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Standard Guide for Conducting Subjective Pavement Ride Quality Ratings[1]

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1. Scope

1.1 This guide covers a procedure for obtaining subjective numerical ride ratings for a group of representative highway pavement sections having a broad spectrum of physical characteristics.

1.2 The intent of this guide is to describe a procedure for generating a set of comparatively scaled ride ratings, subjectively derived, for a subgroup of pavement sections having a ride quality distribution approximating the general population of highways of interest. This set will provide statistical estimates of the average subjective ride ratings which would be obtained for the same group of pavement sections if the entire population of users could be interrogated.

1.3 For the data to be a reasonable representation of the average ride quality judgments of the total highway user community for the total population of highway pavements, certain sampling theory precepts must be observed; The size of the rating panel, the selection of its members from the user community, the method of quantifying the individual judgments, as well as the selection of the sample pavement sections are all important areas to be considered.

1.4 An important use of the resulting ride quality data would be to determine the ability of various hypothesized deterministic functions of physical parameters of the pavement samples, such as measured longitudinal profile, and so forth, to provide an estimate of subjective ride quality judgments.

1.5 This guide is based on guidelines described in Appendix F of NCHRP Report 275,[2] and in Appendix E of NCHRP Report 308.[3]

1.6 The values stated in both inch-pound and SI units are to be regarded separately as the standard. The units given in parentheses are for information only.

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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[4]

E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods

E178 Practice for Dealing With Outlying Observations

E867 Terminology Relating to Vehicle-Pavement Systems

E950 Test Method for Measuring the Longitudinal Profile of Traveled Surfaces with an Accelerometer Established Inertial Profiling Reference

3. Terminology

3.1 *Definitions:*

3.1.1 *mean panel rating (MPR), n*—the average value, for each section of highway pavement, of ride quality ratings assigned by a ride quality rating panel

3.1.2 *ride quality rating, n*—a numerical value subjectively assigned to a section of highway pavement by an individual quantifying his judgment of the level of ride quality for that section based on a psychophysical scale.

3.1.3 *ride quality rating panel, n*—a group of highway users, statistically representative of the total expected highway user population, in rating the ride qualities of pavements.

3.1.4 *rideability, n*—a subjective judgment of the comparative discomfort induced by traveling over a specific section of highway pavement in a vehicle.

4. Summary of Guide

4.1 This guide is intended to provide a statistically valid and practical method of obtaining a set of scaled ride quality ratings, based on subjective judgments by a sample group of raters selected from the total population of expected users, for a subset of test sections selected to represent the general

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[2] Janoff, M.S., Nick, J.B., Davit, B.S., and Hayhoe, G.F., "Pavement Roughness and Rideability," *NCHRP Report 275*, September 1985.

[3] Janoff, M.S., "Pavement Roughness and Rideability Field Evaluation," *NCHRP Report 308,* July 1988.

[4] 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.

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inventory of pavements in an area of interest. Individual ratings are obtained in a prescribed manner and averaged to give a mean panel rating (MRP) for each test section.

5. Significance and Use

5.1 A primary responsibility of highway agencies is the construction and maintenance of highway pavements in a condition (including ride quality) perceived to be satisfactory by the user community. The ability to quickly, easily, and economically acquire an objective standard numeric (rideability index) that will estimate the current level of satisfaction for lengths of pavement is desirable for determining when an acceptable level of ride quality does not exist and corrective measures are required.

5.1.1 This guide describes a procedure to produce subjectively derived, numerical ride quality ratings for each sample of a broad spectrum of highway pavement sections based on a standard numerical scale (0 to 5, described herein). These rating estimates may be considered to be closely correlated to the collective qualitative judgments of the total related highway user population.

5.1.2 The MPR data set thus obtained can be useful in testing various hypothesized deterministic functions of certain physical parameters of sections of pavement, such as the measured longitudinal profile, as estimators of the ride quality rating the user population might assign to any particular member of the total relevant inventory of highway pavement sections.

5.1.3 Objective, quantitative, easily measurable rideability index data shown to be highly correlated with MPRs are a valuable resource for monitoring the performance of highway pavement construction, maintenance, and repair operations.

6. Apparatus

6.1 *A Ride Quality Rating Panel,* made up of a subset of individual members of a highway user population.

6.2 *A Selected Array of Pavement Sections,* (test sections) to be rated.

6.3 *A Fleet of Vehicles,* with qualified drivers to transport panel members over the test sections.

6.4 *A Central Meeting Facility,* for administrative operations such as instruction to drivers and panel members, compilation of ratings, and so forth.

6.5 *Miscellaneous Materials,* such as route maps and information sheets, driver instruction forms, rater instruction forms, rating forms, summary forms, and so forth.

7. Procedure

7.1 The procedure presented here was developed as part of NCHRP Project 1–23 FY '82 and is described in detail in Report 275 (Appendix A, pp. 37–40, and Appendix F)[2] and further developed in NCHRP Project 1–23 (2), discussed in NCHRP Report 308 (Ref. 2, Chapter One, pp. 3–6, Appendixes A and B, pp. 24–28).[3] Excerpts from these references are included in Appendix X1 and Appendix X2 for convenience.

7.2 *Preliminary Requirements:*

7.2.1 *Pavement Test Sections*—Select an appropriate number of pavement sections in the region of interest. Each section should have homogeneous physical characteristics throughout its length. The set of test sections should be well distributed by roughness level and surface type, and should be straight and free of anomalies. Sections should be of equal length, long enough to provide panel members adequate exposure and should be located so that a driving route can be developed that will allow approximately equal travel time between sections that is long enough for raters to record their values. After the test sections have been selected, the beginning and end of each section must be marked as well as the "runup" to the section.

7.2.2 *Transport Vehicles and Drivers*—Provide a sufficient number of vehicles to permit the rating panel members to be transported over the test route in one or two days. They should be of the same type and condition. Drivers should remain constant throughout the test.

7.2.3 *Ride Quality Rating Panel*—Choose a panel size based on the acceptable error (see Table 1). The panel should be composed of licensed drivers selected from a wide range of qualifications, that is, sex, age, experience, and so forth. In order to keep the panel study error at an acceptable level, the investigators in the NCHRP 1–23[2] study chose a panel size of thirty six members.

7.2.4 *Test Route*—Develop a test route that will traverse all of the test sections at approximately equal intervals, and includes adequate rest stops, meal stops, and so forth.

7.2.5 *Test Schedule*—Prepare a schedule of dates and times the tests will be conducted.

7.2.6 *Materials*—Prepare an adequate supply of driver instruction forms and route maps, panel member instruction forms, panel member rating forms.

7.3 *Conduct of Rating Operation:*

7.3.1 *Driver Meeting*—At the meeting facility, as scheduled, instruct drivers concerning the experiment, that is, constant speed (usually 80 kph (50 mph)), handling of completed rating forms, and so forth. Assign panel members to seating positions at this time; these should remain constant throughout the test.

7.3.2 *Panel Member Meeting*—Prior to the test run, instruct the raters regarding the rating scales, completing the rating forms, and handling the completed form. The Weaver/AASHO 0 to 5 rating scale and rating form to be used in this practice is shown in Appendix X1 (Fig. X1.1). Secrecy is required between panel members.

TABLE 1 Panel Size as a Function of Error

Error (MPR Units)	Non-Normal distribution	Normal distribution
0.1	319	138
0.2	80	35
0.3	36	15
0.4	20	9
0.5	13	6
0.6	9	4
0.7	7	3
0.8	5	—
0.9	4	—
1.0	3	—

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7.3.3 *Perform Test Run*—Transport all panel members over the entire test section route (two days might be required), with the drivers collecting the completed rating forms after traversing each test section.

7.4 *Process Data:*

7.4.1 *Mean Panel Rating (MPR)*—The mean of the panel ratings and standard deviation of the data about the mean rating may now be calculated for each test section. Where the ride quality rating panel members were in close agreement on the pavement rideability, the standard deviation about the mean panel rating will be small and should approximate the error in MPR units shown in Table 1. A test site where the computed standard deviation exceeds the error listed in Table 1 shall be removed from the ride quality study.

7.4.2 *Need for repair*—The percent of rating panel members who judged that a section is in need of repair can also be calculated for each test section. The table of these values represent the product of this experiment.

8. Report

8.1 The report for studies conducted using this guide shall contain the following information:

8.1.1 *Ride Quality Ratings*—Each ride quality rating for all panel members shall be tabulated and recorded for each section included in the study.

8.1.2 *Mean Panel Ratings*—For each test section, the mean panel rating and corresponding standard deviation shall be computed and recorded to two decimal places.

8.1.3 *Study Identification Information*—General information to identify the conditions under which the study was conducted shall be recorded. As a minimum the date(s) and the type(s) of vehicles used for the study shall be recorded.

9. Statement on Precision

9.1 The standard deviation of the subjective ride quality ratings about the mean panel rating for each test site should not exceed the error listed in Table 1 (0.3 MPR units for a thirty-six member panel

10. Physical Parameters

10.1 The measurement of physical parameters of the pavement sections to be used for correlation with the mean panel ratings shall be made in the same time frame as the collection of panel rating data.

11. Keywords

11.1 need for repair; pavement ride quality; ride number; ride quality rating panel; rideability; subjective ride quality

APPENDIXES

(Nonmandatory Information)

X1. GUIDELINES FOR PAVEMENT RIDEABILITY STUDIES

X1.1 The guidelines presented here are excerpted and paraphrased from NCHRP 1–23 (Appendix E).[2]

X1.2 This appendix provides a sample set of detailed guidelines for highway agency personnel to conduct panel rating studies of rideability or ride quality. The guide describes the six key issues that must be addressed: selection of test sections and route formation, panel selection, rating procedures, panel study, date reduction, and physical measurements.

X1.3 *Selection of Test Sections and Route Formation*—This section of the user's guide describes the steps required to: identify potential test sections; select test sections; develop the route; create an inventory of the test sections and their characteristics; mark the test sections; and inform maintenance departments about the necessary deferment of repair work on the test sections:

X1.3.1 *Identification of Potential Test Sections*—Identification of potential test sections is begun by reviewing historical roughness data, including road logs or inventories, pavement roughness or serviceability index data, and local knowledge. Some states have road logs or pavement inventories (by particular district, division, or county) which describe the physical and geographical characteristics of pavement sections. For example, the road log books of the Pennsylvania Department of Transportation (PADOT) include the following informative data: legislative route, station number, maintenance functional code (MFC), functional class code, federal-aid status, traffic route, urban or rural location, length of test section, average daily traffic, surface width, year built, year resurfaced, and description of pavement.

X1.3.1.1 Some of these data can be useful background for identifying pavement and other characteristics of routes. The road log can provide the historical record of when routes were constructed and repaired and also can provide a logical starting place for the field survey team. For example, determining where to look for extremely "rough" road surface sections could be logically deduced from routes that were constructed long ago or have a history of frequent repair (such as a route that is in a poor drainage area where the road surface often cracks). Determining where to look for an extremely "smooth" road could be logically deduced from identifying the newly constructed highways or the roads that have been freshly overlaid with new asphalt. In addition, traffic patterns identified in the road logs can give the survey team an idea of what level of pavement roughness can be expected on certain routes.

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