 33050 SB BRIDGE DECK

Color	Percent	Area (S.F.)
Red	0.1	4.2
Orange	0.3	24.8
Yellow	4.3	340.3
Green	21.4	1706.9
Cyan	73.9	5896.3

INDOT NDT



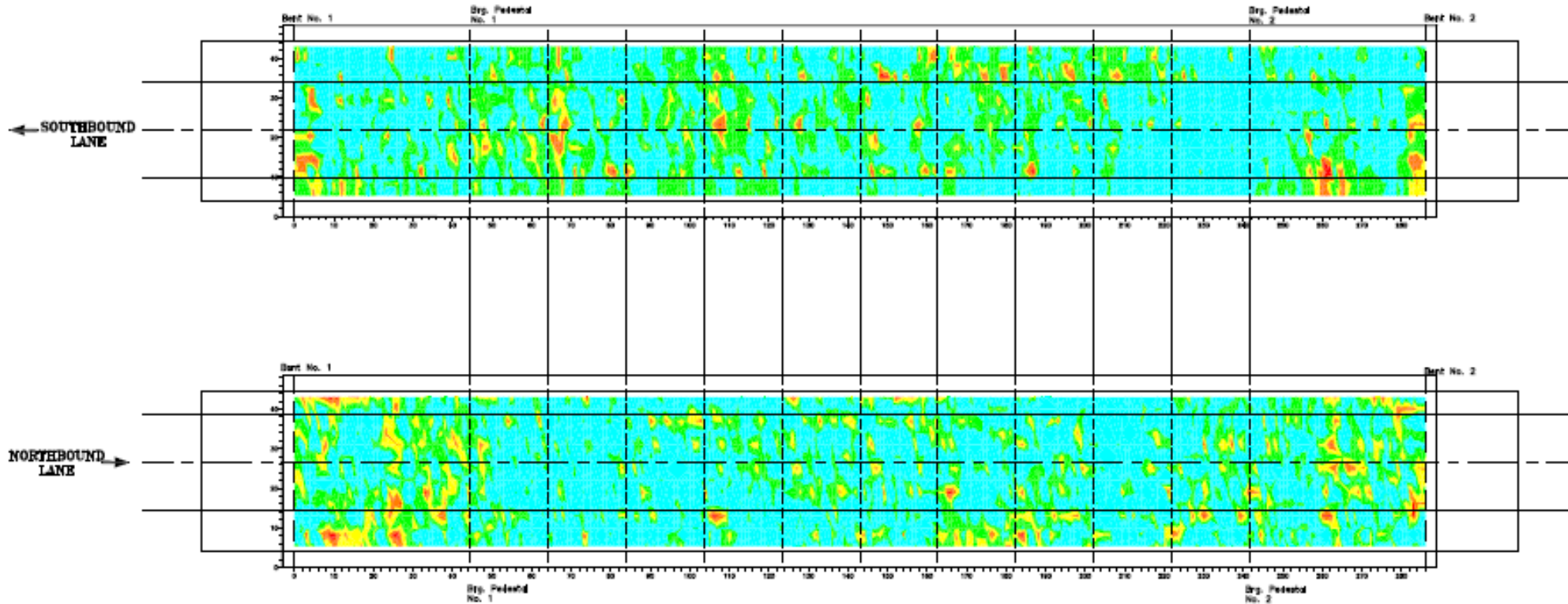
Bridge deck constructed in 1994 – 25 year old bridge deck
Deterioration just over 10%

INDOT NDT

I65-68-7910
 Bartholomew County
 Complex Bridge built
 with a latex overlay

The deterioration is
 just over 10%

The structure is 20
 years old.



DETERIORATION - 35520 NB BRIDGE DECK

Color	Percent	Area (S.F.)
Red	0.1	12.8
Orange	1.6	167.8
Yellow	9.1	985.7
Green	28.5	3065.4
Cyan	60.7	6541.0

DETERIORATION - 35520 SB BRIDGE DECK

Color	Percent	Area (S.F.)
Red	0.1	13.7
Orange	2.3	247.3
Yellow	5.0	542.2
Green	32.0	3441.8
Cyan	60.6	6527.6



INDOT NDT

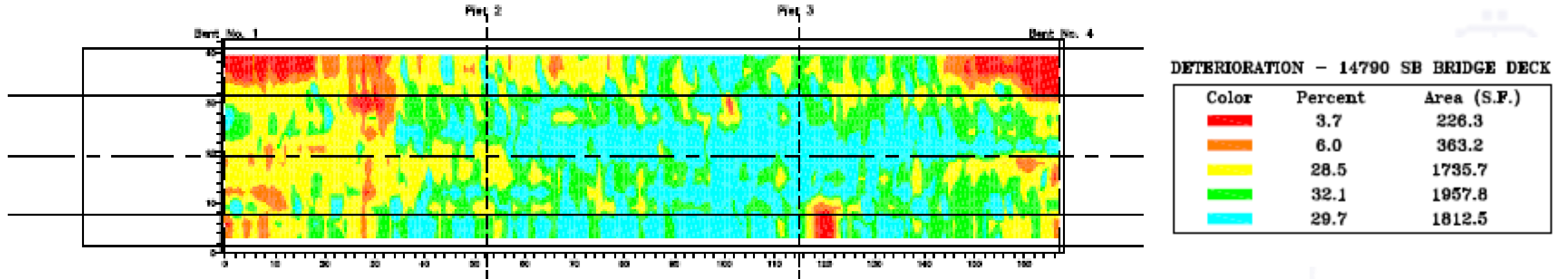
- In order to obtain a 28 day yield strength of 4000 psi 658 pounds of cement is used in the mix design.
- Indiana is known for its' Indiana Limestone, also know as Bedford Limestone.
- Bedford Indiana has been noted to have the highest quality quarried limestone in the United States.
- Wonderful product for building products.
- Not a great stone for obtaining a high strength concrete.

INDOT NDT

- It appears that building a bridge deck with an overlay may not provide additional protection to the deck. The shrinkage cracks from the deck seem to extend into the overlay.
- Our best protection with our current mix design is to allow the shrinkage cracks to form and then provide protection with a polymeric concrete bridge deck overlay.
- Designing a concrete mix to overcome the shrinkage cracks increases the cost of the concrete by about four and a half times.

INDOT NDT

- 41-42-5935 BSBL



- 9.7% highly deteriorated
- 38.2% total deterioration
- 48 year old deck
- 24 year old 2nd overlay
- Structure is programmed to be rehabilitated in 2020. The inspector rated the deck a low 6 by notation and recommend the deck be replaced.

INDOT NDT

Preliminary statistical findings

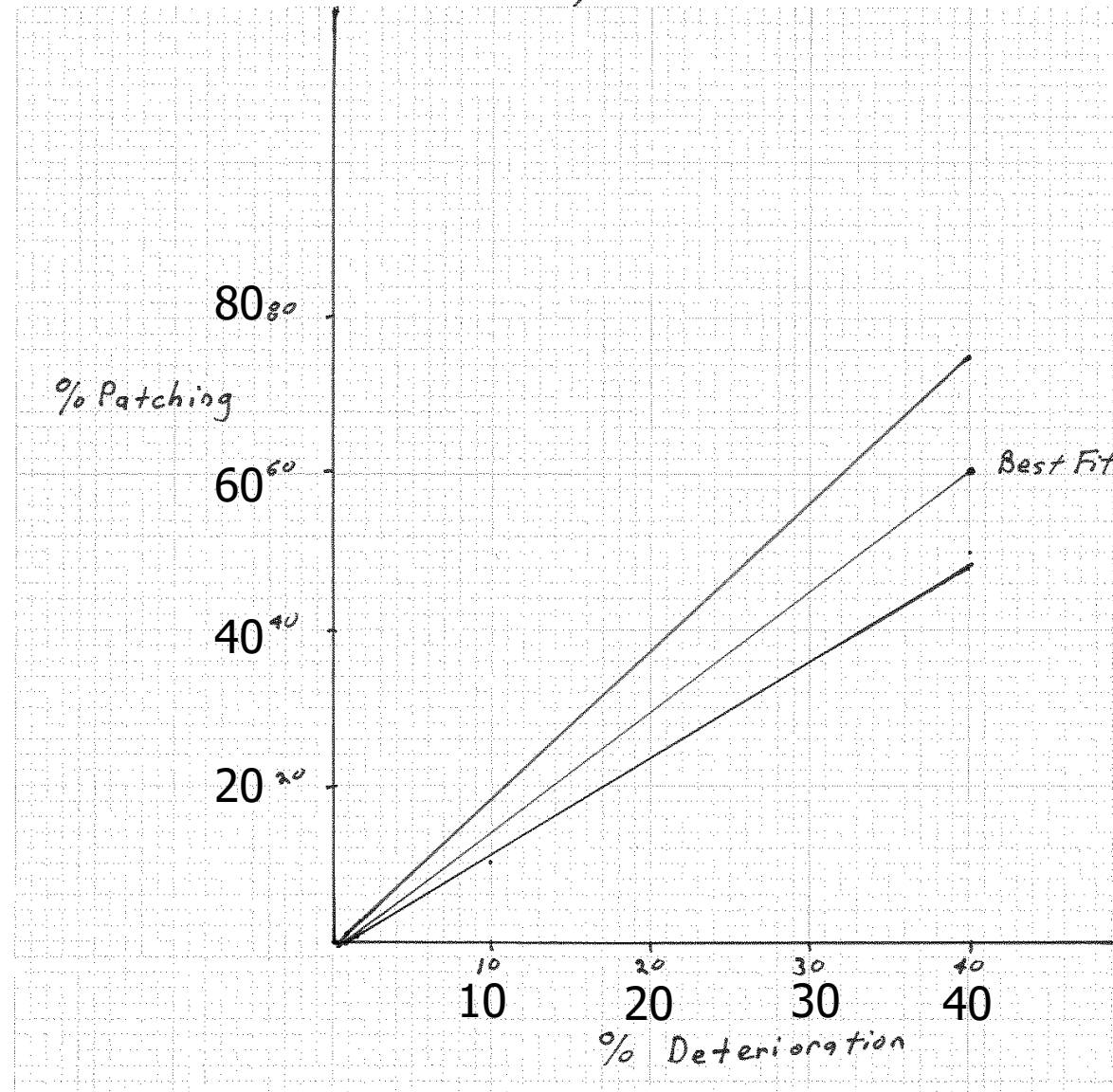
- Bridges with approximately 10% deterioration should be considered to be in fair condition.
- Bridges with approximately 10% – 20% deterioration may require further testing.
- Bridges with greater than 20% deterioration should be considered in poor condition.

INDOT NDT

The relation between percent deterioration and percent patching is not a one to one correlation.

This graph is an approximation of the relationship.

Structure/Project No. GPR NDT
Design Computations for: % Patching vs % Deterioration



INDOT NDT

When and how often should testing be done?

- The deterioration appears to be minor in bridge decks less than twenty years old
- The deterioration in latex overlays appears to follow very closely to the same time line.
- The bridge inspectors can not accurately determine the condition of the bridge decks by visual inspection. A large amount of the deterioration is simply not visible.
- Using NDT at the appropriate time line can assist in the proper evaluation of the bridge deck.

INDOT NDT

- INDOT Bridge Inspectors can use the NDT results to more accurately rate bridge decks.
- Percentage of deterioration does not directly correlate to bridge deck patching.
- Ground penetrating radar is a valuable tool for screening bridge decks.
- The correlation of deterioration percentage to patching has not been accurately determined.

INDOT NDT

- In 2019 we would like to use different methods of NDT and perform quality assurance on the bridge decks tested.
- Perhaps in order to minimize traffic disruption, the touch based NDT might be performed on the bridge deck shoulder then the traffic lanes can be tested at highway speeds.
- Several bridge decks will be followed through the construction contract in order to obtain the correlation between percentage deterioration to bridge deck patching.
- The upper limit of deterioration needs to be identified.