



Designation: D6087 – 22

Standard Test Method for Evaluating Asphalt-Covered Concrete Bridge Decks Using Ground Penetrating Radar¹

This standard is issued under the fixed designation D6087; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method covers several ground penetrating radar (GPR) evaluation procedures that can be used to evaluate the condition of concrete bridge decks overlaid with asphaltic concrete wearing surfaces. These procedures can also be used for bridge decks overlaid with portland cement concrete and for bridge decks without an overlay. Specifically, this test method predicts the presence or absence of concrete or rebar deterioration at or above the level of the top layer of reinforcing bar.

1.2 Deterioration in concrete bridge decks is manifested by the corrosion of embedded reinforcement or the decomposition of concrete, or both. The most serious form of deterioration is that which is caused by corrosion of embedded reinforcement. Corrosion may be initiated by deicing salts, used for snow and ice control in the winter months, penetrating the concrete. In arid climates, the corrosion can be initiated by chloride ions contained in the mix ingredients. Deterioration may also be initiated by the intrusion of water and aggravated by subsequent freeze/thaw cycles, causing damage to the concrete and subsequent debonding of the reinforcing steel with the surrounding compromised concrete.

1.2.1 As the reinforcing steel corrodes, it expands and creates a crack or subsurface fracture plane in the concrete at or just above the level of the reinforcement. The fracture plane, or delamination, may be localized or may extend over a substantial area, especially if the concrete cover to the reinforcement is small. It is not uncommon for more than one delamination to occur on different planes between the concrete surface and the reinforcing steel. Delaminations are not visible on the concrete surface. However, if repairs are not made, the delaminations progress to open spalls and, with continued corrosion, eventually affect the structural integrity of the deck.

1.2.2 The portion of concrete contaminated with excessive chlorides is generally structurally deficient compared with

non-contaminated concrete. Additionally, the chloride-contaminated concrete provides a pathway for the chloride ions to initiate corrosion of the reinforcing steel. It is therefore of particular interest in bridge deck condition investigations to locate not only the areas of active reinforcement corrosion, but also areas of chloride-contaminated and otherwise deteriorated concrete.

1.3 This test method may not be suitable for evaluating bridges with delaminations that are localized over the diameter of the reinforcement, or for those bridges that have cathodic protection (coke breeze as cathode) installed on the bridge or for which a conductive aggregate has been used in the asphalt (that is, blast furnace slag). This is because metals are perfect reflectors of electromagnetic waves, since the wave impedances for metals are zero.

1.4 Since a precision estimate for this standard has not been developed, the test method is to be used for research and informational purposes only. Therefore, this standard should not be used for acceptance or rejection of a material for purchasing purposes.

1.5 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.6 The text of this standard references notes and footnotes which provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of the standard.

1.7 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use. Specific precautionary statements are given in Section 5.*

1.8 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

¹ This test method is under the jurisdiction of ASTM Committee D04 on Road and Paving Materials and is the direct responsibility of Subcommittee D04.32 on Bridges and Structures.

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2. Summary of Test Method

2.1 The data collection equipment consists of a GPR device, data acquisition device, recording device, and data processing and interpretation equipment. The user makes repeated passes with the data collection equipment in a direction parallel or perpendicular to the centerline across a bridge deck at specified locations. Bridge deck condition is quantified based on the data obtained.

3. Significance and Use

3.1 This test method provides information on the condition of concrete bridge decks overlaid with asphaltic concrete without necessitating removal of the overlay, or other destructive procedures.

3.2 This test method also provides information on the condition of bridge decks without overlays and with portland cement concrete overlays.

3.3 A systematic approach to bridge deck rehabilitation requires considerable data on the condition of the decks. In the past, data has been collected using the traditional methods of visual inspection supplemented by physical testing and coring. Such methods have proven to be tedious, expensive, and of limited accuracy. Consequently, GPR provides a mechanism to rapidly survey bridges in an efficient, nondestructive manner.

3.4 Information on the condition of asphalt-covered concrete bridge decks is needed to estimate bridge deck condition for maintenance and rehabilitation, to provide cost-effective information necessary for rehabilitation contracts.

3.5 GPR is currently the only nondestructive method that can evaluate bridge deck condition on bridge decks containing an asphalt overlay.

4. Apparatus

4.1 *GPR System*—There are two categories of GPR systems, depending on the type of antenna utilized for data collection.

4.1.1 GPR systems using air-launched horn antennas with central frequencies 1 GHz and greater. The equipment may consist of an air-coupled, short-pulse monostatic or bistatic antenna(s) with sufficient central frequency to provide the accurate measurement of a 5 cm thick asphalt pavement.

4.1.2 GPR systems using ground-coupled antennas with central frequencies greater than 1 GHz.

4.2 *Data Acquisition System*—A data acquisition system, consisting of equipment for gathering GPR data at the minimum frequencies specified in 4.1.1 and 4.1.2. The system shall be capable of accurately acquiring GPR data with a minimum of 60 dB dynamic range.

4.3 *Distance Measurement System*—A distance measurement system consisting of a fifth-wheel or appropriate distance measurement instrument (DMI) with accuracy of ± 100 mm/km and a resolution of 25 mm.

NOTE 1—Fig. 1 shows a functional block diagram for multiple GPRs and support equipment.

5. Hazards

5.1 During operation of the GPR system, observe the manufacturer's safety directions at all times. When conducting inspections, ensure that appropriate traffic protection is utilized in accordance with accepted standards.

5.2 Electromagnetic emissions from the GPR apparatus, if the system is improperly operated, could potentially interfere with commercial communications, especially if the antenna is not properly oriented toward the ground. Ensure that all such

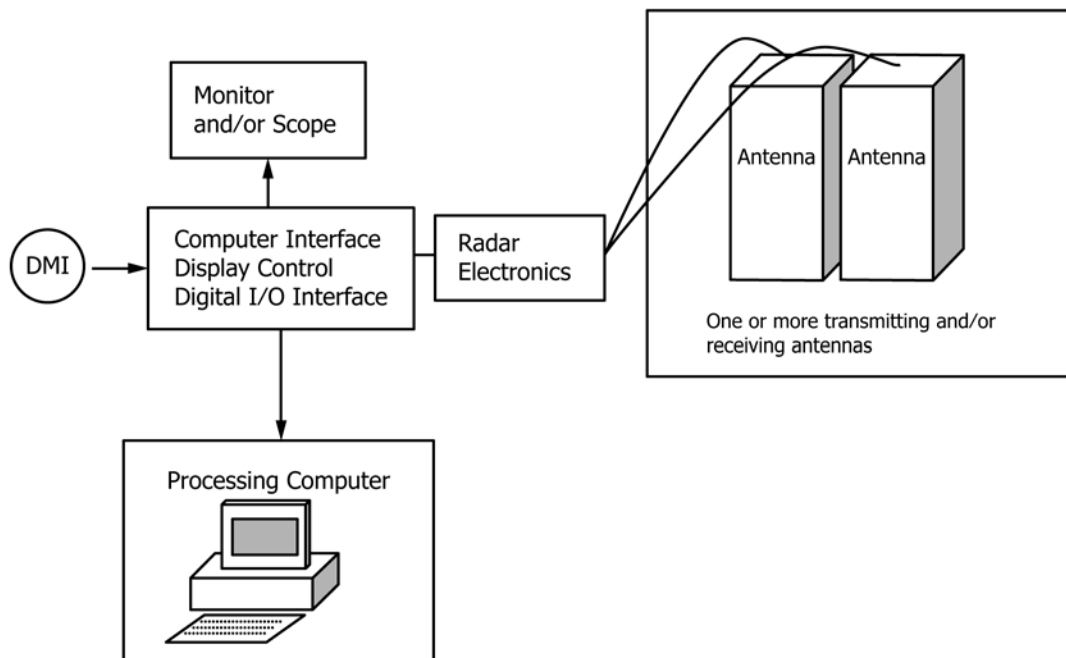


FIG. 1 Block Diagram of GPR and Support Equipment