

CIVIL ENGINEERING STUDIES

Illinois Center for Transportation Series No. 19-005

UILU-ENG-2019-2005

ISSN: 0197-9191

PAVEMENT REHABILITATION STRATEGY COURSE DEVELOPMENT

Prepared By

Hasan Ozer

Imad L. Al-Qadi

Angeli Gamez

Seunggu Kang

Jeffery R. Roesler

Marshall R. Thompson

University of Illinois at Urbana-Champaign

Timothy R. Murphy

Murphy Pavement Technology, Inc.

Abbas A. Butt

Engineering & Research International, Inc.

Research Report No. FHWA-ICT-19-004

A report of the findings of

ICT PROJECT R27-170

Pavement Rehabilitation Strategy Course Development

Illinois Center for Transportation

March 2019

**ILLINOIS CENTER FOR
TRANSPORTATION**



TECHNICAL REPORT DOCUMENTATION PAGE

1. Report No. FHWA-ICT-19-004		2. Government Accession No. N/A		3. Recipient's Catalog No. N/A	
4. Title and Subtitle Pavement Rehabilitation Strategy Course Development				5. Report Date March 2019	
				6. Performing Organization Code N/A	
7. Author(s) Hasan Ozer, Imad L. Al-Qadi, Jeffery R. Roesler, Marshall R. Thompson, Timothy R. Murphy, Abbas A. Butt, Angeli Gamez, and Seunggu Kang				8. Performing Organization Report No. ICT-19-005 UILU-ENG-2019-2005	
9. Performing Organization Name and Address Illinois Center for Transportation Department of Civil and Environmental Engineering University of Illinois at Urbana-Champaign 205 North Mathews Avenue, MC-250 Urbana, IL 61801				10. Work Unit No. N/A	
				11. Contract or Grant No. R27-170	
12. Sponsoring Agency Name and Address Illinois Department of Transportation (SPR) Bureau of Research 126 East Ash Street Springfield, IL 62704				13. Type of Report and Period Covered 1/1/16 – 3/31/19	
				14. Sponsoring Agency Code	
15. Supplementary Notes Conducted in cooperation with the U.S. Department of Transportation, Federal Highway Administration.					
16. Abstract Pavement rehabilitation and preservation treatments have become standard practice for state and local transportation agencies. The ultimate goals include maintaining a safe and reliable level of service for all users, maximizing pavement service life, and optimizing budget allocations for infrastructure construction projects. The essential key to meet these goals requires transportation agencies to identify the right treatment for the right pavement at the right time. Based on the manuals of Bureau of Design and Environment (BDE) within the Illinois Department of Transportation (IDOT), training course materials were developed in this project. The goals of the training course are to enhance the understanding of fundamental concepts of pavement rehabilitation and preservation strategies, establish consistent practices following the guidance manuals and minimize potential errors by selecting appropriate treatments. The training course is designed to be completed in one-and-a-half days, covering seven blocks: (1) Introduction, (2) Preservation and Rehabilitation Definitions, (3) Distresses, (4) Condition Rating Survey, (5) Testing, (6) Treatments, and (7) Selection Guidelines. The final completed deliverables of this project include PowerPoint slides for in-class instruction, a stand-alone online platform, and review and final examination questions for the initial three blocks.					
17. Key Words Rehabilitation, preservation, pavement, training			18. Distribution Statement No restrictions. This document is available through the National Technical Information Service, Springfield, VA 22161.		
19. Security Classif. (of this report) Unclassified		20. Security Classif. (of this page) Unclassified		21. No. of Pages	22. Price N/A

ACKNOWLEDGMENT, DISCLAIMER, MANUFACTURERS' NAMES

This publication is based on the results of **ICT-R27-170, Pavement Rehabilitation Strategy Course Development**. ICT-R27-170 was conducted in cooperation with the Illinois Center for Transportation; the Illinois Department of Transportation; and the U.S. Department of Transportation, Federal Highway Administration.

Members of the Technical Review panel were the following:

- Charles Wienrank – IDOT Bureau of Research, TRP Chair
- Jeannie Bland – IDOT District 5
- Michael Brand – IDOT Bureau of Design and Environment
- Gregory Heckel – IDOT District 6
- Travis Lobmaster – IDOT Office of Planning and Programming
- Thomas Ronan – IDOT District 7
- LaDonna Rowden – IDOT Bureau of Research
- John Senger – IDOT Bureau of Research
- Dennis Bachman – FHWA

The research team would like to thank Districts personnel who participated in the interviews and contributed to the project by providing materials used in the development of the course. The contributions of Steve Worsfold, Mike Boyer, Derek Parish, Terrisa Worsfold, and Ray Barnes from District 4; Sal Madonia and Wes Clark from District 6; Bret Walker, Dave Miller, Kristi Sandschafer, and Brian Lewis from District 7 are greatly appreciated. We also would like to acknowledge Greg Runyard from Office of Planning and Programming for his inputs.

The contents of this report reflect the view of the authors, who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the Illinois Center for Transportation, the Illinois Department of Transportation, or the Federal Highway Administration. This report does not constitute a standard, specification, or regulation.

Trademark or manufacturers' names appear in this report only because they are considered essential to the object of this document and do not constitute an endorsement of product by the Federal Highway Administration, the Illinois Department of Transportation, or the Illinois Center for Transportation.

EXECUTIVE SUMMARY

Pavement rehabilitation and preservation treatments have become standard practice for state and local transportation agencies. The ultimate goals include maintaining a safe and reliable level of service for all users, maximizing pavement service life, and optimizing budget allocations for infrastructure construction projects. The essential key to meet these goals requires transportation agencies to identify the right treatment for the right pavement at the right time. Rather than a needs-based approach, a proper implementation of rehabilitation and preservation strategies requires an adequate understanding of the philosophy of rehabilitation and preservation, treatment type and applicability, methodological project- and network-level selection strategies, and construction feasibility.

The Illinois Department of Transportation (IDOT) provides guideline materials within the Bureau of Design and Environment (BDE) Manual, specifically Chapters 52 and 53 for Pavement Preservation and Pavement Rehabilitation strategies, respectively. The chapters describe the policies and procedures to assess functional and structural characteristics, identify the difference between surficial and structural defects, collect various pavement condition data, implement proper coring and testing protocols, and determine several baseline treatment options. In this project, training materials for IDOT personnel were developed to enhance the understanding of fundamental concepts of pavement rehabilitation and preservation strategies, establish consistent practices following the guidance manuals, and minimize potential errors by selecting appropriate treatments.

During the preparation of course materials, however, the technical research panel (TRP) identified several inconsistencies between the information from the BDE chapters and field practice. In lieu of relying solely on the BDE chapters, the research team agreed to interview engineers and programmers in several IDOT Districts to gather information on their typical rehabilitation and preservation practices. The materials obtained from the District interviews identified seven case studies that include common, successful practices relating to standard and structural overlays, pavement reconstruction, and rubblization. The case studies also examine how investigations were used to warrant structural overlays, diagnose the cause of certain distresses, and select appropriate treatment techniques.

Through IDOT TRP leadership, the course materials evolved with new findings and ongoing modifications to treatment selection guidelines. The training session is designed to be completed in one-and-a-half days, covering seven distinct blocks: (1) Introduction, (2) Preservation and Rehabilitation Definitions, (3) Distresses, (4) Condition Rating Survey, (5) Testing, (6) Treatments, and (7) Selection Guidelines. The class roadmap is presented in Figure 1. A brief overview of each block's objectives is provided, as follows.

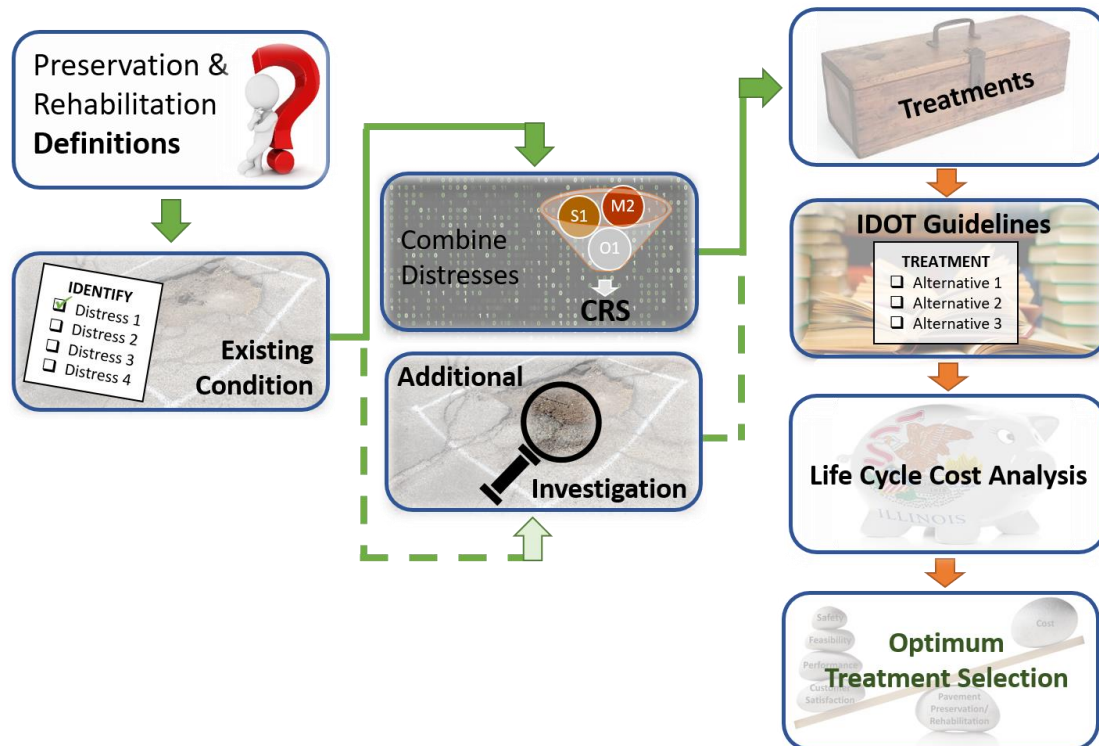


Figure 1. Course roadmap presented at the beginning and end of each block.

BLOCK 1: INTRODUCTION

The course begins with a brief overview of the scope and objectives of the training materials.

BLOCK 2: PRESERVATION AND REHABILITATION DEFINITION

The block begins with a basic overview of the definitions that distinguish preservation from rehabilitation strategies. An overview of key steps is presented, with an initial outlook on the philosophy of applying the right treatment to the right pavement at the right time. The block explains the necessity of developing a comprehensive pavement treatment toolbox to maintain an acceptable level of service (LOS). Sample distresses and preservation/rehabilitation techniques are also covered, to put some of the aforementioned concepts into a larger perspective without requiring the students to delve into the details.

BLOCK 3: DISTRESSES

Block 3 introduces various types of distresses found in hot-mix asphalt (HMA), Portland cement concrete (PCC), and composite pavements. The goal of this block is to introduce all types of distresses included in IDOT's Condition Rating Survey (CRS) models and provide the necessary background to make critical decisions such as those on rehabilitation, preservation,

or testing. The types of distress are largely divided into two categories: structural and functional. Structural distresses are those that deteriorate the load-carrying capacity of pavement, whereas functional distresses typically are deterioration in pavement surface characteristics primarily due to environmental conditions. Best-quality and representative photographs were selected from various sources to show typical pavement distresses. For each distress, this block presents a description of its physical appearance and/or location, potential cause(s) of the distress, diagnosis, and severity levels (if applicable). The severity levels of distresses are consistent with the CRS distress codes (where possible), and the description of each CRS distress code is also discussed.

BLOCK 4: CONDITION RATING SURVEY

Block 4 introduces an overview of the collection, processing, and application of pavement data. Pavement data are collected using data collection vehicles (DCVs), which record rutting, International Roughness Index (IRI), faulting, and pavement images for identifying different distresses and determining their severity and frequency. The collected data are used to calculate the pavement condition index, or CRS in Illinois, based on multiple linear-regression equations for different types of facilities and pavements. The students are guided to expand their pavement evaluation techniques in Block 4, specifically building on the information on distresses in Block 3. At the end of the block, preservation decision trees are introduced, in which the students can select an appropriate preservation treatment based on the information about facility type, distresses, CRS, and traffic.

BLOCK 5: TESTING

For times that visual evaluation is not enough to diagnose existing distresses or confidently identify preservation/rehabilitation techniques, Block 5 provides guidance on selecting additional testing. In this block, various types and applications of field testing, as well as a testing selection flowchart, are provided. It is important to understand the reason for conducting field testing, as students may encounter (1) inconclusive pavement distress data, (2) detailed condition assessment, and (3) rehabilitation alternative selection/design.

The testing program flowchart presented in Block 5 helps to identify whether testing is necessary, based on various criteria such as the presence of structural and/or material-related problems, high variability in distress severity or type, and the presence of medium- to high-severity nonstructural distress(es). To better demonstrate how the testing flowchart is utilized, example case studies were presented based on two actual rehabilitation projects: a non-Interstate pavement and an Interstate highway pavement. In addition, Block 5 also discusses coring procedure and testing of cored samples.

BLOCK 6: TREATMENTS

After properly identifying distresses that govern existing pavement conditions, the course transitions to identifying preservation/rehabilitation treatments. Block 6 introduces various preservation and rehabilitation treatments for HMA and PCC pavements. This block reiterates the general philosophy of identifying the right treatment for the right pavement at the right time. The block is divided into two parts: preservation and rehabilitation. For each preservation and rehabilitation treatment, the following topics are covered: (1) treatment description, (2) distress(es) that the treatment can address, (3) suggested application, (4) best practices, and (5) photographs of treatment application (if applicable). Combining this information with the knowledge gained from previous blocks (distress, pavement condition assessment, and testing), the students are ready to learn about the rehabilitation selection process in the next block.

BLOCK 7: GUIDELINES

In the final block, the students are expected to have built their toolbox that includes (1) preservation/rehabilitation definitions, (2) distress identification, (3) existing pavement evaluation, and (4) application (if warranted) of additional testing. The rehabilitation decision trees are also introduced, which consider the facility type, pavement surface type, CRS value, distress category (functional or structural), and traffic count. Several examples are also integrated with the decision trees to show how the trees can be effectively used to identify treatment options. A summary of the treatment selection logic is also presented for the selected examples. At the end of Block 7, the students can apply an effective decision-making process using treatment selection matrices, properly utilize pavement evaluation and additional testing data (if necessary) to make a rehabilitation/preservation treatment selection, consider constraints of real-life case studies, and balance trade-offs between alternative solutions. Moreover, a slide deck of case studies from the information obtained from IDOT District interviews was also prepared and may be used by the instructor to conduct breakout discussions.

The final deliverables of this project include PowerPoint slides, associated handouts and background information, a stand-alone online platform (with the same materials, to present in class), and a pool of final examination questions. The platform used in this project is iSpring, which is an add-on to the PowerPoint program. Complete and online versions of Blocks 2 and 3 will be provided. Block 3 also includes a voice recording and quiz questions. The blocks can be accessed through an online link (currently hosted on the ICT server). A sample snapshot of the Block 3 online platform is shown in Figure 2. Moreover, IDOT may collect test results from students for records and/or future certification of completing the course. A sample step-by-step process of the quiz is illustrated in Figure 3. Online but incomplete conversions of Blocks 4 and 6 are also provided without voice recordings. These blocks, along with Blocks 5 and 7, were not finalized within the scope of the project due to pending changes in the rehabilitation and preservation guidelines outlined in the BDE Manual.


Resources | Presenter Info | Marker Tools

I
II

Block 3: Pavement Performance & Distress Types

*Illinois Department of Transportation
BDE Manual Chapter 53 & CRS Manual*

Total Listening Duration: **1 hour & 30 minutes**
Please click the slide window or play button
on the bottom-left corner to advance the slide.



I II III IV V VI VII VIII TEST

1

OUTLINE | NOTES

Search...

1. Block 3: Pavement Performance & Distress Types
2. Learning Objectives
3. Outline
4. Pavement Distress Type
5. Why Distinguish Functional from Structural?
6. Flexible Pavement Distresses
7. Overview of HMA Distresses
8. Alligator (Fatigue) Cracking
9. Alligator (Fatigue) Cracking

▶
1 / 143
00:21 / 00:21
↺
⏮
⏭

PREV
NEXT

Figure 2. Snapshot of the stand-alone online platform using the iSpring add-on in PowerPoint.

Time for a review test! Let's review what we've learned in this block.

Click the "Start Quiz" button to proceed

[Back](#) [Start Quiz](#)

(a)

Enter Your Details

Name*

Email*

[Submit](#)

(b)

Question 1 of 4 Point Value: 25 | Total Points: 25 out of 100 [Print Results](#)

Here is a curve that describes the change of pavement performance over time. Please match each terminology with the right definition. Click on the picture to zoom in.

Reconstruction	Existing pavement reached the end of its service life. Demolishing existing pavemen...
Routine maintenance	Day-to-day non-contractual activities scheduled to maintain condition that restores the hig...
Rehabilitation	existing deteriorated

Correct

That's right! Good job!

[Continue](#)

(c)

 Congratulations. You passed!

Feel free to review the test results.

Quiz Result

Your Score: **100%**

Passing Score: **75%**

[Back](#) [Review Quiz](#) [Continue](#)

(d)

Figure 3. Snapshot of the online review platform integrated in each block and review option at the end of the test.



I ILLINOIS