Designation: E3013/E3013M – 17 (Reapproved 2022)

Standard Test Method for Evaluating Concrete Pavement Dowel Bar Alignment Using Magnetic Pulse Induction[1]

This standard is issued under the fixed designation E3013/E3013M; 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 the equipment, field procedures, and interpretation methods for the assessment of portland cement concrete pavement dowel bar alignment using magnetic pulse induction (MPI), also referred to as magnetic imaging tomography or eddy current tomography. Magnetic pulse induction (MPI) devices induce a weak-pulsed magnetic field that causes the induction of eddy currents in metal objects disturbing the field. When metal (dowel bar) enters into the field, an electrical signal is produced and processed through algorithms to detect and produce quantitative values for the depth, alignment, and side shift locations of each dowel and tie bar present in the pavement joint.

1.2 MPI equipment includes the following: systems scanning device that induces the magnetic field and collects the electrical signal; orientation system such as a rail system; field data collection device that collects the signal data from the scanner, performs field analysis, and stores data; analysis software package that calculates the dowel bar positions, allows data adjustments to account for detected anomalies, and produces reports.

1.3 MPI field procedures describe the steps and processes required to collect reliable, repeatable, and accurate results from the scanner operation and orientation system. Critical to the accuracy is the absence of any metal items except for the dowel bars in the vicinity of the joints being tested. Metal in the scanner and orientation system should be minimized. The scanner operation procedures cover the collecting of the data, reviewing the results on the field data collector, and determining if the data collection test was successful.

1.4 MPI interpretation methods describe how to analyze data collected in the field procedure, steps taken to address interferences, and anomalies discovered during the data analysis to provide accurate results for the dowel bar positions. Also, minimum report content is prescribed for the production of meaningful test information substantiating the results.

1.5 *Units*—The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in nonconformance with the standard.

1.6 *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.*

1.7 *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.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

A615/A615M Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

A1078/A1078M Specification for Epoxy-Coated Steel Dowels for Concrete Pavement

3. Terminology

3.1 *Definitions:*

3.1.1 *composite misalignment, n*—the composite misalignment using the horizontal and vertical misalignments as components in calculating a total spatial deviation of the dowel axis from design orientation.

3.1.1.1 *Discussion*—Horizontal and vertical misalignment are the legs of a right-angle triangle, and the composite misalignment is the hypotenuse.

[1] This test method is under the jurisdiction of ASTM Committee E17 on Vehicle - Pavement Systems and is the direct responsibility of Subcommittee E17.41 on Pavement Testing and Evaluation.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

3.1.2 *depth, n*—the measured position of the centroid of the dowel bar from the surface of the concrete pavement in the *z*-axis.

3.1.3 *depth deviation, n*—the difference in specified or design depth of the dowel bar versus the measured depth at the centroid of the dowel bar.

3.1.3.1 *Discussion*—Values are expressed as either positive for additional depth or negative for less depth.

3.1.4 *horizontal misalignment, n—also referred to as horizontal skew*, the amount of horizontal rotation in a dowel bar about its center point when viewed from above the pavement or lane where the test was initiated.

3.1.4.1 *Discussion*—Rotation in a clockwise direction is reflected as a positive value. Rotation in a counterclockwise direction is reflected as a negative value. The value is the distance from specified or design orientation to the as-measured location on the end of the dowel bar. See Fig. 1.

3.1.5 *horizontal translation, n—also referred to as dowel position (x-position)*, the movement of the dowel bar laterally along the centerline of the sawed joint in the concrete pavement.

3.1.5.1 *Discussion*—Positive values are expressed for movement away from the starting point of the test.

3.1.6 *side shift, n*—the movement of the dowel bar longitudinally from the centerline of the transverse joint (*y*-axis) in the concrete pavement.

3.1.6.1 *Discussion*—Values are expressed as either positive for movement to the right of the joint or negative to the left of the joint. This term can be used interchangeably with *longitudinal translation*. See Fig. 1.

3.1.7 *testing coordinate system, n*—spatial location reference methodology for establishing baselines to measure from in three dimensions.

3.1.7.1 *Discussion*—The *x*-axis lies along the transverse joint line, the *y*-axis lies along the pavement or lane edge, and the *z*-axis is down from the surface of the concrete pavement. Its origin point (0, 0, 0) begins with the intersection of the transverse joint line (*x*-axis), the longitudinal edge of the pavement (*y*-axis), and the surface of the concrete pavement (*z*-axis). Positive values represent points away from the edge of pavement for the *x*-axis, to the right of the joint for the *y*-axis. (Note that it can be the inside or outside edge pavement depending upon the direction the test is performed, and down from the surface of the concrete pavement for the *z*-axis.)

3.1.8 *vertical misalignment, n—also known as vertical tilt*, the amount of vertical rotation in a dowel bar about its center point when viewed from the edge of pavement or lane where the test was initiated.

3.1.8.1 *Discussion*—Rotation in a clockwise direction is reflected as a positive value. Rotation in a counterclockwise direction is reflected as a negative value. The value is the

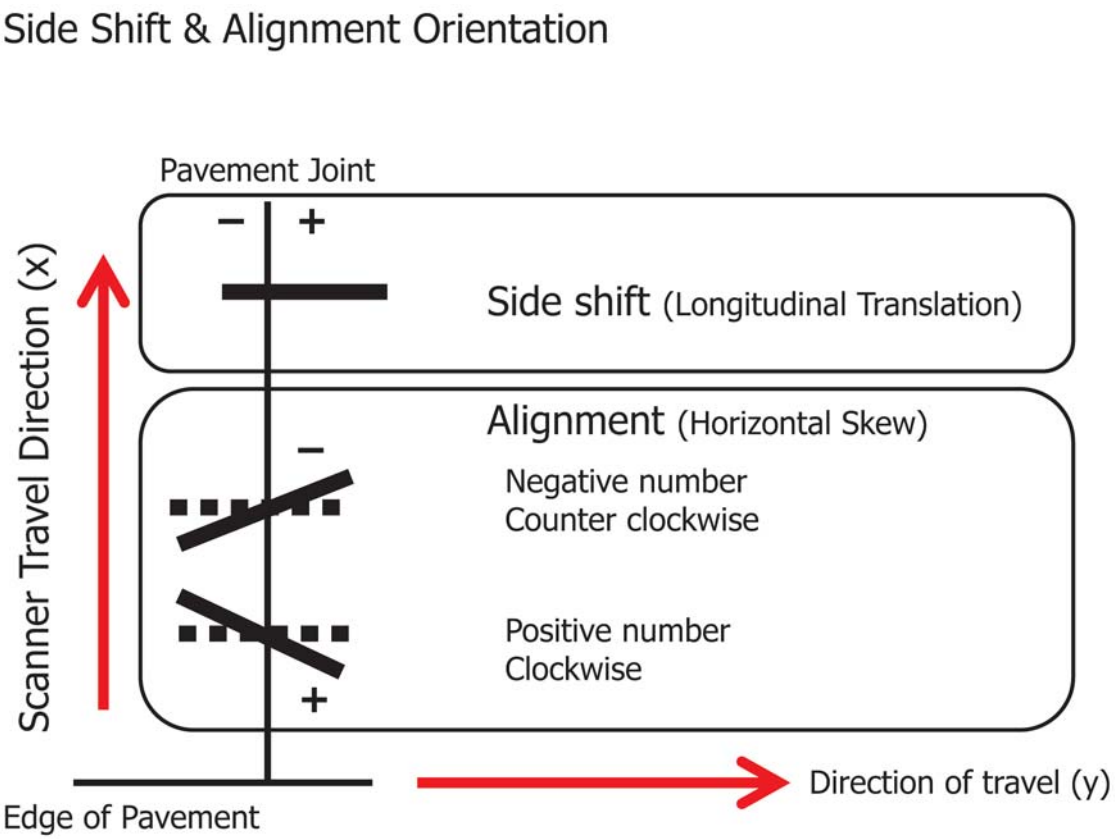

FIG. 1 Side Shift and Alignment Orientation