# Quantifying Reinforced Concrete Bridge Deck Corrosion Using GPR
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ABSTRACT

• Timely and proper bridge deck repairs start with up-to-date and accurate assessments

• Ground penetrating radar (GPR) can assess bridge decks in minutes without closing traffic

• The amplitude of the reflected GPR signals scattered from the rebar are reduced when corrosion is present

• A rebar reflection amplitude threshold based on correlation with corrosion activity is currently unavailable for rapid and accurate condition evaluations.
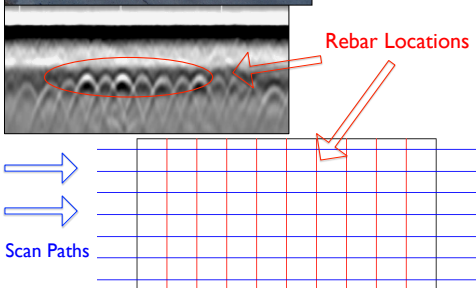
TECHNOLOGY
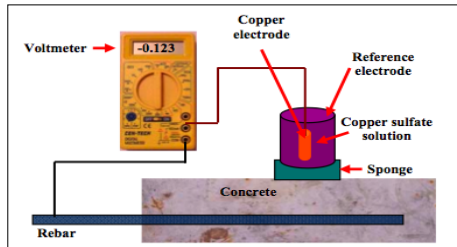
Half-cell potential (HCP) detects bridge deck corrosion.

GPR emits electromagnetic signals as it scans the surface along the direction of vehicular travel. The GPR signals reflect off of the rebar. Their amplitudes are decreased when corrosion is present in the concrete.

The amount of data points collected for each deck is determined by multiplying the number of scan paths times the number of rebar.
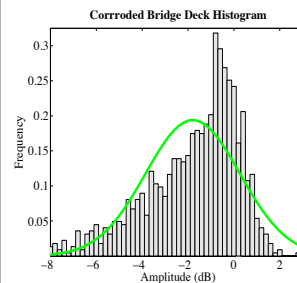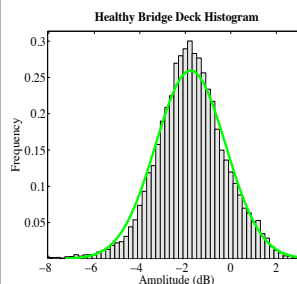
CURRENT FINDINGS

HCP

GPR
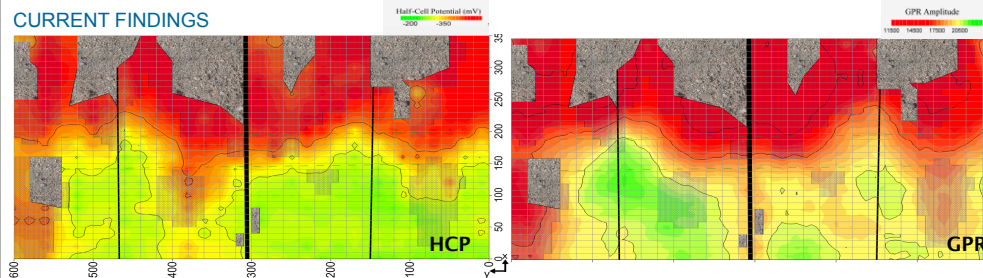
Measurements: *HCP* = 20 cm grid *GPR* = 10cm spacing
Color Contour Plot Assembly: *HCP* = Threshold based on ASTM C876
GPR = Threshold varied until best spatial correlation found between HCP and GPR

Methods Compared	HCP Threshold	GPR Threshold (0 to 1 scale)	% Match
GPR vs. HCP	−350 mV	0.45	90.2%

	Mean	Mean value of the amplitude distribution.
	Skewness	Measure of asymmetry of the distribution. (How much the histogram is leaning to the left.)

Bridge	Condition	Skew x Mean	% Corroded < −350 mV
Humpback	New	0.6259	0
Phillipston	New	0.2066	0
Pingree	Unexposed	−0.2322	0
Maine I95	Corroded	1.7297	38.19
Maine Slabs	Corroded	2.261	30
Chandler Over 495**	Corroded	3.195	54.39
Chandler Over 93**	Corroded	3.449	46.35
Hopkins Street**	Corroded	4.973	71.04

The skew and mean of rebar reflection amplitudes calculated for 8 bridge decks. Actual corrosion quantities determined using % of area with HCP <-350mV.
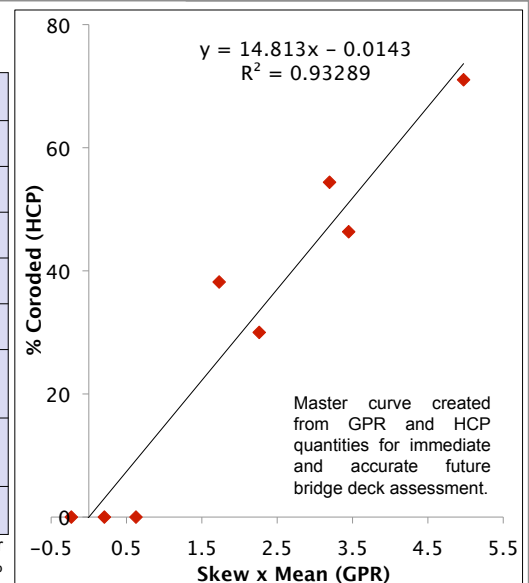
CONCLUSIONS

• GPR rebar reflection amplitudes have been shown to strongly correlate with active corrosion

• Histograms of healthy and corroded bridge decks have differing qualities

• Statistical parameters like the mean and the skewness at different stages of corrosion have notable differences

• GPR rebar reflection amplitude statistics plotted against deterioration quantities computed from HCP measurements are in agreement

• This relationship can be used on future bridge decks for determining accurate deterioration estimates by simply driving over the bridge deck with GPR.

$$y = 14.813x - 0.0143$$
$$R^2 = 0.93289$$

Master curve created from GPR and HCP quantities for immediate and accurate future bridge deck assessment.