A METHOD FOR FRICTION TESTING OF OPEN GRATED STEEL BRIDGE DECKS

PROBLEM STATEMENT

Standard methods of measuring pavement friction have been used for more than 40 years as a means of judging the quality of pavement surfaces, as controls for new construction, and as criteria for repair or reconstruction. In 1958, the First International Skid Prevention Conference in Charlottesville, Virginia was convened to standardize commonly used measuring methods. The standardization of those methods led to the development of the American Society of Testing and Measurement (ASTM) Committee E17 on skid resistance in 1960. Since that time, friction standards have been concerned primarily with roadway pavements such as concrete and asphaltic concrete. Hundreds of studies have been conducted on the measurement of friction and texture of pavements, but very few have been conducted on other types of roadway surfaces.

Since method E-274 was originally conceived with the measurement of paved roads as the primary concern throughout the country, other road surfaces were overlooked or only indirectly addressed. As road safety and accident causation is becoming more important to state agencies, it is imperative to include the atypical road surfaces, such as bridges with open grated steel decks, in a measurement program. To do this properly, a standardized test method, such as ASTM E-274, must be shown to be applicable for measuring the roadway surfaces of steel bridge decks as well as pavements.

OBJECTIVES

The primary objective of this work was to develop a standard method of determining the surface friction or skid resistance of an open grated steel bridge deck. This study addressed only the measurement of friction on open grated steel deck bridges and not what those values should or should not be. Just as with the friction measurement of pavements, the maintenance criteria should be left up to each state or local agency. Researchers also investigated (1) whether open grated steel bridge decks contributed to vehicle instability by producing lateral forces at the tire interface and (2) potential methods of improving the friction of steel bridges.

FINDINGS AND CONCLUSIONS

Throughout this project, the foremost objective was to discover any significant differences between the quality of friction measurements taken on pavements and those taken on open grated steel bridges as they may relate to the traveling public. Even though ASTM E-274 is a maintenance tool and states that “The values are insufficient to determine the distance required to stop a vehicle on either a wet or dry pavement,” a correlation between pavements, steel bridge decks, and automobiles was investigated. Utilizing three ASTM test tires on the friction trailer, researchers conducted friction testing both on the paved approach to the bridge and then on the steel bridge deck . The ASTM E- 1136 test tire, which is a full tread, Uniroyal Tiger Paw radial, was included to represent the locked wheel friction of a passenger car on the different surfaces. The other tires were the standard ASTM E-501 ribbed and the E-524 smooth tire. All testing was done using unmodified E-274-97 procedures at 40 mph.

After testing five bridges and approaches, researchers found that the ratios and absolute values between radial and ribbed test tires on the pavements were similar to the ratios and absolute values between radial and ribbed test tires on the steel bridges. This finding affirms that the E-274 test method, with an E-501 ribbed tire, produces friction values similar to those of a radial passenger car tire, E1136, on either a paved surface or an open grated steel bridge. Previous studies also showed a good correlation between an automobile and a 2-wheel E-274 system on seven different bridges, with an average difference of three friction numbers.

In the case of the E-524 smooth test tire, friction values on the steel bridge deck were very similar to those of the other two test tires but varied considerably on the paved surfaces. With the smooth tire, some bridges showed higher friction on the steel deck, while others showed higher friction on the pavement.

During the December 2001 meeting, the recommendation was made to ASTM Committee E17.21 to include in ASTM Standard E-274 open grated steel bridges as a road surface that may be measured by this method, without modification, but with proper documentation as to the type of surface. It was also recommended that states be allowed to determine acceptable Friction Number values for the open grated steel bridge deck maintenance, just as they now do for pavements. This recommendation has been incorporated into a draft revision of E-274 that should go out soon for ballot. Work will continue to implement these changes to E-274. A standard test procedure for measuring the friction characteristics of steel grated bridge decks will be produced once the recommendations of this study are included in ASTM E-274.

Steering Stability on Oven Grated Steel Bridges

After evaluating the steering stability of automobiles crossing ten open grated steel bridges by both instrumentation and subjective measures, researchers detected no adverse effects. Over the thirty-two test runs, several maneuvers were investigated such as maintaining a straight path, light braking, and light steering while on the bridge deck. None of the test runs produced any hint of instability on the instruments or to the driver.

Increasing Friction of Open Grated Steel Bridges

The final portion of the study was designed to locate a surface treatment that may be applied to open grated steel bridge decks, which may require an increase in friction values. A product called Ceram-Kote 54 was located and a sample of decking was treated, with positive results. The coating firmly bonded to the steel and initially was immune to abrasion. Further research is needed to determine whether this product is a suitable coating for steel deck bridges.

BENEFITS

This research provides evidence that the ASTM E-274 standard test method can be used to assess friction characteristics on both paved surfaces and open grated steel bridges. Such information is critical to support informed highway planning, policy, and decision-making. In addition, the project findings are being used as a basis to revise the current ASTM standard to include open grated steel bridges.

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