Effects of Position, Orientation, and Metal Loss on Ground Penetrating Radar Signals from Structural Rebar

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Past experimental work on a highway bridge in central Iowa [1] suggested that ground penetrating radar (GPR) signals could possibly be used to differentiate intact rebar from those having substantial metal loss due to corrosion. That study made use of the amplitudes of GPR signals reflected by rebar, as obtained using a commercial instrument operated in pulse/echo mode. Many factors can contribute to the strength of the echo seen from a given rebar, including the rebar’s length, its distance from and tilt angle relative to the antenna, and the location and size of the metal-loss region. In this paper we systematically investigate these geometric effects. We begin with measurements of reflected signals where only an air layer separates the antenna from the rebar. There, using standard ½-inch diameter rebar, the GPR signal is systematically studied as a function of the length of the rebar, the stand-off distance from the antenna, the rebar tilt angle, and the size of the metal-loss region. The metal loss region is conveniently simulated by taking two parallel and abutting rebar lengths and pulling them apart to introduce a small gap between them. After summarizing the measurements in air, we discuss efforts to extend the study to rebar embedded in concrete. One idea being explored is the use of a powdered “phantom” material (having GPR properties similar to concrete) which can be sandwiched between two concrete blocks. The rebar can then be inserted into the powder layer and its position and orientation can be altered at will. We conclude with a discussion of the implications of our studies to the practical detection of corroded rebar in bridge barrier rails.

References: