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Accreditation for the Long-Term Pavement Performance Studies Pavement Distress Raters

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ABSTRACT

Distress surveys are one element of the monitoring effort currently underway by the Strategic Highway Research Program (SHRP) for the Long Term Pavement Performance (LTPP) study. To achieve the objectives of this effort, SHRP is making use of photographic distress survey technology, which provides for high resolution 35-mm black and white photographs and photographic transverse-profile measurements. In those instances where the units cannot be used, due to time constraints or the difficulty of getting the photographic survey vehicles to the site, manual distress surveys serve as the backup data collection method.

Because accurate data is key to the success of the LTPP study, SHRP has developed and implemented an accreditation process to ensure the quality of distress data collected from manual surveys. The purpose of SHRP's accreditation process is to provide a means for ensuring, to the extent possible, the quality and consistency of distress data being collected by the raters. The process consists of two parts, a written examination and a two-part field survey examination, and is being administered in a workshop situation. Although the process is still in its early stages, it is SHRP's intent that all distress data for the LTPP study be collected by raters who have successfully completed the accreditation.

To date, the accreditation workshop has been conducted on two separate occasions, both in Reno, Nevada. All raters who attended the workshops successfully completed the accreditation process, which is not surprising since the raters had several years of experience in the conduct of SHRP distress surveys. Other objectives targeted during these workshops were also successfully completed: (1) the concept of accreditation workshops for SHRP raters was shown to be feasible; (2) preliminary measures of rater variability were established; (3) the accreditation grading system was shown to work satisfactorily, although changes will be required to account for the subjective nature of distress surveys; and (4) ground truth distress values were established for two accreditation sites for use in near future workshops. This report describes the SHRP accreditation process and the results of its implementation to date.

ACCREDITATION OF SHRP LTPP PAVEMENT DISTRESS RATERS

INTRODUCTION

SHRP's efforts to monitor surface distress on the test sections under study in the Long-Term Pavement Performance (LTPP) research serve two primary purposes. The first is to provide a permanent, objective, high resolution record of pavement condition over the full length and width of the sections under study; the second is to provide detailed, distress-specific condition data for use in the development of pavement performance prediction models.

To achieve these objectives, SHRP is making use of the photographic distress survey technology, which provides for high resolution 35-mm black and white photographs and photographic transverse-profile measurements. The reduction of distress data from the film is accomplished through a computer assisted interpretation process. The film interpretations and the initial quality assurance (QA) of the interpretations are performed under close supervision of experienced engineers and technicians in an office environment. Further QA of the film interpretations is performed at the SHRP regional coordination offices (RCO's) by the personnel most knowledgeable of the actual conditions at the sites.

In those instances where the photographic surveys cannot be used, due to time constraints or the difficulty of getting the survey vehicles to the site, manual distress surveys serve as the backup data collection method. By definition, however, these surveys can not have the same level of detailed, thorough supervision and QA checking as is available in the film interpretation process. Another important facet of the manual survey is the fact that no permanent objective records, such as the photographs obtained in a consistent and controlled manner, are left behind to supplement the hand-drawn maps and observations and interpretations (possibly subjective) of the rater.

As a consequence, an accreditation process to develop consistency among raters has been established by SHRP. The specific purpose of this accreditation process is to provide a means for ensuring, to the extent possible, the quality and consistency of distress data being collected for LTPP program by the RCO raters. Although the process is still in its early implementation phase, it is SHRP's intent that all distress data for the LTPP study be collected by raters who have successfully completed the accreditation.

This report describes the LTPP accreditation process and its implementation to date. The first part of the report presents an overview of the accreditation procedure, including its basis, components, and grading system. The next portion of the report focuses on two workshops conducted by SHRP in May and June of this year, as part of the implementation process. Particular emphasis is placed on the changes to the accreditation process that resulted from these workshops. Finally, the major conclusions to date and recommendations for improving the overall process and its implementation are presented in the last portion of this report.

ACCREDITATION PROCEDURE

Achieving the desired consistency in distress data collection requires a firm basis for the actual identification, measurement, and recording of distresses. Pavement distresses are defined and measurement and recording requirements established in SHRP's "Distress Identification Manual for the Long-Term Pavement Performance Studies" (DIM). Manual distress surveys are performed using the procedures published in an appendix of the DIM. This appendix contains instructions for performing manual surveys, standard map symbols for recording distress occurrences, map sheets, and distress data summary sheets. The maps are prepared in the field by the rater and all distress quantities are then summarized and recorded on distress survey summary sheets appropriate for the pavement type.

The importance of the distress data to the goals of the LTPP program requires minimum levels of experience and expertise for the personnel performing surveys. To participate in the accreditation process, and hence future distress data collection activities, RCO raters must have the following: high school education (or equivalent), previous training in distress surveys (either formal or informal), and familiarity with the LTPP DIM and field data collection procedures. Previous field experience (minimum of 1 year) is highly desirable, but not mandatory.

The actual accreditation process consists of two major parts: a written examination and a two-part field survey examination. The written examination is intended to test the general knowledge of the rater, in a closed-book situation. The examination consists of the following:

- Identification of distresses from slides - A total of 45 to 60 slides are shown to the RCO raters, covering various distress types on asphalt surfaced, jointed concrete and continuously reinforced concrete pavements. The raters are allowed 15 to 20 seconds to identify the distress type(s) shown in each slide and to write it on the examination sheet provided. This portion of the examination is 15 to 20 minutes in length and is worth 25% of the total written exam.

- Knowledge of distress types, severities and measurement procedures - RCO raters are required to answer a total of 10 short-answer questions, selected at random by the examiners, covering the description of distress types, severity level definitions, and/or field measurement procedures. This part of the examination is 45 minutes in length and is worth 60% of the total written exam.

- Interpretation of distress maps - RCO raters are required to summarize distress types and quantities from a map sheet. This portion of the examination is 20 minutes in length and is worth 15% of the total written exam.

An example of the written examination is given in Appendix A. If a rater fails to achieve the minimum grade, review sessions are held and a reexamination using different questions is conducted. If, after the second attempt, the rater cannot pass the written examination, the rater is excused from further participation in the accreditation workshop. It is recognized that in practice, the manuals are part of the field equipment the raters are required to have. As such, the inability of the rater to recall all of the criteria for distress severity level determination should not be of overriding concern.

The field survey examinations, on the other hand, are intended to measure the capabilities of the raters in observing and recording distress data. The successful completion of these examinations will identify the rater as possessing the level of knowledge, competence, and accuracy in observation to provide distress data of acceptable reliability for inclusion in the LTPP data base.

The field survey examinations are conducted on two 150 m (500 ft) pavement sections, one asphalt concrete surfaced and one portland cement concrete surfaced pavement. These sections will have been surveyed in detail by a committee of experienced raters, including the accreditation workshop leaders and other knowledgeable personnel, to determine the extent and types of distresses present. Individual surveys by the experienced raters will be followed by a group survey and review to ensure that all points of view are addressed in reaching a consensus. The results of the committee surveys are considered the ground truth or the "actual values" against which the individual rater's results will be compared for grade.

Each RCO rater is required to perform, independently, a distress survey of the sections included in the accreditation process. These surveys are performed using LTPP procedures; i.e., detailed scaled mapping of the section followed by reduction of the mapped quantities and completion of the appropriate distress summary forms. At each accreditation section, the RCO raters are allowed 3 hours to complete the survey and to reduce the distress data for each section. All forms are then returned to the session leader(s) before departing the survey site.

For reasons of practicality certain measurements are not fully incorporated in the field survey portion of the accreditation. These are: lane to shoulder drop off, crack and joint faulting and transverse profile measurements. Single station measuring activities for these distresses are included in the field survey exercises prior to the examinations, but are not part of the assessment of the raters. Faulting measurements for determining severity levels of cracks in portland cement concrete pavements are not required for the examination surveys.

Grading the distress surveys is accomplished by comparing the individual rater's results to the actual values determined by the committee of experienced raters. Weighting factors are applied at several levels based on:

- the precision of the total quantity recorded for each distress,
- the precision of the individual quantities for each severity level of the distress, and
- the relative importance of the distress.

The point value system used for grading consists of a maximum of 10 points for each distress type actually in the section. These 10 points are distributed among the individual severity levels, where applicable, as well as the total quantity of the distress type. Accuracy in identifying and recording distress determines the number of points received for each severity level and for the total. In turn, accuracy is determined by comparing the variance of the rater's results to those from the committee of experienced raters (i.e., ground truth or actual quantities). The point values received based on variance between committee and rater observations are calculated using the following formula:

$$Points = \left(1 - \frac{(Actual - Rater)}{Actual}\right) \times QtyWgt$$

where: Actual = quantity of distress from the committee survey; Rater = quantity observed and recorded by the rater; QtyWgt = quantity weight factor applied to the total and to each severity level -- QtyWgt = 7 for total quantity of the distress and 0.5, 1.0 and 1.5 for the total quantity of low, moderate and high severity distress, respectively.

As an example, assume a rater recorded 60 m^2 of alligator cracking in the section. Of this total, 20 m^2 were low severity and 40 m^2 medium severity. The actual values totaled 80 m^2; 30 m^2 low severity and 50 m^2 moderate severity. Thus, the rater's grade for this particular distress is:

				Points	
	Actual	Rater	Variance, %	Possible	Actual
Total quantity distress	80.0	60.0	25.0	7.0	5.3
Total quantity low severity	30.0	20.0	33.3	0.5	0.3
Total quantity moderate severity	50.0	40.0	20.0	1.0	0.8
Total quantity high severity	0.0	0.0	0.0	1.5	1.5

The sum of the points from rating the variance is 7.9 out of a total possible of 10 points. Also note that if there is no distress at one severity level, the correct determination that no distress is present is given full credit.

The total number of points received for each distress type is then weighted for the significance of the distress. Tables 1, 2, and 3 present the weight factors for all distress types for asphalt concrete surfaced, jointed concrete and continuously reinforced concrete pavements, respectively. Thus, for the above example, an additional weighting factor of 5 (since alligator cracking is a highly significant distress) is applied to the number of points computed based on the rater variance. Taking this one step further, the maximum possible number of points for this distress type is equal to the distress weight (5) times the maximum number of points gained from complete accuracy in recording (10), or 50 points. When the variance rating is weighted for the distress type, the points received value becomes 39.5 (or 79%) out of a maximum possible 50 (or 100%).

In addition, deductions are also imposed on the sum of points received for all distress types when the rater misses a distress type or records a distress type not identified by the committee. This deduction is set at 2% of the total number of possible points in the section and is assessed for each occurrence of missed or misidentified distress. The final grade is the ratio of adjusted points received (points received minus deductions) to the maximum possible in the section, expressed as a percentage:

$$Grade_i = 15 + \frac{\sum_{j=1}^{m} (DstWgt_j x Points_j) - \sum_{k=1}^{n} Deducts_k}{\sum_{j=1}^{m} DstWgt_j x Points_{max,j}}$$

where Grade = final grade for section surveyed by the ith rater; $DstWgt_j$ = distress weight applied to jth distress, where j = 1 to m; $Points_j$ = points received by rater for jth distress; $Points_{Max,j}$ = maximum possible number of points for the jth distress; and, $Deducts_k$ = deduct points for kth distress (missed or not identified), where k = 1 to n. Complete examples of the field accreditation scoring system are presented in Tables 4 and 5 for asphalt concrete surfaced and jointed concrete pavements, respectively.

Also note that a constant (i.e., 15) has been introduced in the above equation to allow for, in a very crude fashion, "reasonable" deviations from the actual or ground truth values established by the committee of experienced raters, so that the raters are not unduly penalized. This value was established based on the results of the pilot workshop, which are discussed in the next section. However, as experience with the real variability of the

Table 1. AC PAVEMENT DISTRESS ASSESSMENT PARAMETERS

DISTRESS TYPE	UNIT	WEIGHT
Cracking		
1. Alligator (Fatigue) Cracking	Square Meters	5
2. Block Cracking	Square Meters	5
3. Edge Cracking	Meters	5
4. Longitud. Cracking - Edge		
Length	Meters	5
Length Sealed	Meters	0.5
4. Longitud. Cracking - Other		
Length	Meters	5
Length Sealed	Meters	0.5
5. Reflection Cracking at Joints		
Number	Number	5
Length (Transv. Joints)	Meters	3
Length Sealed (Transv.)	Meters	0.5
Length (Longt. Joints)	Meters	3
Length Sealed (Longt.)	Meters	0.5
6. Transverse Cracking		
Number	Number	5
Length	Meters	3
Length Sealed	Meters	0.5
Patching and Potholes		
7. Patch/Patch Deterioration		
Number	Number	2
Area	Square Meters	1
8. Potholes		
Number	Number	2
Area	Square Meters	1
Surface Deformation		
9. Rutting	Millimeters	2
10. Shoving		
Number	Number	2
Area	Square Meters	2
Surface Defects		
11. Bleeding	Square Meters	0.5
12. Polished Aggregate	Square Meters	0.5
13. Raveling and Weathering	Square Meters	0.5
Miscellaneous Distress		
14. Lane-to-Shoulder Dropoff	Millimeters	2
15. Lane-to-Shoulder Separation		
Length	Meters	2
Length Sealed	Meters	0.5
16. Water Bleeding and Pumping		
Number	Number	2
Length	Meters	1

Table 2. JOINTED CONCRETE PAVEMENT DISTRESS ASSESSMENT PARAMETERS

DISTRESS TYPE	UNIT	WEIGHT
Cracking		
1. Corner Breaks	Number	5
2. Durability "D" Cracking		
Number	Number	1
Area	Square Meters	3
3. Longitudinal Cracking		
Length	Meters	5
Length Sealed	Meters	0.5
4. Transverse Cracking		
Number	Number	5
Length	Meters	3
Length Sealed	Meters	0.5
Joint Deficiencies		
5. Joint Seal Damage of Transv. Joints	Number	2
5. Joint Seal Damage of Longt. Joints		
Number	Number	2
Length	Meters	1
6. Spalling of Longitudinal Joints	Meters	2
7. Spalling of Transverse Joints		
Number	Number	2
Length	Meters	1
Surface Defects		
8. Map Cracking		
Number	Number	2
Area	Square Meters	1
8. Scaling		
Number	Number	2
Area	Square Meters	1
9. Polished Aggregate	Square Meters	0.5
10. Popouts	Number	0.5
Miscellaneous Distress		
11. Blowup	Number	1
12. Faulting of Transverse Joints & Cracks	Millimeters	2
13. Lane-to-Shoulder Dropoff	Millimeters	1
14. Lane-to-Shoulder Separation	Millimeters	2
15. Patch/Patch Deterioration		
Number	Number	2
Area	Square Meters	1
16. Water Bleeding and Pumping		
Number	Number	1
Area	Square Meters	0.5

Table 3. CRC PAVEMENT DISTRESS ASSESSMENT PARAMETERS

DISTRESS TYPE	UNIT	WEIGHT
Cracking		
1. Durability "D" Cracking		
Number	Number	1
Area	Square Meters	3
2. Longitudinal Cracking		
Length	Meters	5
Length Sealed	Meters	0.5
3. Transverse Cracking		
Number	Number	5
Length	Meters	3
Surface Defects		
4. Map Cracking		
Number	Number	2
Area	Square Meters	1
4. Scaling		
Number	Number	2
Area	Square Meters	1
5. Polished Aggregate	Square Meters	0.5
6. Popouts	Number	0.5
Miscellaneous Distress		
7. Blowups	Number	1
8. Construction Joint Deterioration	Number	1
9. Lane-to-Shoulder Dropoff	Millimeters	1
10. Lane-to-Shoulder Separation	Millimeters	2
11. Patch/Patch Deterioration		
Number	Number	2
Area	Square Meters	1
12. Punchouts	Number	3
13. Spalling of Longitudinal Joint	Meters	2
14. Water Bleeding and Pumping		
Number	Number	1
Length	Meters	0.5
15. Longitudinal Joint Seal Damage	Length	2

Table 4. EXAMPLE OF ACCREDITATION GRADING SYSTEM FOR FIELD SURVEYS: AC SURFACED PAVEMENTS

Distress Type	Units	Rater Observations				Actual Quantities *				Scoring Summary		
		Total	Low	Moderate	High	Total	Low	Moderate	High	Possible Points	Points Received	Deduct Points
Cracking												
1. Alligator Cracking - Area	Sq. Meters	17.8	0.4	17.4	0.0	14.9	1.9	13.0	0.0	50.0	39.2	0.0
2. Block Cracking - Area	Sq. Meters	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3. Edge Cracking - Length	Meters	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4. Longitudinal Cracking:Edge - Length	Meters	4.7	4.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.7
4. Longitudinal Cracking:Edge - Length Sealed	Meters	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4. Longitudinal Cracking: Other - Lenght	Meters	86.3	21.3	39.7	25.3	89.1	22.1	44.0	23.0	50.0	47.6	0.0
4. Longitudinal Cracking: Other - Lenght Sealed	Meters	0.0	0.0	0.0	0.0	0.8	0.8	0.0	0.0	5.0	0.0	3.7
5. Reflection Cracking at Joints - Number	Number	0	0	0	0	0	0	0	0	0.0	0.0	0.0
5. Reflec. Crack. at Trans Joints - Length	Meters	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5. Reflec. Crack. at Trans Joints - Length Seale	Meters	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5. Reflec. Crack. at Long Joints - Length	Meters	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5. Reflec. Crack. at Long Joints - Length Sealed	Meters	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6. Transverse Cracking - Number	Number	52	21	17	14	56	25	20	11	50.0	44.3	0.0
6. Transverse Cracking - Length	Meters	77.7	20.0	29.0	28.7	74.6	21.8	28.2	24.6	30.0	28.2	0.0
6. Transverse Cracking - Length Sealed	Meters	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Patching and Potholes												
7. Patch/Patch Deterioration - Number	Number	0	0	0	0	0	0	0	0	0.0	0.0	0.0
7. Patch/Patch Deterioration - Area	Sq. Meters	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8. Potholes - Number	Number	0	0	0	0	0	0	0	0	0.0	0.0	0.0
8. Potholes - Area	Sq. Meters	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Surface Deformation												
9. Rutting - Length	Millimeters	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10. Shoving - Number	Number	0	0	0	0	0	0	0	0	0.0	0.0	0.0
10. Shoving - Area	Sq. Meters	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Surface Defects												
11. Bleeding - Area	Sq. Meters	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12. Polished Aggregate - Area	Sq. Meters	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13. Raveling and Weathering - Area	Sq. Meters	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Miscellaneous Distress												
14. Lane-to-Shoulder Dropoff - Length	Millimeters	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15. Lane-to-Shoulder Separation - Length	Meters	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15. Lane-to-Shoulder Separation - Length Seale	Meters	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16. Water Bleeding and Pumping - Number	Number	0	0	0	0	0	0	0	0	0.0	0.0	0.0
16. Water Bleeding and Pumping - Length	Meters	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
									Totals:	185.0	159.3	7.4
											Grade:	97.1

* Based on control group survey

Table 5. EXAMPLE OF ACCREDITATION GRADING SYSTEM FOR FIELD SURVEYS: JOINTED CONCRETE PAVEMENT

Distress Type	Units	Rater Observations				Actual Quantities *				Scoring Summary		
		Total	Low	Moderate	High	Total	Low	Moderate	High	Possible Points	Points Received	Deduct Points
Cracking												
1. Corner Breaks - Number	Number	0	0	0	0	0	0	0	0	0.0	0.0	0.0
2. Durability "D" Cracking - Number	Number	0	0	0	0	0	0	0	0	0.0	0.0	0.0
2. Durability "D" Cracking - Area	Sq. Meters	0	0	0	0	0	0	0	0	0.0	0.0	0.0
3. Longitudinal Cracking - Length	Meters	101.6	34.6	43.2	23.8	100.0	19.0	51.0	30.0	50.0	45.1	0.0
3. Longitudinal Cracking - Length Sealed	Meters	0.3	0.3	0.0	0.0	1.0	1.0	0.0	0.0	5.0	1.6	0.0
4. Transverse Cracking - Number	Number	22	7	9	6	21	8	10	3	50.0	40.8	0.0
4. Transverse Cracking - Length	Meters	42.8	13.5	29.3	0.0	47.0	12.0	26.0	9.0	30.0	23.1	0.0
4. Transverse Cracking - Length Sealed	Meters	1.0	0.3	0.7	0.0	1.0	0.0	1.0	0.0	5.0	4.6	0.0
Joint Deficiencies												
5. Joint Seal Damage of Trans. Joints - Number	Number	15	0	12	3	15	1	8	6	20.0	15.3	0.0
5. Joint Seal Damage of Long. Joints - Number	Number	2	2	0	0	2	2	0	0	20.0	20.0	0.0
5. Joint Seal Damage of Long. Joints - Length	Meters	69.7	69.7	0.0	0.0	62.0	62.0	0.0	0.0	10.0	9.1	0.0
6. Spalling of Longitudinal Joints - Length	Meters	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.9
7. Spalling of Transverse Joints - Number	Number	1	1	0	0	0	0	0	0	0.0	0.0	3.9
7. Spalling of Transverse Joints - Length	Meters	0.7	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.9
Surface Defects												
8. Map Cracking - Number	Number	0	0	0	0	0	0	0	0	0.0	0.0	0.0
8. Map Cracking - Area	Sq. Meters	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8. Scaling - Number	Number	0	0	0	0	0	0	0	0	0.0	0.0	0.0
8. Scaling - Area	Sq. Meters	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9. Polished Aggregate - Area	Sq. Meters	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10. Popouts - Number	Number	200	200	0	0	225	225	0	0	5.0	4.6	0.0
Miscellaneous Distress												
11. Blowup - Number	Number	0	0	0	0	0	0	0	0	0.0	0.0	0.0
12. Faulting of Trans. Joints & Cracks - Length	Millimeters	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13. Lane-to-Shoulder Dropoff - Length	Millimeters	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14. Lane-to-Shoulder Separation - Length	Millimeters	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15. Patch/Patch Deterioration - Number	Number	0	0	0	0	0	0	0	0	0.0	0.0	0.0
15. Patch/Patch Deterioration - Area	Sq. Meters	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16. Water Bleeding and Pumping - Number	Number	0	0	0	0	0	0	0	0	0.0	0.0	0.0
16. Water Bleeding and Pumping - Length	Meters	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
									Totals:	195.0	164.1	11.7
											Grade:	93.1

* Based on control group survey

measurements is gained through future implementations of the accreditation process, it is recommended that a measure of variability (e.g., actual value $\pm$ one standard deviation for each distress type) be included in the scoring system, instead of using a somewhat arbitrary constant.

In terms of the overall accreditation grade, the written examination is worth 20% of the total score, while the field survey portion is worth 80% (or 40% per examination site). To receive accreditation, a rater must achieve a combined 75% grade for the written and field examinations, but no less than 70% on either portion. The passing grades noted are expected to affirm the competence of the raters in distress data collection. The minimum examination grades, however, are not intended to suggest that errors in the field of up to 30% are in any way acceptable.

ACCREDITATION WORKSHOPS

The accreditation of LTPP distress raters is being administered by SHRP in a workshop situation. The raters are brought to a single location for one week of classroom and field work. The workshop agenda covers the following general tasks:

- Classroom sessions for review and discussion of DIM changes and new procedures
- Field survey exercises
- Field survey examinations
- Written examination

The first two days of the workshop are devoted to distress surveys on asphalt concrete surfaced pavements, the next two days focus on distress surveys of jointed and continuously reinforced concrete pavements, while the last day of the workshop includes the written examination and a group assessment of the week's efforts, including a summary and critique of the workshop. An example of a typical workshop agenda is given in Appendix B.

Classroom activity is limited in scope due to the level of experience required for attendance. Primary emphasis in the classroom is on any changes or revisions to the DIM, along with any changes in field procedures. However, a general review of distress types is conducted

using slides and video to reinforce the attendees' knowledge of the most current DIM and field procedures. Time is available for questions and any discussion required to help raters clearly understand the subject matter.

Field survey exercises are conducted as a calibration of the raters. For each pavement type, short pavement sections (60 to 90 m) will have been selected and surveyed by the committee of experienced raters, prior to the start of the workshop. On each of these sections, the RCO raters are required to identify and measure the distresses present. Sections in the early portion of the field exercises are more complex, in order to identify the level of experience of the raters and areas of confusion and error which should be addressed in additional review and discussion. The next test section consists of fewer examples of distresses, with additional time spent in detailed walkdown of the site and discussion of the individual distresses. The objective of these surveys is to determine the individual rater's bias and, as necessary, retrain or correct those individual's misperceptions.

As indicated earlier, the field survey and written examinations are intended to appraise the capabilities of RCO raters in observing and recording distress data and to assess their specific knowledge of the field procedures and distress definitions. The field survey examinations are conducted after completion of the field survey exercises for each pavement type, scheduled at the end of the second and fourth day, while the written examination is administered on the last day of the workshop.

To date, the SHRP accreditation workshop has been conducted on two separate occasions, both in Reno, Nevada. The first workshop took place in May 1992 and the second one in June 1992. Both of these workshops are discussed next, along with a summary of the major findings and conclusions.

Pilot Distress Raters Accreditation Workshop

Two months prior to the pilot workshop, a meeting was held in Reno to identify and plan the various activities related to the workshop, to schedule these activities, and to assign responsibility for their completion. In attendance were representatives of SHRP-DC (FHWA-LTPP), the P-001B Contractor, Texas DOT (formerly SHRP Loaned Staff), the Regional Engineer for the Western Region, and staff and one consultant from the Western Region RCO.

At the planning meeting, an "accreditation committee" was formed to finalize all workshop plans, materials and selection of survey sections. This committee was comprised of SHRP-DC (FHWA-LTPP), SHRP contractor personnel, the Texas DOT representative, and RCO staff. The initial activity consisted of visits to potential test sites to assess their suitability for use in the workshop. Only one site was rejected, solely due to safety concerns, resulting in the following sections used for the workshop:

- Lemon Drive; Lemon Valley, Nevada - complex and simple sections; asphalt concrete surfaced pavements.
- McCarren Boulevard, Westbound (SHRP GPS Section No. 321021); Reno, Nevada - accreditation section; asphalt concrete surfaced pavement.
- Interstate I-80 Westbound; Hirschdale, California - complex section; jointed concrete pavement.
- US 395, Southbound; Reno, Nevada - simple and accreditation sections; jointed concrete pavement.

Once the site selections had been made, it was decided that a "control group" was necessary to provide detailed distress surveys for the test sections chosen for the workshop. This group consisted of the accreditation committee members and one representative from each of the four SHRP regions, each ostensibly the most knowledgeable distress rater at that RCO office. Their results, as noted earlier, would serve as the ground truth or actual distress data against which the individual rater's results would be compared for grade.

The pilot workshop took place during the week of May 18-22, 1992. It had been decided at the planning meeting to limit the pilot workshop to 3 days in order to allow for site selection and general setup of the workshop prior to the arrival of the RCO personnel. As a result, the classroom time was compressed and all field activities associated with the simple sections had to be eliminated.

Although the ultimate goal of this pilot workshop was the accreditation of RCO raters, several other objectives were targeted as part of this initial workshop:

- To determine the feasibility of the planned accreditation workshops,
- To assess the grading system developed for the accreditation of the RCO raters,

- To assess RCO rater variability, and
- To establish actual or ground truth distress data for use in future workshops

The accreditation committee met during the two days prior to the pilot workshop and completed all the tasks it had set out to accomplish, i.e., finalize survey sites, finalize workshop plans and materials. For the three day workshop, this committee was joined by the remainder of the control group members, the RCO representatives.

Classroom activity, significantly shortened to fit within the 3 day time frame, was limited to review of the DIM revisions and new map sheets summary forms. Field activities consisted of individual distress surveys of the complex sections, conducted by each member of the "control group", followed by a walkdown of the sites and discussion of the distresses observed. Although it was intended that a group survey would be conducted on the complex sites, insufficient time was available due to the tight schedule and traffic control restrictions.

A thorough review and discussion of the results for the complex sections led to a number of changes to the SHRP distress identification manual (i.e., DIM), which were aimed at eliminating the ambiguity associated with some of the distress definitions. Once these issues had been resolved, individual surveys were performed by the "control group" raters on the accreditation sites. The results of these surveys, and in particular rater variability, were also reviewed and discussed prior to conduct of the control group surveys for the accreditation sites, which was the last field activity for each pavement type. Both the accreditation committee and RCO raters walked the sections as a group, identifying all distresses present and mapping them. Where disagreements occurred, the alternate viewpoints were discussed by the group prior to reaching a final decision; in all cases, a consensus decision was reached.

The last pilot workshop activity was the written examination, which included the identification of distresses from slides and short-answer questions relating to distress definitions and field procedures. Although initially envisioned as an open-book exam, since RCO raters must have the DIM with them when conducting LTPP surveys, it was decided to proceed with a closed-book examination. This did not seem to be a problem, as all RCO raters scored very high in the exam (more than 90%). All the RCO raters recommended that the exam be kept closed-book in future workshops. Furthermore, it was decided by the

accreditation committee to add to the examination a question or questions dealing with the interpretation and summary of distresses from maps.

Overall, the pilot accreditation workshop is considered a success, as all targeted objectives were "satisfactorily" completed. The concept of accreditation workshops for SHRP-LTPP RCO raters was shown to be feasible; measures of rater variability were established (albeit limited); the grading system was shown to work satisfactorily, although changes will be required in the future to account for the inherent variability associated with "subjective" ratings; and, ground truth values were established for the accreditation sites that will be used in future workshops.

Besides the ambiguity problems associated with the DIM (which were corrected) and their impact on the individual accreditation surveys, the only other difficulty encountered in the workshop was the change in measurement units from English, which the RCO raters were accustomed to, to SI. This problem, however, was quickly overcome after the first couple of surveys. The results of the individual and group surveys, including rater variability, for both the pilot and first workshop are discussed later in the report, as are the final RCO rater grades.

First Distress Raters Accreditation Workshop

The first full-scale workshop took place during the week of June 8-12, 1992. It had been decided at the planning meeting to limit the workshop attendance to 3 persons per region (i.e., total of 12 participants) in order to allow for adequate discussion time and to make field surveys manageable. As a result, the classroom time was more than adequate to answer questions and the field activities were completed within the time allotted.

On day one of the workshop, the first activity consisted of approximately 3 hours of review and discussion of distresses in asphalt surfaced pavements. Overhead transparencies of the definitions and sketches along with slides of actual examples of distresses were used to inform the attendees of changes in the DIM. Map sheets and distress survey data sheets were also presented, since the DIM revisions and conversion to SI units greatly affected these forms. The final portion of the classroom session consisted of a presentation on specific procedures recommended for performing surveys including the sequence of activities, setting up all the forms, a pre-survey walkdown, use of measuring tape versus a

wheel, faultmeter and Dipstick measurements, all intended to help the raters perform systematic and reliable surveys in an efficient manner.

Field activity commenced on the afternoon of day one with individual surveys of a complex site located on Lemon Drive, north of Reno. A 90 m section was surveyed by each individual for comparison to the pilot workshop findings and to assess the relative abilities of the attendees. The time required for this exercise required detailed evaluation of individual results to be conducted the following day, day two.

On day two, the complex site on Lemon Drive was reviewed during a walkdown along with discussion directed at resolving differences in distress identification. In addition, examples of some distress types found outside the test sections were examined and discussed as a supplement to the classroom slide presentation. This activity was followed by another individual surveys of a 60 m section performed concurrently with a briefing and hands-on exercise with the Dipstick. The short survey allowed the raters to use the "adjusted" definitions, i.e., the corrections and clarifications resulting from the complex section surveys and discussions. The Dipstick exercises provided insight into proper handling and operation of the device and an opportunity for each rater to perform transverse profile measurements.

The afternoon of day two consisted of the individual surveys of the accreditation site on McCarren Boulevard. All raters were given 3 hours to map and reduce the distresses for entry on distress data sheets. This site is a GPS section (321021) marked out for the standard 500 feet (152.5 m). The zero station was used in remarking the section into 15 m increments, to a total length used for the accreditation survey of 150 m (492.1 feet).

Day 3 of the workshop consisted of morning classroom sessions for review the results of the asphalt surfaced pavement accreditation surveys followed by separate sessions on distresses found in continuously reinforced pavement and jointed portland cement concrete pavement. Overhead transparencies of the definitions and forms and slides of typical distresses were used in the same way as for the asphalt surfaced pavement classroom sessions to familiarize the raters with changes to the DIM and related changes in the forms. The final classroom activity was a presentation and demonstration of the Georgia DOT Faultmeter. These devices were scheduled for modifications at the time of the workshop. One region provided a modified device in order for the participants to become familiar with the changes in procedures and fault values resulting from the modification.

The afternoon of day 3 consisted of field activities conducted in I-80, in California. A 90 m section of this highway was marked out for individual surveys of a complex jointed concrete pavement. Prior to the surveys, a group walkdown and discussion was held to orient the raters to the site conditions. Sufficient time was available for the raters to complete their surveys and then conduct another group walkdown to discuss and compare the findings. This served to identify differences in interpretations of the defects observed as well as reinforcing and supplementing the classroom presentation.

Day 4 consisted of field activities on jointed concrete sections at the US 395 site in Nevada. In the morning, a 60 m section was surveyed by each rater. This allowed time for some faultmeter use by each person and time to complete the survey and distress summaries. The results of the morning survey were discussed in a walkdown prior to departing the site and returning to the classroom. In the afternoon, the raters were returned to the site to perform individual surveys of a 150 m accreditation section.

Day 5 activities were conducted in the classroom. These consisted of a review of the jointed concrete pavement accreditation surveys followed by the written examination. The examination included identification of distress types from slides, short answer questions on distress identification, and reduction of distresses from map sheets. Once the examination was completed, the raters were allowed to grade their own papers during a presentation and discussion of the correct answers to all questions. Day 5 concluded with the raters completing course critique forms.

Accreditation Workshop Results

The distress survey results for the two accreditation workshops are given in Tables 6 through 11. Tables 6 through 8 summarize the results for the asphalt concrete surfaced pavement sections, while Table 9 through 11 summarize those for the jointed concrete pavement sections. In both cases, the results are presented in the following order: (1) complex section or exercise site number 1, (2) simple section or exercise site number 2, and (3) and accreditation section. In each table, the mean and standard deviation for each distress type-severity level combination are given, along with the ground truth values where available.

Because the pilot workshop was limited to three days, time only permitted the conduct of group surveys for the accreditation sites; not the complex and simple sections. Thus, only

Table 6. BETWEEN RATER STATISTICAL SUMMARY: AC SURFACED PAVEMENT - EXERCISE SITE No. 1

Distress Type	Units	Severity Level	Actual Values *	Means		Standard Deviations	
				Pilot Workshop	First Workshop	Pilot Workshop	First Workshop
Alligator Cracking - Area	Sq. Meters	Low	n/a	5.1	8.4	5.4	9.4
		Moderate	n/a	8.8	14.6	3.9	6.4
		High	n/a	0.9	2.8	0.7	3.3
		Total	n/a	14.8	25.8	6.1	11.6
Longitudinal Cracking: Other - Length	Meters	Low	n/a	7.3	0.3	5.0	0.5
		Moderate	n/a	7.7	0.0	9.4	0.0
		High	n/a	1.5	0.5	1.5	1.2
		Total	n/a	16.4	0.8	11.8	1.2
Longitudinal Cracking: Other - Length Sealed	Meters	Low	n/a	0.2	0.4	0.5	0.6
		Moderate	n/a	0.0	0.8	0.0	1.8
		High	n/a	0.1	0.0	0.2	0.0
		Total	n/a	0.3	1.2	0.5	2.1
Transverse Cracking - Number	Number	Low	n/a	41.6	40.7	10.9	8.1
		Moderate	n/a	19.8	18.0	10.9	10.2
		High	n/a	3.4	0.7	4.3	0.8
		Total	n/a	64.8	59.3	8.8	4.3
Transverse Cracking - Length	Meters	Low	n/a	39.3	51.9	15.3	14
		Moderate	n/a	45.6	46.6	19.9	20.2
		High	n/a	10.2	2.4	13.7	2.7
		Total	n/a	95.1	100.8	19.5	17.5
Transverse Cracking - Length Sealed	Meters	Low	n/a	7.3	14.8	6.8	7.3
		Moderate	n/a	14.4	19.9	11.3	16.5
		High	n/a	5.4	1.2	12.9	1.7
		Total	n/a	27.1	35.9	22.5	23.6
Patch/Patch Deterioration - Number	Number	Low	n/a	0.1	0	0.3	0
		Moderate	n/a	0.1	0	0.3	0
		High	n/a	0.6	1	0.5	0
		Total	n/a	0.8	1	0.6	0
Patch/Patch Deterioration - Area	Sq. Meters	Low	n/a	<0.1	0	<0.1	0
		Moderate	n/a	<0.1	0	<0.1	0
		High	n/a	0.4	0.3	0.6	0.2
		Total	n/a	0.5	0.3	0.6	0.2
Ravelling and Weathering - Area	Sq. Meters	Low	n/a	104.0	0.0	147.3	0.0
		Moderate	n/a	50.0	54.0	111.8	120.8
		High	n/a	26.3	0.0	87.1	0.0
		Total	n/a	180.3	54.0	152.6	120.8

* Based on control group survey

Table 7. BETWEEN RATER STATISTICAL SUMMARY:
AC SURFACED PAVEMENT – EXERCISE SITE No. 2

Distress Type	Units	Severity Level	Actual Values *	Means		Standard Deviations	
				Pilot Workshop	First Workshop	Pilot Workshop	First Workshop
Alligator Cracking - Area	Sq. Meters	Low	n/a	n/a	4.3	n/a	1.8
		Moderate	n/a	n/a	9.2	n/a	3.2
		High	n/a	n/a	0.1	n/a	0.3
		Total	n/a	n/a	13.6	n/a	4.0
Transverse Cracking - Number	Number	Low	n/a	n/a	5.1	n/a	1.2
		Moderate	n/a	n/a	4.9	n/a	1.7
		High	n/a	n/a	6.6	n/a	1.7
		Total	n/a	n/a	16.6	n/a	2.4
Transverse Cracking - Length	Meters	Low	n/a	n/a	4.1	n/a	1.2
		Moderate	n/a	n/a	9.5	n/a	3.8
		High	n/a	n/a	15.8	n/a	3.6
		Total	n/a	n/a	29.4	n/a	3.5
Ravelling and Weathering - Area	Sq. Meters	Low	n/a	n/a	41.5	n/a	78.3
		Moderate	n/a	n/a	162.7	n/a	84.5
		High	n/a	n/a	0.0	n/a	0.0
		Total	n/a	n/a	204.2	n/a	21.8

* Based on control group survey

Table 8. BETWEEN RATER STATISTICAL SUMMARY:
AC SURFACED PAVEMENT – ACCREDITATION SITE

Distress Type	Units	Severity Level	Actual Values *	Means		Standard Deviations	
				Pilot Workshop	First Workshop	Pilot Workshop	First Workshop
Alligator Cracking - Area	Sq. Meters	Low	1.9	10.0	4.8	9.4	5.2
		Moderate	13.0	6.0	15.1	6.8	11.8
		High	0.0	0.7	3.0	0.2	4.2
		Total	14.9	16.1	22.9	9.3	11.1
Longitudinal Cracking: Edge - Length	Meters	Low	0.0	6.3	0.0	8.6	0.0
		Moderate	0.0	2.3	0.0	3.3	0.0
		High	0.0	24.9	0.0	35.9	0.0
		Total	0.0	33.5	0.0	46.6	0.0
Longitudinal Cracking: Other - Length	Meters	Low	22.1	27.2	31.4	3.0	13.8
		Moderate	44.0	26.7	25.1	8.3	18.2
		High	23.0	26.9	34.6	6.6	21.6
		Total	89.1	80.8	88.8	3.2	14.6
Transverse Cracking - Number	Number	Low	25	27.0	28.2	3.4	7.5
		Moderate	20	11.5	11.8	4.7	4.7
		High	11	14.7	11.3	3.0	4.4
		Total	56	53.2	51.9	6.1	6.8
Transverse Cracking - Length	Meters	Low	21.8	24.5	27.7	3.4	10.6
		Moderate	28.2	19.1	21.5	6.1	10.3
		High	24.6	33.5	23.4	7.9	10.4
		Total	74.6	77.1	70.8	8.0	24.0

* Based on control group survey

Table 9. BETWEEN RATER STATISTICAL SUMMARY:
JOINTED CONCRETE PAVEMENT – EXERCISE SITE No. 1

Distress Type	Units	Severity Level	Actual Values *	Means		Standard Deviations	
				Pilot Workshop	First Workshop	Pilot Workshop	First Workshop
Longitudinal Cracking - Length	Meters	Low	n/a	18.7	25.3	9.6	6.4
		Moderate	n/a	51.5	56.9	21.2	12.2
		High	n/a	29.8	11.4	20.2	8.4
		Total	n/a	100.0	93.6	4.2	8.3
Longitudinal Cracking - Length Sealed	Meters	Low	n/a	0.5	0.3	0.8	0.6
		Moderate	n/a	0.2	0.6	0.5	1.0
		High	n/a	0.0	0.1	0.0	0.3
		Total	n/a	0.7	0.9	0.8	1.3
Transverse Cracking - Number	Number	Low	n/a	7.6	10.2	1.6	2.4
		Moderate	n/a	10.0	9.3	4.3	1.8
		High	n/a	2.6	0.6	2.7	1.4
		Total	n/a	20.2	20.0	2.4	2.6
Transverse Cracking - Length	Meters	Low	n/a	12.0	17.5	5.8	5.0
		Moderate	n/a	26.1	31.3	7.6	6.3
		High	n/a	8.5	1.7	9.8	3.7
		Total	n/a	46.6	50.5	5.0	3.9
Transverse Cracking - Length Sealed	Meters	Low	n/a	0.1	0.0	0.1	0.0
		Moderate	n/a	0.6	0.0	0.8	0.0
		High	n/a	0.0	0.0	0.0	0.0
		Total	n/a	0.6	0.0	0.8	0.0
Joint Seal Damage of Trans. Joints - Number	Number	Low	n/a	0.6	0.6	1.2	1.2
		Moderate	n/a	8.4	5.3	3.9	4.0
		High	n/a	5.8	6.2	3.5	4.8
		Total	n/a	14.8	12.1	0.4	5.5
Joint Seal Damage of Long. Joints - Number	Number	Total	n/a	2	1.8	0	0.4
Joint Seal Damage of Long. Joints - Length	Meters	Total	n/a	61.5	53.1	4.2	20.9
Spalling of Longitudinal Joints - Length	Meters	Low	n/a	0.2	3.3	0.4	10.4
		Moderate	n/a	0.0	3.8	0.0	12.5
		High	n/a	0.0	0.5	0.0	1.7
		Total	n/a	0.2	7.5	0.4	24.5
Spalling of Transverse Joints - Number	Number	Low	n/a	4.4	0.6	5.6	1.0
		Moderate	n/a	0.0	0.2	0.0	0.6
		High	n/a	0.0	0.2	0.0	0.6
		Total	n/a	4.4	0.9	5.6	1.0
Spalling of Transverse Joints - Length	Meters	Low	n/a	11.1	0.3	20.7	0.6
		Moderate	n/a	0.0	0.2	0.0	0.5
		High	n/a	0.0	0.1	0.0	0.1
		Total	n/a	11.1	0.5	20.7	0.7
Popouts - Number	Number	Total	n/a	220.6	114.8	609.6	590.1

* Based on control group survey

Table 10. BETWEEN RATER STATISTICAL SUMMARY: JOINTED CONCRETE PAVEMENT – EXERCISE SITE No. 2

Distress Type	Units	Severity Level	Actual Values *	Means		Standard Deviations	
				Pilot Workshop	First Workshop	Pilot Workshop	First Workshop
Corner Breaks - Number	Number	Low	n/a	n/a	1.1	n/a	0.3
		Moderate	n/a	n/a	2.9	n/a	0.6
		High	n/a	n/a	0.1	n/a	0.3
		Total	n/a	n/a	4.1	n/a	0.3
Longitudinal Cracking - Length	Meters	Low	n/a	n/a	1.9	n/a	0.9
		Moderate	n/a	n/a	1.9	n/a	1.0
		High	n/a	n/a	0.8	n/a	2.6
		Total	n/a	n/a	4.7	n/a	3.0
Longitudinal Cracking - Length Sealed	Meters	Low	n/a	n/a	0.2	n/a	0.6
		Moderate	n/a	n/a	1.6	n/a	1.1
		High	n/a	n/a	0.1	n/a	0.3
		Total	n/a	n/a	1.9	n/a	1.1
Transverse Cracking - Number	Number	Low	n/a	n/a	1.2	n/a	1.0
		Moderate	n/a	n/a	0.9	n/a	0.3
		High	n/a	n/a	0.0	n/a	0.0
		Total	n/a	n/a	2.1	n/a	0.9
Transverse Cracking - Length	Meters	Low	n/a	n/a	0.7	n/a	0.6
		Moderate	n/a	n/a	3.4	n/a	1.0
		High	n/a	n/a	0.0	n/a	0.0
		Total	n/a	n/a	4.1	n/a	1.0
Joint Seal Damage of Trans. Joints - Number	Number	Low	n/a	n/a	12.8	n/a	0.4
		Moderate	n/a	n/a	0.2	n/a	0.2
		High	n/a	n/a	0.0	n/a	0.0
		Total	n/a	n/a	13.0	n/a	0.0
Joint Seal Damage of Long. Joints - Number	Number	Total	n/a	n/a	2.0	n/a	0.0
Joint Seal Damage of Long. Joints - Length	Meters	Total	n/a	n/a	11.5	n/a	5.0
Spalling of Longitudinal Joints - Length	Meters	Low	n/a	n/a	9.7	n/a	7.2
		Moderate	n/a	n/a	0.1	n/a	0.2
		High	n/a	n/a	0.2	n/a	0.1
		Total	n/a	n/a	10.0	n/a	7.1
Spalling of Transverse Joints - Number	Number	Low	n/a	n/a	0.6	n/a	0.6
		Moderate	n/a	n/a	0.0	n/a	0.0
		High	n/a	n/a	0.0	n/a	0.0
		Total	n/a	n/a	0.6	n/a	0.6
Spalling of Transverse Joints - Length	Meters	Low	n/a	n/a	0.9	n/a	1.3
		Moderate	n/a	n/a	0.0	n/a	0.0
		High	n/a	n/a	0.0	n/a	0.0
		Total	n/a	n/a	0.9	n/a	1.3
Popouts	Number	Total	n/a	n/a	20.3	n/a	13.5

* Based on control group survey

Table 11. BETWEEN RATER STATISTICAL SUMMARY: JOINTED CONCRETE PAVEMENT – ACCREDITATION SITE

Distress Type	Units	Severity Level	Actual Values *	Means		Standard Deviations	
				Pilot Workshop	First Workshop	Pilot Workshop	First Workshop
Corner Breaks - Number	Number	Low	2	4.6	2.8	3.1	1.9
		Moderate	7	4.6	5.8	2.8	2.1
		High	0	0.8	0.3	1.2	0.6
		Total	9	10.0	8.8	1.1	1.2
Longitudinal Cracking - Length	Meters	Low	11.3	10.0	11.8	3.6	1.1
		Moderate	4.5	3.3	3.6	2.9	1.4
		High	3.0	1.3	0.3	1.1	1.1
		Total	18.8	14.7	15.7	4.9	1.1
Longitudinal Cracking - Length Sealed	Meters	Low	0.0	0.0	0.0	0.0	0.0
		Moderate	0.0	0.5	1.6	1.0	1.1
		High	3.0	1.3	0.2	1.1	0.7
		Total	3.0	1.8	1.8	0.9	1.1
Transverse Cracking - Number	Number	Low	0	0.8	0.8	0.4	0.6
		Moderate	1	0.6	1.1	0.8	1.0
		High	2	1.4	1.7	0.8	1.6
		Total	3	2.8	3.5	0.4	1.7
Transverse Cracking - Length	Meters	Low	0.00	3.0	2.5	1.5	1.8
		Moderate	3.70	1.5	3.7	1.9	3.7
		High	7.40	5.3	4.8	3.1	4.0
		Total	11.1	9.8	11.0	2.9	2.1
Transverse Cracking - Length Sealed	Meters	Low	0.0	0.0	0.0	0.0	0.0
		Moderate	3.7	0.0	2.5	0.0	3.1
		High	7.4	3.7	4.4	3.3	3.9
		Total	11.1	3.7	6.9	3.3	3.1
Joint Seal Damage of Trans. Joints - Number	Number	Low	32	31.8	32.1	0.4	0.3
		Moderate	0	0.2	0.0	0.4	0.0
		High	0	0.0	0.0	0.0	0.0
		Total	32	32.0	32.1	0.0	0.3
Spalling of Longitudinal Joints - Length	Meters	Low	15.0	17.4	12.2	11.2	5.6
		Moderate	0.0	0.2	1.1	0.3	0.8
		High	0.0	0.0	0.2	0.0	0.3
		Total	15.0	17.5	13.5	11.2	6.0
Spalling of Transverse Joints - Number	Number	Low	2	5.4	0.5	3.4	1.1
		Moderate	0	2.6	0.0	3.3	0.0
		High	0	0.2	0.2	0.4	0.6
		Total	2	8.2	0.7	5.1	1.3
Spalling of Transverse Joints - Length	Meters	Low	0.6	2.3	0.1	1.1	0.2
		Moderate	0.0	0.9	0.0	1.2	0.0
		High	0.0	0.1	0.1	0.1	0.1
		Total	0.6	3.3	0.2	1.7	0.3
Popouts - Number	Number	Total	18	1.8	28.2	2.2	14.3

* Based on control group survey

Tables 8 and 11 contain actual or ground truth distress data. Time constraints during the pilot workshop also prohibited the conduct of individual or group surveys on the simple sections so no results exist for Tables 7 and 10.

From the information contained in these tables, the following observations and/or conclusions are made:

Asphalt Concrete Surfaced Pavement - Complex Section (Table 6): In general, there is good agreement between the results from both workshops for this section. Significant differences do occur in the amount of alligator cracking and longitudinal cracking identified by the raters at each workshop. These differences, however, are due almost exclusively to changes made to the DIM during the pilot workshop, prior to the full workshop surveys. Because the DIM did not clearly distinguish between low severity alligator cracking and longitudinal cracking (other than construction) in the wheel path, it was collectively decided at the pilot workshop that single, longitudinal cracks within the wheel path be defined as low severity alligator cracking. Thus, the differences shown in Table 6 reflect the impact of the DIM change on the survey results. The only other major difference occurred in the amount of ravelling and weathering, where significantly higher quantities were identified by the raters at the pilot workshop. This difference is attributed to the lack of familiarity of the raters with the construction materials used at the site and the effect of studded-tires on the pavement surface, both of which were explained prior to the full workshop surveys.

Asphalt Concrete Surfaced Pavement - Simple Section (Table 7): Due to the limited amount of information available, little can be said about the results for this section other than the fact that the standard deviation (i.e., variability) for most distress type - severity level combinations was very low, indicating excellent agreement among the raters at the full accreditation workshop.

Asphalt Concrete Surfaced Pavement - Accreditation Section (Table 8): Unlike the two previous sections, ground truth distress data were available for this accreditation site in addition to the results from the individual surveys performed during the two workshops. With the exception of longitudinal cracking (edge or construction), there is excellent agreement amongst all raters within and between workshops, as reflected

by the similar means and low standard deviations. Even the differences in longitudinal cracking are somewhat misleading in that only one RCO rater (out of 4) incorrectly identified this distress type, instead of alligator cracking which was the "correct" distress. There are also small differences in the quantities of alligator cracking shown in Table 8, but these are due almost entirely to differences in the way that widths were defined by the raters for low severity alligator cracking (generally a single crack). Guidelines for measuring these widths were developed during the full workshop as a result of the observed differences, and will be implemented in future workshops.

Jointed Concrete Pavement - Complex Section (Table 9): Survey results for this section were very similar for both the pilot and first full workshops. The major differences between the two were in the quantities of joint spalling and popouts identified by the RCO raters in the respective workshops. These differences are also attributed to the DIM changes that took place after the pilot surveys, but before the full workshop surveys; thus, they were to be expected. Otherwise, the two sets of surveys are in excellent agreement with each other. Furthermore, it is noted that the standard deviation is generally low for most distress type - severity level combinations, indicating consistency among all raters.

Jointed Concrete Pavement - Simple Section (Table 10): Like its flexible pavement counterpart, very little information was available for this particular section, thus limiting the number of observations or conclusions that can be derived from it. One observation that can be made from these data is that the standard deviation for most distress type - severity level combinations was very low, indicating excellent agreement among the RCO raters at the full workshop.

Jointed Concrete Pavement - Accreditation Section (Table 11): The results for this section are very similar to those of the complex section in that, with few exceptions, they were very similar for both workshops. In addition, the results are also very similar to the ground truth values established by the control group, particularly those from the full workshop. In general, the major differences between the pilot survey results and those of the control group and the full workshop surveys are due, as explained earlier, to changes to the DIM made after the pilot surveys. To a lesser degree, some of the differences can simply be attributed to rater variability. Overall,

the results of these accreditation surveys are quite good, in that they show very consistent, uniform results among the raters; i.e., similar means and low standard deviations for most distress type - severity level combinations.

Turning the focus of the discussion now to how these survey results translate into grades, and hence the results of the accreditation process for the 16 RCO raters who participated in the workshops, Table 12 summarizes the scores received by the raters for each accreditation site and the written examination as well as the final (composite) accreditation grade. All scores are based on a scale of 0 to 100, with 100 being excellent. These same data are graphically shown in Figure 1.

It can be observed from Table 12 and Figure 1, that the scores were, for the most part, in the good to excellent range (80 to 100%). Also, the composite score for all RCO raters exceeded 75%, while their individual survey and written examination grades exceeded 70%, thus satisfying the accreditation criteria established by SHRP. These results were by no means unexpected as all raters involved in the workshops had two or more years of experience in the conduct of field distress surveys using SHRP procedures. In addition to the accreditation of the 16 RCO raters, the results of from both workshops were also quite encouraging in terms of the consistency of the distress data being collected by the RCO contractors.

SUMMARY AND CONCLUSIONS

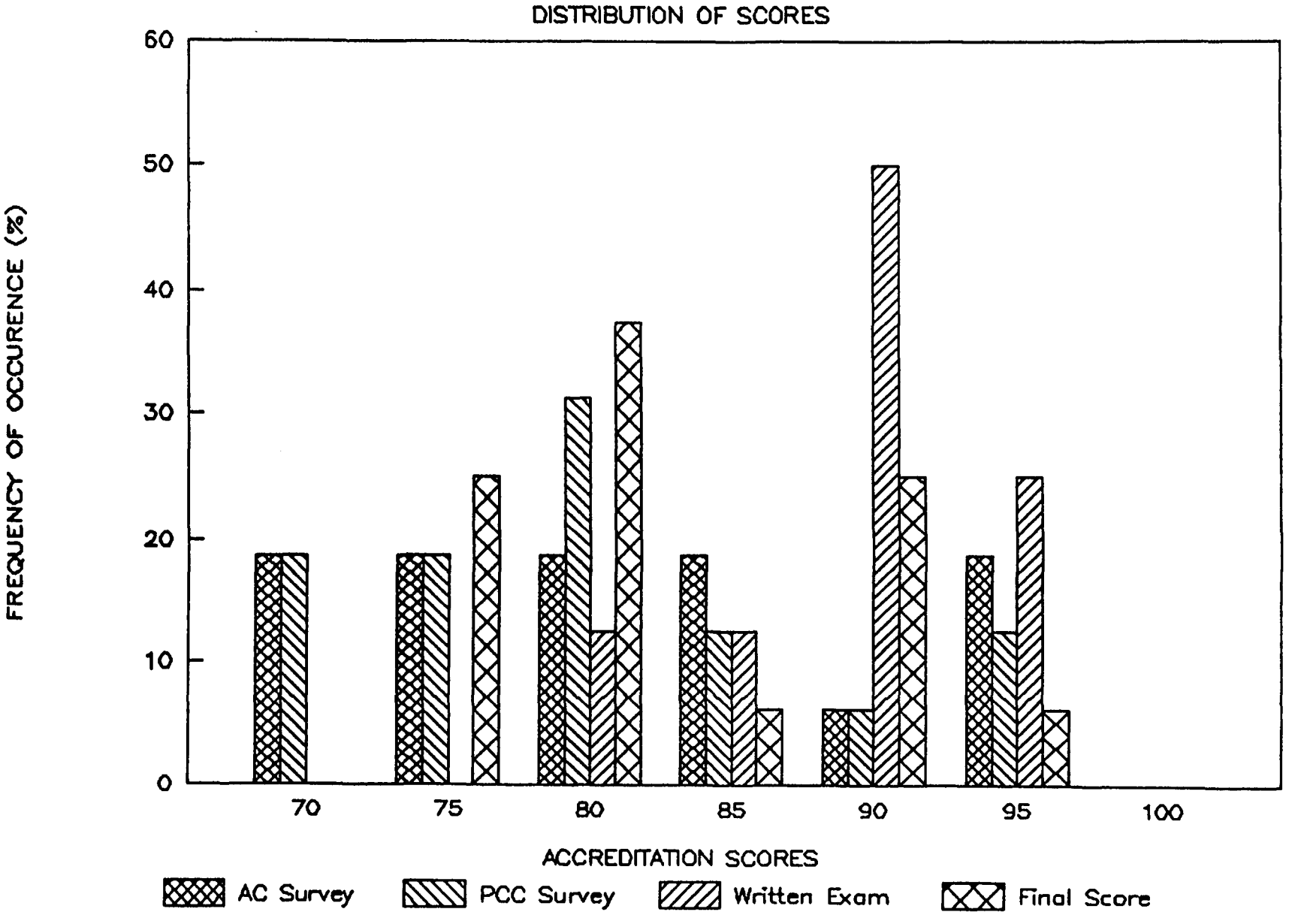
The purpose of SHRP's accreditation process is to provide a means for ensuring, to the extent possible, the quality and consistency of distress data being collected by the RCO raters. The process consists of two parts: a written examination and a two-part field survey examination. The successful completion of these examinations will identify the rater as possessing the knowledge, competence and accuracy to provide distress data of acceptable reliability for inclusion in the LTPP data base. Although the process is still in its early stages, it is SHRP's intent that all distress data for the LTPP study be collected by raters who have successfully completed the accreditation.

The SHRP accreditation process is being administered in a workshop situation, involving both classroom and field work. To date, the workshop has been conducted two separate

Table 12. ACCREDITATION WORKSHOP SCORES

Workshop	RCO Rater ID	Flexible Section	Rigid Section	Written Examination	Final Grade
Pilot Workshop	1	82	80	92	83
	2	82	70	90	79
	3	99	81	96	91
	4	72	88	97	83
	Average:	84	80	94	84
	Std. Dev.:	10	6	3	4
Full Workshop	1	85	99	98	93
	2	73	80	93	80
	3	79	71	96	79
	4	70	79	90	78
	5	99	88	88	92
	6	77	83	80	80
	7	86	97	94	92
	8	85	76	83	81
	9	84	81	90	84
	10	97	94	91	95
	11	92	73	93	85
	12	75	77	89	79
	Average:	84	83	90	85
	Std. Dev.:	9	9	5	6
Combined Statistics	Average:	84	82	91	85
	Std. Dev.:	9	8	5	6

Figure 1. ACCREDITATION WORKSHOP SCORES



occasions, both in Reno, Nevada. The first, a pilot workshop, took place in May of 1992, and the other in June of 1992. While the ultimate objective was the accreditation of RCO raters, several other objectives were targeted during these workshops and successfully completed:

- The concept of accreditation workshops for RCO raters was shown to be feasible,
- Preliminary measures of rater variability were established,
- The accreditation grading system was shown to work satisfactorily, although changes will be required to account for the subjective nature of distress surveys, and
- Ground truth distress values were established for two accreditation sites that will be used in future workshops.

In terms of the ultimate objective, all 16 RCO raters who attended the workshops successfully completed the accreditation process (i.e., satisfied the accreditation criteria established by SHRP). This is not surprising since the RCO raters who participated in the accreditation workshops had several year of experience in the conduct of SHRP distress surveys. Thus, another measure of the success of the accreditation process will come in future months as additional workshops are conducted involving less experienced personnel.

Another important outcome resulting from the initial accreditation workshops were revisions to the SHRP-LTPP distress identification manual or DIM. In all cases, the changes to the DIM were made to eliminate, as much as possible, the ambiguity associated with some of the distress definitions. It is emphasized, however, that further revisions to the DIM may be required as experience with the current manual is gained.

Finally, while the accreditation process has proven quite successful so far, improvements can be made in a number of areas. The include:

- Revision of the accreditation scoring system for the field examination in order to incorporate the inherent variability associated with subjective distress surveys; i.e., a measure of the anticipated variability, as determined from several workshops, should be included in the scoring system (e.g., actual value $\pm$ one standard deviation for each distress type severity level combination).

Likewise, further improvements to the existing distress weighting and deduct procedures within the scoring system are quite possible and may be required.

- Inclusion of a continuously reinforced concrete pavement section as part of the field examinations. Such a section was not included in the initial workshops for two reasons: (1) there were no such sections within the vicinity of the workshop site and (2) time constraints (although this may be overcome by extending the workshop from 4 and 1/2 days to 5 full-days).

- Compilation of a better, more complete set of slides showing the various distress type - severity level combinations included in the DIM. At both of the initial workshops, these slides were somewhat lacking, as is reflected by the comments in the evaluation forms completed by the RCO raters.

- Because many distresses have the tendency to take on certain appearance characteristics based on climatic (regional) conditions, it may be worthwhile to establish several accreditation sites (e.g., one for each SHRP RCO) throughout the country, with the workshops alternating from one site to another. This would expose the RCO raters to different appearances of the same distress type.

APPENDIX A

EXAMPLE OF WRITTEN EXAMINATION

Name: _____ Date: _____

Region: _____ Score: _____

EXAM FOR ACCREDITATION OF FHWA-LTPP DISTRESS RATERS

PART I: IDENTIFICATION OF DISTRESS TYPE FROM SLIDES

Introduction: Over the next 20 minutes, you will be shown a total of 60 slides; three slides per minute. Please identify the distress type shown in each slide. Each slide is worth 2% of the total exam score.

Slide No.	Distress Type	Slide No.	Distress Level
1		31	
2		32	
3		33	
4		34	
5		35	
6		36	
7		37	
8		38	
9		39	
10		40	
11		41	
12		42	
13		43	
14		44	
15		45	
16		46	
17		47	
18		48	
19		49	
20		50	
21		51	
22		52	
23		53	
24		54	
25		55	
26		56	
27		57	
28		58	
29		59	
30		60	

PART II: DISTRESS DESCRIPTIONS AND SEVERITY LEVEL DEFINITIONS

Introduction: Over the next 30 minutes, you will be required to provide short-answers to a number of questions related to the description severity level definitions and measurement procedures for various distress types. Each of the first 5 questions is worth 9% of the total exam score, the remaining 5 questions are worth 3% each.

1. Lane-to-Shoulder Dropoff (AC Pavements)

   a. Provide a brief description of lane-to-shoulder dropoff.

   b. Are severity levels defined for this distress type?

   c. How (with what and where) is lane-to-shoulder dropoff measured?

2. Transverse Cracking (JPC and JRC Pavements)

   a. A 6 mm (1/4 in.) transverse crack is considered low severity if measured in AC Pavements. Is this also true for jointed concrete pavements?

   b. Are transverse cracks in jointed concrete pavements measured any differently than in AC pavements? If so, explain.

   c. Besides crack width, name one more factor (distress manifestation) used to define transverse cracking severity levels.

3. Transverse Cracking (AC Pavements)

   a. Provide a brief description of transverse cracking.

   b. An unsealed transverse crack has a mean width of 13 mm (1/2 in.). What is the severity level?

   c. The SHRP DIM requires that each transverse crack be assigned a unique severity level. If a transverse crack does not have the same severity level along its entire length, how is its severity level determined?

4. Fatigue Cracking (AC Pavements)

   a. Several descriptions are used to define fatigue cracking. Provide two of these descriptions.

   b. How is low severity fatigue cracking distinguished from medium severity?

   c. If different severity levels existing within an area cannot be distinguished, how is the area rated?

5. Durability "D" Cracking (JPC or JRC Pavements)

   a. Where do durability crack generally occur?

   b. If durability cracks are well defined, and some small pieces are loose or have been displaced, what is their severity level?

c. How is durability cracking measured?

6. Other than SHRP SPS-3 sections, how (with what and where) are transverse profiles measured in AC pavements (when not measured in conjunction with photographic distress surveys)?

7. Does edge cracking apply to AC pavements with paved shoulders?

8. According to the SHRP DIM, is transverse cracking defined as a distress for continuously reinforced concrete pavements?

9. Where is faulting measured in jointed concrete pavements?

10. How are punchouts measured in continuously reinforced concrete pavements?

PART III: INTERPRETATION OF DISTRESS MAPS

Introduction: Over the next 15 minutes, you will be required to complete the distress summary table provided below based on data provided in the attached survey maps. This question is worth 10% of the total exam score.

DISTRESS TYPE	SEVERITY LEVEL LOW	MODERATE	HIGH
CRACKING			
1. CORNER BREAKS (Number)	___	___	___
2. DURABILITY "D" CRACKING (Number of Affected Slabs)	___	___	___
AREA AFFECTED (Square Meters)	___.__	___.__	___.__
3. LONGITUDINAL CRACKING (Meters)	___.__	___.__	___.__
Length Sealed (Meters)	___.__	___.__	___.__
4. TRANSVERSE CRACKING (Number of Cracks)	___	___	___
(Meters)	___.__	___.__	___.__
Length Sealed (Meters)	___.__	___.__	___.__
JOINT DEFICIENCIES			
5a. TRANSVERSE JOINT SEAL DAMAGE Sealed? (Y, N)			_
If "Y" Number of Joints	__	__	__
5b. LONGITUDINAL JOINT SEAL DAMAGE Number of Longitudinal Joints that have been sealed (0, 1, or 2)			_
Length of Damaged Sealant (Meters)			___.__
6. SPALLING OF LONGITUDINAL JOINTS (Meters)	___.__	___.__	___.__
7. SPALLING OF TRANSVERSE JOINTS Number	__	__	__
Length (Meters)	___.__	___.__	___.__

DISTRESS TYPE	SEVERITY LEVEL		
	LOW	MODERATE	HIGH
SURFACE DEFORMATION			
8a. MAP CRACKING (Number)			___
(Square Meters)			___.__
8b. SCALING (Number)			___
(Square Meters)			___.__
9. POLISHED AGGREGATE (Square Meters)			___.__
10. POPOUTS (Number)			____.
MISCELLANEOUS DISTRESSES			
11. BLOWUPS (Number)			___
12. PATCH/PATCH DETERIORATION			
Flexible (Number)	___	___	___
(Square Meters)	___.__	___.__	___.__
Rigid (Number)	___	___	___
(Square Meters)	___.__	___.__	___.__
13. WATER BLEEDING AND PUMPING (Number of Occurrences)			___
Length Affected (Meters)			___.__

Date 5-21-92

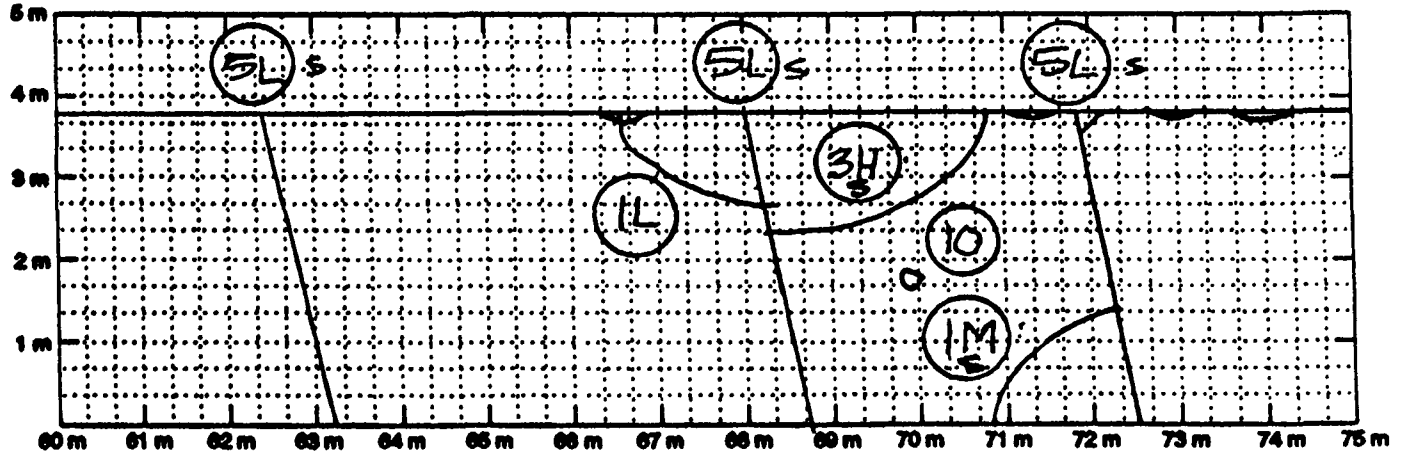
CONTROL GROUP SURVEY

6 - ALL LOW

State Assigned ID _____

State Code __

SHRP Section ID __B2



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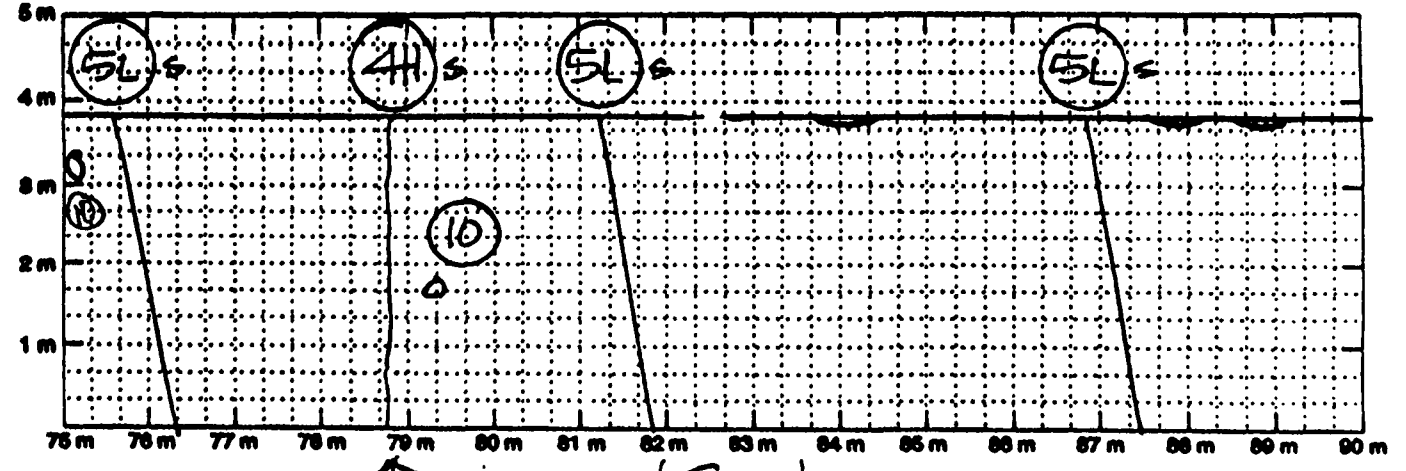

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IV

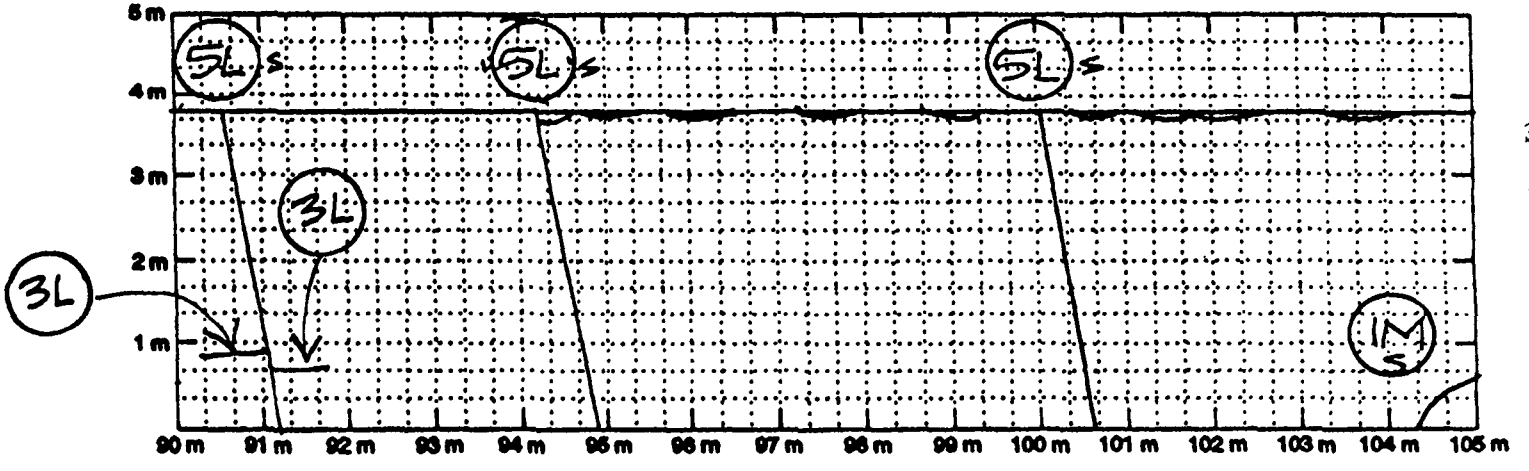
Date 5-21-92

CONTROL GROUP SURVEY

State Assigned ID _____

State Code ___

SHRP Section ID ___R2



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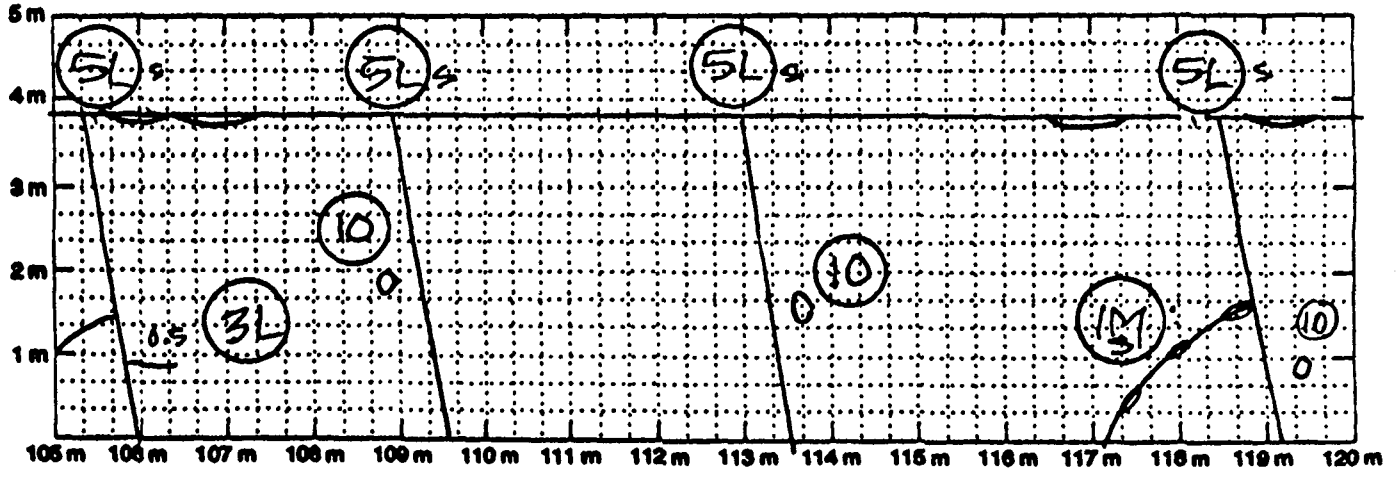

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III

APPENDIX B

EXAMPLE OF ACCREDITATION WORKSHOP AGENDA

WORKSHOP FOR
ACCREDITATION OF FHWA LTPP FIELD DISTRESS SURVEY RATERS
June 8-12, 1992
Reno, Nevada

WORKSHOP AGENDA

Monday - June 8, 1992

8:00 a.m.	Introduction	
	• Welcoming Remarks	(C. Berge)
	• Workshop Schedule and Logistics	(G. Rada)
	• Workshop Objectives	(G. Rada)
8:30 a.m.	Distress Identification Manual - Flexible Pavements	(J. Miller)
10:15 a.m.	BREAK	
10:30 a.m.	Procedures and Forms for Performing Distress Surveys - Flexible Pavements	(J. Miller)
11:30 a.m.	Field Survey Techniques	(D. Frith)
12:00 noon	LUNCH & TRAVEL (Flexible Pavement - Site 1: Lemon Drive)	
1:00 p.m.	Perform Distress Survey: Flexible Pavement - Site 1	
4:00 p.m.	Classroom Review and Evaluation of Distress Surveys (Flexible Pavement - Site 1)	(G. Rada, J. Miller)
5:00 p.m.	Review of Next Day's Activities	(G. Rada)
5:30 p.m.	ADJOURN	

Tuesday - June 9, 1992

7:45 a.m.	TRAVEL (Flexible Pavement - Site 2: Lemon Drive)	
8:00 a.m.	Perform Distress Survey: Flexible Pavement - Site 2; Dipstick Demonstration	
11:30 a.m.	LUNCH, DISCUSSION & TRAVEL (Flexible Pavement - Accreditation Site: McCarren Blvd.)	
12:30 p.m.	Perform Distress Survey: Flexible Pavement - Accreditation Site	
4:30 p.m.	Classroom Review and Evaluation of Distress Surveys (Flexible Pavement - Site 2)	(G. Rada, J. Miller)

5:30 p.m.	ADJOURN	

Wednesday - June 10, 1992

8:00 a.m.	Classroom Review and Evaluation of Distress Survey (Flexible Pavement - Accreditation Site)	(G. Rada, J. Miller)
9:00 a.m.	Distress Identification Manual - Rigid Pavements	(R. Rogers)
10:45 a.m.	BREAK	
11:00 a.m.	Procedures and Forms for Performing Distress Surveys - Rigid Pavements	(R. Rogers)
12:00 noon	LUNCH & TRAVEL (Rigid Pavement - Site 1: I-80)	
1:30 p.m.	Perform Distress Survey: Rigid Pavement - Site 1; Faultmeter Demonstration	
5:00 p.m.	Review of Next Day's Activities	(G. Rada)
5:30 p.m.	ADJOURN	

Thursday - June 11, 1992

7:30 a.m.	Classroom Review and Evaluation of Distress Surveys (Rigid Pavement - Site 1)	(G. Rada, R. Rogers)
8:45 a.m.	TRAVEL (Rigid Pavement - Site 2: I-395)	
9:00 a.m.	Perform Distress Survey - Rigid Pavement: Site 2	
12:00 noon	LUNCH, DISCUSSION, & TRAVEL (Rigid Pavement - Accreditation Site: I-395)	
12:30 p.m.	Perform Distress Survey - Rigid Pavement: Accreditation Site	
4:30 p.m.	Classroom Review and Evaluation of Distress Surveys (Rigid Pavement - Site 2)	(G. Rada, R. Rogers)
5:30 p.m.	ADJOURN	

Friday - June 12, 1992

8:00 a.m.	Classroom Review and Evaluation of Distress Surveys (Rigid Pavement - Accreditation Site)	(G. Rada)
9:30 a.m.	Written Examination for Accreditation	(G. Rada, R. Rogers,

		J. Miller)
10:45 a.m.	BREAK	
11:00 a.m.	Workshop Summary and Critique	(G. Rada, R. Rogers, J. Miller)
12:00 noon	ADJOURN	

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