



**TRANSPORTATION
RESEARCH BOARD**

AED70

**STANDING COMMITTEE ON
PAVEMENT REHABILITATION**

COMMEMORATIVE BOOKLET • JANUARY 2017

TRB COMMITTEE AFD70, STANDING COMMITTEE ON PAVEMENT REHABILITATION
SCOPE

The committee addresses rehabilitation methods, reliable design criteria, and improved performance models intended to extend the service life of existing pavement structures. The committee focuses on the selection of pavement rehabilitation strategies, development and evaluation of structural overlay design procedures, evaluation of other methods for rehabilitation design, and analysis of destructive and nondestructive testing data to determine optimal timing for conducting the rehabilitation.

CURRENT COMMITTEE LEADERSHIP

CHAIR Kurt Smith, Applied Pavement Technology, Inc.
SECRETARY John Donahue, Missouri Department of Transportation
RESEARCH COORDINATOR Bouzid Choubane, Florida Department of Transportation
COMMUNICATIONS COORDINATOR David Merritt, Transtec, Inc.
EMERITUS MEMBERS Tom Kazmierowski, Roger Olson, Gene Skok, Shiraz Tayabji

2014-2017 MEMBERSHIP

Tim Aschenbrener, FHWA	David Merritt, Transtec, Inc.
Jose Balbo, University of São Paolo	Dennis Morian, QES
Manik Barman, University of Minnesota-Duluth	Roger Olson, Minnesota DOT (retired)
Amanda Bordelon, University of Utah	Amy Schutzbach, Illinois DOT (retired)
Tom Burnham, Minnesota DOT	Larry Scofield, ACPA/IGGA
Armelle AC Chabot, IFSTTAR	Tom Scullion, Texas A&M University
Dar-Hao Chen, Texas DOT	James Signore, NCE
Bouzid Choubane, Florida DOT	Eugene L. Skok, retired
Judith Corley-Lay, North Carolina, DOT	Kurt Smith, Applied Pavement Technology, Inc.
Brian Diefenderfer, Virginia DOT	John Staton, Michigan DOT
John Donahue, Missouri DOT	Shiraz Tayabji, ARA
Laura Fenley, Wisconsin DOT	Gabriele Tebaldi, University of Parma Italy
Navneet Garg, FAA	Jeff Uhlmeyer, Washington State DOT
Roger Green, Ohio University	Julie Vandenbossche, University of Pittsburgh
Kevin Hall, University of Arkansas	Eileen Velez-Vega, Kimley-Horn
Robert Brooks Hogan, California DOT	Haifang Wen, Washington State University
Newton Jackson, NCE	Tom Yu, FHWA
Tom Kazmierowski, Golder Associates, Ltd.	Dan Zollinger, Texas A&M University
K. Wayne Lee, University of Rhode Island	

*The AFD70 Committee operates within the Pavement Section (AFD00), which is part of the Design and Construction Group (AF000). Leadership of those groups is provided by:
AFD00, Pavement Section Chair: Cheryl Richter, Federal Highway Administration
AF000, Design and Construction Group Chair: Tom Kazmierowski, Golder Associates
TRB Staff Representative: Stephen F. Maher*



TABLE OF CONTENTS

1	Preface » Introduction
2	Evolution of AFD70 Committee
5	Tributes from Former AFD70 Chairs
8	AFD70 Subcommittees
9	Summary of Awards and Achievements
13	AFD70 Emeritus Members
16	Pavement Rehabilitation Committee Membership and Rosters
26	Some Major Pavement Rehabilitation Highlights, 1976-2016
28	Partial Listing of Selected Noteworthy Pavement Rehabilitation References, 1980-2017
36	Appendix: Year 2000 Millennial Document



PREFACE » INTRODUCTION

KURT SMITH, CURRENT AFD70 CHAIR

As most of you are aware, TRB Committee AFD70 on Pavement Rehabilitation is sunseting after the January 2017 Annual Meeting. Based on a 2014-2015 review of all committees within TRB’s Pavement Management

Section (AFD00), it was determined that the pavement rehabilitation needs for both asphalt and concrete pavements could be better served from within the Design Committees for each pavement type; consequently, the former *Standing Committee on Flexible Pavement Design* (AFD60) and the former *Standing Committee on Rigid Pavement Design* (AFD50) now incorporate pavement-specific rehabilitation activities within their scopes and have adopted new committee titles as a reflection of this change (AFD50 is now the *Standing Committee on Design and Rehabilitation of Asphalt Pavements* and AFD60 is now the *Standing Committee on Design and Rehabilitation of Concrete Pavements*). This is believed to provide a better focus to the needs of each pavement technology and will help clarify the assignments and requirements of each group. The current chairs of both committees (AFD60, Dr. David Timm and AFD50, Ms. Georgene Geary) have indicated their commitment to maintain a strong focus on rehabilitation.

AFD70 has a long history of service to TRB, dating back to at least 1980. Over the years, the committee has been very successful in developing numerous Research Needs Statements (RNS), sponsoring sessions and workshops at the TRB Annual Meeting, contributing to national rehabilitation conferences and events, and providing guidance on rehabilitation issues. The committee has been the beneficiary of strong leaders and dedicated members who have worked tirelessly over the years to deliver these services, and over the last 3 years it has been my privilege to work with an equally devoted membership who have provided strong support to the activities of the committee. To those current members I offer my humble thanks and appreciation.

This booklet has been developed as a way of commemorating the work of TRB’s Pavement Rehabilitation Committee and is dedicated to the many individuals who have volunteered their time and efforts to contribute to the success of the committee. I would like to acknowledge Dr. Shiraz Tayabji, Dr. Julie Vandenbossche, Mr. Roger Olson, and Dr. David Newcomb for their assistance in preparing this booklet, and I also express my appreciation to Ms. Jessica Snyder for her graphical and editorial support. Together we hope you find this booklet both interesting and enjoyable

EVOLUTION OF AFD70 COMMITTEE

Under various designations, TRB Committee AFD70 has been an active and engaged committee since its establishment in 1980. Prior to that time, the Transportation Research Board (TRB) and its predecessor the Highway Research Board (HRB) assigned the broad topic of pavement rehabilitation to the Committees of Design or Maintenance (with separate committees devoted to maintenance of bituminous and portland cement concrete pavements). Additionally, in the early 1960s, a Committee on “Salvaging Old Pavements By Resurfacing” was formed to address issues related to overlays. Rosters from 1969 for some of these forerunner groups to the Pavement Rehabilitation committee are shown below.

DEPARTMENT OF MAINTENANCE

J. F. ANDREWS, CHAIRMAN (NEW JERSEY DEPARTMENT OF TRANSPORTATION)
ADRIAN G. CLARY (HIGHWAY RESEARCH BOARD)

Committee on Salvaging Old Pavements By Resurfacing (*as of December 31, 1969*)

Michael J. Stump, Chairman (Iowa State Highway Commission)

J. O. Bacon		
John E. Burke	Columbus E. Lord	Thomas L. Speer
Leslie B. Crowley	Robert F. McDowell	Earle E. Towlson
Warren G. Davison	John L. Palmer	Paul I. Wagner
Vern L. Dorsey	John B. Purinton, Jr.	Ralph Walker
H. K. Eggleston	Martin C. Rissel	Dillard D. Woodson

Committee on Maintenance of Bituminous Pavements (*as of December 31, 1969*)

W. L. Hinderman, Chairman (The Asphalt Institute)

Ara Arman	J. A. Hester	Paul W. McHugh
Charles W. Beagle	Michael P. Jones	Louis G. O’Brien
Harry R. Cedergren	James O. Kyser	David W. Rand
John L. Haller	David C. Mahone	R. K. Williams, Jr.
John W. Heller	James D. McGee	

Committee on Maintenance of Portland Cement Concrete Pavements (*as of December 31, 1969*)

Francis C. Staib, Chairman (Ohio Turnpike Commission)	R. J. Ervin	Keith M. Saville
William J. Buglass	J. D. Geesaman	Donald R. Schwartz
Lloyd G. Byrd	Israel Narrow	Chris Seibel, Jr.
Ronald L. Zook	John P. Pendleton	Richard K. Shaffer

Beginning in the late 1970s , there was a growing recognition of the need to manage the substantial pavement investment that had been made in the construction of the Interstate System. As part of this, it was acknowledged that a broader range of solutions beyond just simple maintenance and overlays needed to be considered for these facilities. Consequently, in about 1980, the Committee on Pavement Rehabilitation Design was formed, with Dr. Matt Witzcak (then with the University of Maryland) serving as the first Chair. The composition of that inaugural group is believed to have consisted of the individuals shown in the table below, and is noted to include a number of acclaimed and prominent pavement scholars.

COMMITTEE ON PAVEMENT REHABILITATION DESIGN (AS OF DEC 31, 1980)

MATT WITCZAK, UNIVERSITY OF MARYLAND (CHAIR)

Ernie Barenberg
Walter Barker
W. G. Davison
Paul Diethelm
Fred Finn
William Green
J.H. Haven
W.J. Head
Ali Kemahli
Edwin Lokken
Kamran Majidzadeh
Dick McComb

GORDON BEECROFT, OREGON DOT (SECRETARY)

Carl Monismith
Gene Morris
August Muller
John Rice
Don Schwartz
Jim Shook
Larry Smith
Richard Stewart
Harvey Treybig
Hugh Tyner
Loren Womack

Over the years, the Pavement Rehabilitation Committee (under various TRB designations, most recently A2B04 and then AFD70) has served the pavement community well. The meetings of the Committee held as part of the annual TRB program have routinely drawn large audiences, during which the Committee equitably embraced both flexible pavement rehabilitation and rigid pavement rehabilitation topics. In 2000, the Committee prepared a “white paper” documenting the current state of the practice on and future needs for pavement rehabilitation, much of which remains relevant today.

Fundamental to the services of the AFD70 Committee has been its work in the development of Research Needs Statements and the organization of technical sessions and workshops. Regarding the former, the Committee has a long history of preparing practical Research Needs Statements of merit to the pavement community, and most recently prepared a Research Needs Statement on *Rapid Field Assessment of Recycled Pavements Constructed Using Asphalt-Based Recycling Agents* that was selected by NCHRP and issued in the fall of 2016 as RFP 09-62. With regards to the latter, strong technical sessions and workshops have long been a hallmark of AFD70, and

that tradition was continued at the 2017 Annual Meeting when a two-part workshop on *Pavement Rehabilitation: Looking Back, Looking Forward* was organized (see program below). That workshop, featuring a veritable Who’s Who of pavement engineers and practitioners, served as a fitting swan song for the Committee as it completes its final mission and relinquishes its responsibilities to the AFD50 and AFD60 Committees. Clearly, the Pavement Rehabilitation Committee has played a meaningful role in the TRB schema and has enjoyed a fruitful journey.

PAVEMENT REHABILITATION: LOOKING BACK, LOOKING FORWARD (A WORKSHOP HELD AT THE 2017 TRB MEETING)

PART 1: FLEXIBLE PAVEMENTS

Moderator: Roger Olson

- Past, Present, and Future of Flexible Pavement Rehabilitation—Jon Epps, Texas A&M Transportation Institute
- DOT Perspective on Flexible Pavement Rehabilitation—Becca Lane, Ontario Ministry of Transportation
- Cold In-Place and Cold Central-Plant Recycling—Brian Diefenderfer, Virginia Department of Transportation
- Hot In-Place Recycling—Thomas Kazmierowski, Golder Associates Inc.
- Thin Asphalt Overlays—Audrey Copeland, National Asphalt Pavement Association
- Slab Fracturing and Asphalt Overlays—Dale Decker, Dale S. Decker, LLC

PART 2: RIGID PAVEMENTS

Moderator: Kurt Smith

- Past, Present, and Future of Rigid Pavement Rehabilitation—Michael Darter, Applied Research Associates, Inc. (ARA)
- DOT Perspective on Rigid Pavement Rehabilitation—John Donahue, Missouri Department of Transportation
- Full- and Partial-Depth Repairs—Mark Snyder
- Rehabilitation with Precast Concrete—Shiraz Tayabji, Advanced Concrete Pavement Consultancy LLC
- Load Transfer Restoration—Linda Pierce, NCE
- Concrete Overlays—Thomas Burnham, Minnesota Department of Transportation

TRIBUTES FROM FORMER AFD70 CHAIRS



Julie Vandebossche, 2008-2014 University of Pittsburgh

During my tenure from 2008 to 2014, the emeritus members (Dr. Eugene Skok and Dr. Shiraz Tayabji) provided a solid foundation for ensuring that the Pavement Rehabilitation Committee continued to have a meaningful impact. In recognition of Dr. Skok’s many contributions in the area of pavement rehabilitation and his mentorship of young professionals, the Committee initiated the AFD70 Gene Skok Award for Outstanding Paper by a Young Author in 2012. The list of prominent

emeritus members of AFD70 grew as Mr. Tom Kazmierowski (2009) and Mr. Roger Olson (2014) were also granted emeritus status.

The strong collaborative relationships previously established with other TRB committees continued to flourish, as exemplified by the many activities (sessions, workshops, webinars) that were jointly sponsored by AFD70 in conjunction with the TRB pavement design, maintenance, and construction committees. The focus of much of this collaborative work during this period was in the areas of sustainability, long-life rehabilitation treatments, concrete overlay design, in-place recycling for asphalt pavements, precast slabs, and accelerated construction. Another unique characteristic of AFD70 is that it not only had strong interactions between committees but also provided a venue that facilitated the interaction and exchange of ideas from experts in the both the flexible pavement and rigid pavement areas. This is essential since the rehabilitation of pavements commonly requires expertise from both fields.

Having the privilege to serve on the AFD70 Committee as a member and the Chair for over 16 years has provided me with additional clarity on how essential pavement rehabilitation is to the vitality of the transportation infrastructure. The fact that it is not uncommon for AFD70 Committee meetings to have standing room only due to the large attendance and that it historically received as many, or more, paper submittals than any of the other committees within the Pavement Section is indicative of the extensive interest and on-going work in this area. With the sunset of AFD70, it is hoped that pavement rehabilitation continues to play a major role in the new organizational structure and that its importance continues to be recognized.



Roger Olson, 2002-2008

Minnesota DOT (retired)

When David Newcomb was named chair in 1990, I was asked to serve as committee secretary. When Dr. Newcomb was replaced by Dr. Shiraz Tayabji in 1996, I continued the role of committee secretary. I was then asked to serve as committee chair from 2002 to 2008. Following my term the committee secretary, Julie Vandenbossche became chair and I tried to help her out. So I have had first hand experience with the evolution of AFD70 for quite a few years.

The committee always received numerous and a wide variety of papers related to pavement rehabilitation, since this is the current status of our highway infrastructure. As committee chair it was often a daunting task to sort papers with potential reviewers since it would involve both rigid pavement design, modeling, and case studies and flexible pavement design, modeling and case studies. Given that, perhaps it is an appropriate time to provide a more structured approach to reviewing and evaluating papers related to pavement rehabilitation. We always had high quality papers and during my tenure had KB Woods award winner: Thomas Bennert and a Fred Burgraaf (young author) award winner: Julie Vandenbossche. Kurt Smith as the current and outgoing chair has done a remarkable job in closing out the AHD70 committee with putting together several sessions and a Sunday workshop for the 2017 TRB meeting, as well as this commemorative booklet.



Shiraz Tayabji, 1996-2002

ARA

It has been an honor to have served as a two-term Chair of the Committee. As a member, as a Chair, and subsequently as an Emeritus Member, I have had the pleasure of interacting with some of the best experts in the pavement rehabilitation field. The committee actively fostered technology transfer related to innovative rehabilitation technologies and supported implementation of these technologies in the US and other countries. With the sunseting of the committee during early 2017, an era

is coming to an end. The committee's work will be missed. Pavement rehabilitation is a major activity for all highway agencies and has several consequences on agency resources and traffic disruptions because of extensive and extended lane closures. Therefore, it is a hope that pavement rehabilitation will continue to receive proper attention as part of other related TRB committees. The challenge in highway pavement rehabilitation continues to be the achievement of longer-lasting pavement rehabilitation while efficiently managing heavy traffic through construction zones. As such, improvements in technology need to be continually made to improve the whole process of pavement rehabilitation, including use of rapid rehabilitation technologies. Leadership on the part of the federal and state agencies and industry working as partners will be necessary to ensure that necessary investments in highway and airport pavements continue to support the economic development and otherwise benefit the well-being of transportation users.



David Newcomb, 1990-1996

Texas A&M University

In the early 1990s, the Committee on Pavement Rehabilitation was focused on the structural and functional assessment of pavements. The use of FWD data in the back-calculation of pavement layer moduli was beginning and the application of moduli for structural design was somewhat cruder than it is today. This was because the advent of desktop computers had happened only a short time before. We were learning about techniques to evaluate NDT data for both concrete and asphalt pavements and

beginning to appreciate the level of variability in our pavement systems.

The committee meetings were somewhat innovative in themselves in that discussion groups were formed during the meeting to develop topics for research needs statements and podium sessions (no poster sessions back then). This interactive approach was somewhat clumsy as the room layout was not always conducive to this type of meeting. However, attendees usually came away with the feeling that they had gotten a chance to provide input to the committee's products.

Finally, the committee was on the forefront of change in the way papers were reviewed and rated. We developed a paper rating system that reviewers could use so that a more objective approach could be taken in the assessment of the quality of papers. This provided authors with a more consistent rating and gave them a better understanding of their submissions' strengths and weaknesses.



AFD70 SUBCOMMITTEES

Over the years, the Pavement Rehabilitation Committee has been served by a number of subcommittees. In some cases, these were small, *ad hoc* groups formed to address a specific need and in other cases these have been formal subcommittees working on a long-term issue. Currently, AFD70 is served by one formal subcommittee and three informal subcommittees:

- AFD70(1): Interlayer Systems to Control Reflective Cracking—Bouzid Choubane, Chair
- Emerging Technologies in Rigid Pavement Rehabilitation—Shiraz Tayabji, Chair
- Emerging Technologies in Flexible Pavement Rehabilitation—Roger Olson, Chair
- In-Place Pavement Recycling—Tom Kazmierowski, Chair

Formal subcommittee AFD70(1) was established in 2007 and was initially chaired by Imad Al-Qadi; during its tenure, the subcommittee sponsored several directed sessions and webinars related to reflective cracking mechanisms and mitigation measures.

In the period from about 2005 to 2012, the following informal subcommittees were active:

- Pavement Rehabilitation In Challenging Places—Trenton Clark, Chair
- Emerging Technologies in Rigid Pavement Rehabilitation—Shiraz Tayabji, Chair
- Emerging Technologies in Flexible Pavement Rehabilitation—Eugene Skok, Chair

In the early 2000s, the Pavement Rehabilitation Committee was served by two informal subcommittees:

- Pavement Rehabilitation in Urban Areas—Jeff Roesler, Chair
- Recycling and Reclaiming AC Pavements—John Huffman, Chair

SUMMARY OF AWARDS AND ACHIEVEMENTS

TRB AWARDS AND RECOGNITION

During the tenure of the Pavement Rehabilitation Committee, a number of award-winning papers related to pavement rehabilitation were recognized by TRB for their quality and significance. Although not all came out of the Pavement Rehabilitation Committee, these award-winning papers are reflective of the importance of rehabilitation in the effective management of the pavement infrastructure. A listing of these award-winning papers is provided below.

- D. Grant Mickle Award (for an outstanding paper published in the field of operation, safety, and maintenance of transportation facilities)
 - » 1996: Joseph E. Ponniah and Gerhard J. Kennepohl, Crack Sealing in Flexible Pavements: A Life-Cycle Cost Analysis
 - » 1988: Michael J. Reiter, Michael I. Darter, and Samuel H. Carpenter, Restoration of Joint Load Transfer
 - » 1980: Wouter Gulden and J. B. Thornton, Pavement Restoration Measures to Precede Joint Resealing
- K. B. Woods Award (for an outstanding paper published in the field of design and construction of transportation facilities)
 - » 2014: Thomas Bennert, Jo Sias Daniel, and Walaa Mogawer, Strategies for Incorporating Higher Recycled Asphalt Pavement Percentages: Review of Implementation Trials in Northeast States
 - » 2010: Michael Hammons, Expedient Spall Repair Methods and Equipment for Airfield Pavements
 - » 2008: Thomas A. Bennert and Ali Maher, Field and Laboratory Evaluation of a Reflective Crack Interlayer in New Jersey
 - » 1999: Marshall R. Thompson, Hot-Mix Asphalt Overlay Design Concepts for Rubblized Portland Cement Concrete Pavements
 - » 1988, Michael M. Sprinkel, High-Early-Strength Latex-Modified Concrete Overlay (AFD70?)
 - » 1986, Donald J. Janssen and Barry J. Dempsey, The Effect of AC Overlays on D-Cracking in PCC Pavements
 - » 1980, Paul A. D’amato and Matthew W. Witzczak, Analysis of In-Situ Granular Layer Modulus from Dynamic Road Rater Deflections
- Fred Burgraff Award (for an outstanding paper in transportation research by researchers 35 years of age or younger)
 - » 2003: Julie M. Vandenbossche, *Performance Analysis of Ultrathin Whitetopping Intersections on US-169: Elk River, Minnesota*
 - » 1993: Yi Jiang and Rebecca S. McDaniel, *Application of Cracking and Sealing and Use of Fibers to Control Reflective Cracking*

National Associates of the National Research Council

Many dedicated individuals serve *pro bono publico* on committees of the National Research Council (NRC), the operating arm of the National Academies of Sciences, Engineering and Medicine. Each year, several thousand individuals serve as members of NRC committees or serve as reviewers draft reports. This service is valued, honored, and appreciated by the National Academies of Sciences, Engineering, and Medicine, as well as by the government and the public at large. The Academies' work in advising government and the public on matters of science, engineering, and health would not be possible without these contributions.

In 2016, the National Academies of Sciences, Engineering, and Medicine announced its 2016 Class of National Associates, which includes nine individuals who have served TRB with distinction and whose dedication is extraordinary. Included in the list of honorees is **Mr. Thomas J. Kazmierowski**, a long-time AFD70 member, contributor, and mentor, and current AFD70 emeritus member. For his long-time service to TRB (as well as to AFD70), Tom is recognized with the honorary title of “National Associate” of the National Research Council.

AFD70 Committee Awards and Achievements

Since 2012, AFD70 has bestowed the “Gene Skok Award for Outstanding Paper By Young Author” to recognize noteworthy papers in the area of pavement rehabilitation led by an author under 35 years of age. The award is named after Dr. Gene Skok, long-time AFD70 member, AFD70 emeritus member, and well-known pavement practitioner and academician. The award winning papers and authors are as follows:

Year	Author(s)	Title	
2012	Priyam Saxena (<35) and Lev Khazanovich	Determination of Critical Bending Stresses in the PCC Layer with Asphalt Overlay	AFD70 Chair Julie Vandenbossche presents Skok Award to Lev Khazanovich, accepting on behalf of Priyam Saxena
2013	No Award		
2014	Qazi Aurangzeb (<35) and Imad Al-Qadi	Asphalt Pavements with High RAP Content: Economic and Environmental Perspectives	AFD70 Chair Julie Vandenbossche presents Skok Award to Qazi Aurangzeb, accompanied by his advisor Imad Al-Qadi

Year	Author(s)	Title	
2015	Dan Swiertz	Method for Determination of Optimum Emulsion Content for Emulsion-Stabilized Full-Depth Reclamation with Field Study	Dan Swiertz (right) accepts Skok Award from AFD70 Chair Kurt Smith
2016	Co-Winners: Min Ook Kim (<35) and Amanda Bordelon Steven Sachs, Kevin Alland, and John DeSantis (all < 35), Julie Vandenbossche, and Lev Khazanovich	Fiber Effect on Interfacial Bond Between Concrete and Fiber Reinforced Mortar Laboratory Investigation into the Effect of Different Interlayer Systems on Reflective Cracking of Unbonded Concrete Overlays of Existing Concrete Pavements (UBOLs)	Amanda Bordelon accepts Skok Award from AFD70 Chair Kurt Smith on behalf of Min Ook Kim Skok Award winners John DeSantis (left), Kevin Alland (second from left), and Steven Sachs (right) with AFD70 Chair Kurt Smith
2017	Mr. Eugene Amarh	Nondestructive in Situ Characterization of Elastic Moduli of Full-Depth Reclamation Base Mixtures	

Other AFD70 Recognition Events

A few highlights of other AFD70 recognition events are presented below.

Year	Event
2008	<p>Outgoing AFD70 Chair Roger Olson (center) is congratulated by TRB Staff Representative Stephen Maher (left) and Pavement Management Section Chair Tom Kazmierowski</p> 
2009	<p>TRB Staff Representative Stephen Maher (right) and Design and Construction Group Chair Mary Lou Ralls (center) recognize Tom Kazmierowski for his appointment as AFD70 Emeritus Member</p> 
2014	<p>Pavement Management Section Chair Cheryl Richter (left), TRB Staff Representative Stephen Maher (second from left) and Design and Construction Group Chair Tom Kazmierowski (right) recognize outgoing AFD70 Chair Julie Vandenbossche</p> 
2014	<p>TRB Staff Representative Stephen Maher (left), AFD70 Chair Julie Vandenbossche (second from right) and Design and Construction Group Chair Tom Kazmierowski (right) recognize Roger Olson as a newly appointed Emeritus Member for AFD70.</p> 

AFD70 EMERITUS MEMBERS

AFD70 has recognized four of its long-standing constituents as Emeritus Members in acknowledgment of their many contributions and efforts to the work of the committee. These members include:



MR. TOM KAZMIEROWSKI, P.E.

Tom Kazmierowski graduated from the University of Toronto, Faculty Applied Science and Engineering in 1976 with an Honors Degree in Civil/Geotechnical Engineering. He spent 37 years with the Ministry of Transportation in Ontario prior to joining Golder Associates Ltd. in 2013. Tom has 30+ years’ experience in pavement and materials engineering as applied to the design, construction, preservation and rehabilitation of Provincial/State and Municipal Roads. He has authored/coauthored in excess of 100 technical papers, including 17 papers published in Transportation Research Records (TRR).

Tom is currently the Chair of the Construction Section and past Chair of the Design and Construction Group for the Transportation Research Board (TRB) in Washington DC. He also co-Chairs the TRR Review Advisory Board. Mr. Kazmierowski was a member of the Pavement Rehabilitation Committee for 18 years prior to becoming an emeritus member of AFD70 in 2009. Recently, the US National Academies of Science, Engineering, and Medicine has awarded Tom the honorary title of “National Associate” of the National Research Council in recognition of his extraordinary service.

Tom has been actively involved in major transportation infrastructure projects in Ontario and has championed the use of sustainable in-place pavement recycling technologies (FDR, CIR, CIREAM, and HIR) and thin lift pavement preservation strategies.

He has taken a leadership role in the development and implementation of performance specifications and their use in long term warranty contracts using various alternate contract delivery methods.

Tom has been involved with numerous R&D projects, particularly on advanced sustainable pavement materials and recycling. He has also successfully led several forensic investigations into poorly performing pavements and roadway construction materials.



MR. ROGER OLSON, P.E.

Roger Olson graduated from North Dakota State in 1968 with a degree in Civil Engineering (the North Dakota State that has won the FCS Football National Title the past 5 years). Roger spent most of his career with the Minnesota Department of Transportation, except for 5 years spent with a local County. Much of his career was spent in Pavement Research, primarily dealing with asphalt technology, pavement rehabilitation, maintenance, preservation, design, and construction. Roger retired in 2011, but then worked 5 years under a Post Retirement Option Program working primarily with the MnROAD test facility and the TERRA organization until full retirement in 2015.

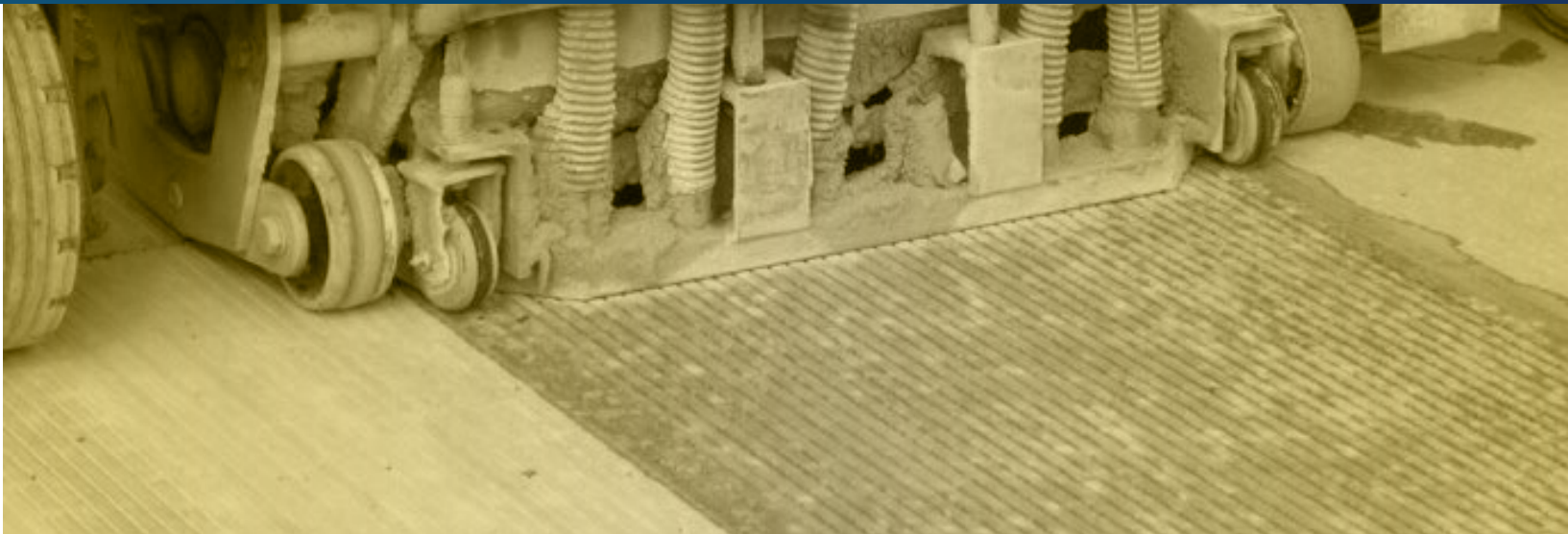
Roger has been very active in TRB activities during his career, serving on numerous committees. Roger chaired the Pavement Rehabilitation committee from 2002 to 2008, prior to becoming an emeritus member in 2014. He then served as chair of the Pavement Maintenance Committee (AHD20) from 2008 to 2014. Roger will be recognized as an emeritus member of AHD20 at the 2017 TRB annual meeting. Roger has also served on numerous NCHRP panels, and currently is a panel member of NCHRP 20-05, "Synthesis of Information Related to Highway Practices." Roger is also a life member of the Association of Asphalt Paving Technologists, receiving the Board of Directors Recognition award in 1999.



DR. EUGENE SKOK, P.E. PH.D.

Dr. Eugene Skok earned B.S. and M.S. degrees in Civil Engineering from the University of Minnesota in the 1960s. His Master's thesis was on asphalt pavement design for which he incorporated the use of data he collected from the AASHTO Road Test, where he worked with pavement greats A.C. Benkelman, Fred Finn, and Carl Monismith. Upon graduation, Dr. Skok moved to Maryland where he accepted a position with the Asphalt Institute, and eventually returned to Minnesota to develop an asphalt pavement design procedure for the state of Minnesota using data from the AASHTO Road Test. Dr. Skok joined the Association of Asphalt Paving Technologists (AAPT) in 1965 and served as Secretary-Treasurer from 1969 until his retirement in 2013.

In the early 1980s, Dr. Skok and two other colleagues formed Midwest Pavement Management, which was later bought by Braun Intertec and provided the technical expertise necessary to serve as a Long Term Pavement Performance Regional Monitoring Center for which Dr. Skok served as the Principal Investigator. In the mid 1990s, Dr. Skok worked for the Minnesota Asphalt Paving Association (MAPA) for a few years, and then returned to academia in the late 1990s, when he joined the faculty at the University of Minnesota. Dr. Skok was a member of AFD70 from 2/1/1990 to 1/31/2002 and became an emeritus member of AFD70 in 2003.



DR. SHIRAZ TAYABJI, P.E, PH.D.

Shiraz Tayabji, Emeritus Member of TRB, served as the Chair of TRB Committee AFD70 (then Committee A2B04) from February 1996 to January 2002. Shiraz obtained his B. Sc. In Civil Engineering degree from the University of Nairobi, Nairobi, Kenya in 1970 and M. Sc. and Ph.D. degrees in Civil Engineering from the University of Illinois at Urbana, Illinois (1972 and 1976, respectively). Shiraz joined the Research and Development Division of the Portland Cement Association in June 1978, the starting point of Shiraz's involvement with concrete pavement technology. Since then, he has been actively involved in developing, improving, and implementing technologies for highway and airfield concrete pavements for more than 35 years and is now a nationally and internationally recognized expert on concrete pavement technology. Shiraz has been invited to conduct workshops and/or be a keynote speaker in Argentina, Brazil, Canada, China, Colombia, Ecuador, Guatemala, India, South Korea, Mexico, Panama, Taiwan, and Turkey.

He has been both an active participant and project leader in numerous R&D studies sponsored by the US FHWA, NCHRP, IPRE, State DOTs, DOD, and industry to improve concrete pavement technology, and has managed numerous multi-year, multi-team projects. Shiraz is one of the leading US experts on precast concrete pavement technologies and an active proponent of the use of precast concrete pavements for rapid repair and rehabilitation of highway pavements. As of January 2017, he serves as the Project Manager for a FHWA project to support wider implementation of precast concrete pavement technologies in the US and has provided technical support for plans and specification preparation to several State highway agencies.

Shiraz is a Senior Principal Engineer with Applied Research Associates, Inc. at the Elkridge, Maryland office and also serves as the President of Advanced Concrete Pavement Consultancy LLC, based in Columbia, Maryland. He is a registered Professional Engineer in several States. He is a Co-Founder and Past President of the International Society for Concrete Pavements, Fellow of ACI, Fellow and Life Member of ASCE, and continues to be actively involved in technical committees of TRB, ACI, ASTM, and ASCE.



PAVEMENT REHABILITATION COMMITTEE MEMBERSHIP AND ROSTERS

COMMITTEE CHAIRS

- Matt Witczak, 1980-1982
- Gordon Beecroft, 1982-1987
- Jim Shook, 1987-1989
- David Newcomb, 1990-1996
- Shiraz Tayabji, 1996-2002
- Roger Olson, 2002-2008
- Julie Vandenbossche, 2008-2014
- Kurt Smith, 2014-2017

Periodic Listing of Pavement Rehabilitation Committee Membership

1980

Committee on Pavement Rehabilitation Design (as of Dec 31, 1980)	
Matt Witczak, University of Maryland, Chair	Gordon Beecroft, Oregon DOT, Secretary
Ernie Barenberg Walter Barker W. G. Davison Paul Diethelm Fred Finn William Green J.H. Haven W.J. Head Ali Kemahli Edwin Lokken Kamran Majidzadeh Dick McComb	Carl Monismith Gene Morris August Muller John Rice Don Schwartz Jim Shook Larry Smith Richard Stewart Harvey Treybig Hugh Tyner Loren Womack

1982

Committee on Pavement Rehabilitation Design (as of Dec 31, 1982)	
Gordon Beecroft, Oregon DOT, Chair	Jim Shook, Asphalt Institute, Secretary
Edward Aikman Walter Barker Martin Cawley W. G. Davison Paul Diethelm Wade Gramling William Greene W. J. Head James Hill Ali Kemahli Richard May Carl Monismith	Gene Morris Louis O'Brien Bob Packard Larry Smith Richard Stewart Dick Stubstad Reuben Thomas Harvey Treybig Hugh Tyner Matt Witczak Loren Womack

1986

Committee on Pavement Rehabilitation Design (as of Dec 31, 1986)	
Gordon Beecroft, Oregon DOT, Chair	Jim Shook, ARE, Inc., Secretary
Edward Aikman	Joe Mahoney
Ralph Allen	Richard May
Martin Cawley	Gene Morris
W. G. Davison	Louis O’Brien
Paul Diethelm	John Potter
Denis Donnelly	Larry Smith
Wade Gramling	Richard Stewart
David Halpenny	Dick Stubstad
Joe Hannon	Reuben Thomas
W. J. Head	Harvey Treybig
James Hill	Loren Womack
Walter P. Kilareski	

1987

Committee on Pavement Rehabilitation (as of early 1987)	
Gordon Beecroft, Oregon DOT, Chair	Jim Shook, ARE, Inc., Secretary
Edward Aikman	Walter P. Kilareski
Ralph Allen	Joe Mahoney
Paul Autret	Richard May
Martin Cawley	William Miley
W. G. Davison	Gene Morris
Paul Diethelm	Louis O’Brien
Denis Donnelly	John Potter
Wade Gramling	Dick Stubstad
David Halpenny	Harvey Treybig
Joe Hannon	Robert White
W. J. Head	Loren Womack
James Hill	

1987

Committee on Pavement Rehabilitation (as of Dec 31, 1987)	
Jim Shook, ARE, Inc., Chair	Richard May, Asphalt Institute, Secretary
Paul Autret	James Hill
Mike Belangie	Walter P. Kilareski
Jim Brown	Joe Mahoney
Martin Cawley	William Miley
John D’Angelo	David Newcomb
W. G. Davison	Louis O’Brien
Paul Diethelm	John Potter
Denis Donnelly	Dick Stubstad
Wade Gramling	Shiraz Tayabji
Jerry Hajek	Robert White
John Hallin	Loren Womack
Joe Hannon	

1989

Committee on Pavement Rehabilitation (as of Dec 31, 1989)	
David Newcomb, University of Minnesota, Chair	Richard May, Asphalt Institute, Secretary
Paul Autret	Don Harriott
Mike Belangie	James Hill
Jim Brown	Walter P. Kilareski
Martin Cawley	Joe Mahoney
John D’Angelo	William Miley
Warren Davison	Louis O’Brien
Paul Diethelm	John Potter
Denis Donnelly	Jim Shook
Wade Gramling	Dick Stubstad
Jerry Hajek	Shiraz Tayabji
John Hallin	Robert White
Joe Hannon	Loren Womack

1992

Committee on Pavement Rehabilitation (as of Dec 31, 1992)	
David Newcomb, University of Minnesota, Chair	Roger Olson, Minnesota DOT, Secretary
Paul Autret Mike Belangie Thomas L Boswell Jim Brown Martin Cawley Denis E. Donnelly Wade Gramling Kathleen T. Hall Joe Hannon Don Harriott Ira J. Huddleston Tom Kazmierowski	Walter P. Kilareski Aramis Lopez Joe Mahoney Richard W. May William Miley Louis O’Brien Gary Wayne Sharpe Jim Shook Gene Skok Dick Stubstad Shiraz Tayabji Robert White

1995

Committee on Pavement Rehabilitation (as of Dec 31, 1995)	
David Newcomb, University of Minnesota, Chair	Roger Olson, Minnesota DOT, Secretary
Janice L. Arellano Fouad M. S. Bayomy Thomas L Boswell Jim Brown Alfred B. Crawley Denis E. Donnelly Kathleen T. Hall Joe Hannon Don Harriott Thomas M. Hearne Mustaque Hossain	Ira J. Huddleston Tom Kazmierowski Walter P. Kilareski Aramis Lopez, Joe Mahoney Emmanuel B. Owusu-Antwi Elias Rmeili Gary Wayne Sharpe Gene Skok Shiraz Tayabji Gerald F. Voigt

1996

Committee on Pavement Rehabilitation (as of 1996)	
Shiraz Tayabji, ERES Consultants, Chair	Roger Olson, Minnesota DOT, Secretary
John R. Anderson Jamshid M. Armaghani Fouad Bayomy Thomas L. Boswell James L. Brown Alfred Crawley Dale S. Decker Denis Donnelly Jose Garcia Kathleen T. Hall Thomas Hearne Mustaque Hossain John E. Huffman	Anastasios M. Ioannides Tom Kazmierowski Aramis Lopez Dennis A. Morian David E. Newcomb Roger Olson Linda M. Pierce Gary W. Sharpe Eugene L. Skok Warren Spaulding Lawrence L. Weiss Sameh M. Zaghoul

1999

Committee on Pavement Rehabilitation (as of 1999)	
Shiraz Tayabji, CTL, Inc., Chair	Roger Olson, Minnesota DOT, Secretary
John R. Anderson Jamshid M. Armaghani Bill Cape Trenton Clark Jerry Daleiden Dale S. Decker Denis Donnelly Chuck Gemayel Thomas Hearne Mustaque Hossain John E. Huffman Anastasios M. Ioannides Tom Kazmierowski	Hans Christian Korsgaard Roger M. Larson Francesca LaTorre James W. Mack Dennis A. Morian Scott D. Murrell Samy Noureldin Emmanuel B. Owusu-Antwi John Pontarollo Peter E. Sebaaly Eugene L. Skok John. J. Weigel

2002-2005

Committee on Pavement Rehabilitation (as of 2002)	
Roger Olson, Minnesota DOT, Chair	Julie Vandenbossche, University of Pittsburgh, Secretary
Jamshid M. Armaghani Trenton M. Clark Angel Correa Jerome F. Daleiden Dale S. Decker Yingwu Fang Chuck A. Gemayel Wouter Gulden Kent Hansen Thomas M. Hearne Thomas J. Kazmierowski Ed Kearney Lev Khazanovich	Hans Christian Korsgaard Francesca LaTorre James W. Mack Dennis A. Morian Scott D. Murrell A. Samy Noureldin John Pontarollo Athar Saeed Peter E. Sebaaly Mark Swanlund Dan Zollinger Leslie Ann Myers Yusuf Mehta

2005-2008

Committee on Pavement Rehabilitation (as of 2005)	
Roger Olson, Minnesota DOT, Chair	Julie Vandenbossche, University of Pittsburgh, Secretary
Jamshid Armaghani Neeraj Buch Trenton Clark Angel L. Correa Jerry Daleiden Yingwu Fang Chuck Gemayel Wouter Gulden Katie Hall Kent Hansen Tom Hearne Tom Kazmierowski Ed Kearney	Lev Khazanovich Hans Christian Korsgaard Francesca La Torre Jim Mack Yusuf Mehta Dennis Morian Leslie Myers Samy Noureldin Athar Saeed Eugene L. Skok Mark Swanlund Shiraz Tayabji Dan Zollinger

2008-2011

Committee on Pavement Rehabilitation (as of 2008)	
Julie Vandenbossche, University of Pittsburgh, Chair	Kurt Smith, Applied Pavement Technology, Inc., Secretary
Randy Battey Sohila Bemanian Tom Bennert France Bernard Phillip B. Blankenship Amanda Bordelon Neeraj Buch Judith Corley-Lay Brian Diefenderfer Navneet Garg Kent Hansen J. J. Henry	Tom Kazmierowski Lev Khazanovich Haus Christian Korsgaard Andreas Loizos David Merritt Roger Olson Linda Pierce Athar Saeed Shiraz Tayabji Haifang Wen Tom Yu

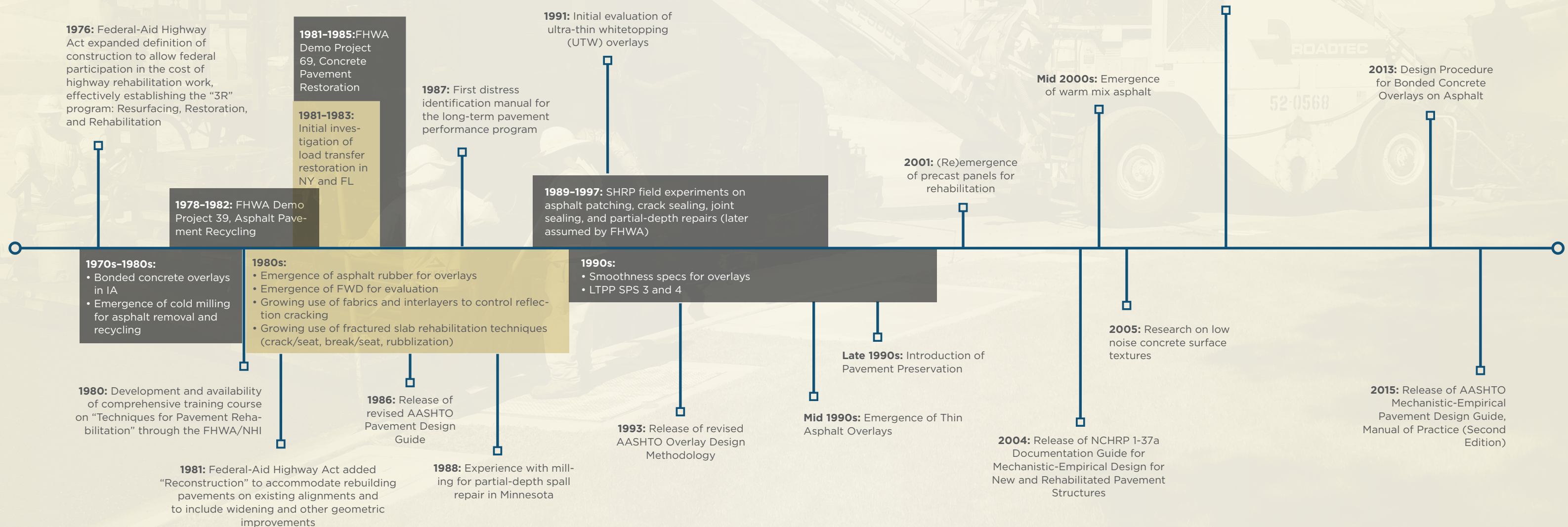
2011-2014

Committee on Pavement Rehabilitation (as of 2011)	
Julie Vandenbossche, University of Pittsburgh, Chair	Kurt Smith, Applied Pavement Technology, Inc., Secretary
Imad L. Al-Qadi Jose Tadeu Balbo Manik Barman Randy L. Battey Sohila Bemanian Thomas A. Bennert Phillip B. Blankenship Amanda C. Bordelon Armelle Chabot Judith B. Corley-Lay Brian Keith Diefenderfer John P. Donahue Laura L. Fenley Navneet Garg Roger L. Green Kevin D. Hall Robert Brooks Hogan	Newton C. Jackson Tom Kazmierowski Kang-Won Wayne Lee Andreas Loizos David K. Merritt Roger Olson Linda M. Pierce John H. Roberts Amy M. Schutzbach Larry A. Scofield Tom Scullion Mate Sršen Shiraz Tayabji Jeffrey S. Uhlmeyer Eileen Marie Vélez-Vega Haifang Wen Tom Yu

Committee on Pavement Rehabilitation (as of 2014)	
Kurt Smith, Applied Pavement Technology, Inc., Chair	John Donahue, Missouri DOT, Secretary
Tim Aschenbrener, FHWA José Balbo, University of São Paolo Manik Barman, University of Minnesota-Duluth Amanda Bordelon, University of Utah Tom Burnham, Minnesota DOT Armelle AC Chabot, IFSTTAR Dar-Hao Chen, Texas DOT Bouzid Choubane, Florida DOT Judith Corley-Lay, North Carolina DOT Brian Diefenderfer, Virginia DOT Laura Fenley, Wisconsin DOT Navneet Garg, FAA Roger Green, Ohio University Kevin Hall, University of Arkansas Robert Brooks Hogan, California DOT Newton Jackson, NCE Tom Kazmierowski, Golder Associates, Ltd. K. Wayne Lee, University of Rhode Island	David Merritt, Transtec, Inc. Dennis Morian, QES Roger Olson, Minnesota DOT (retired) Amy Schutzbach, Illinois DOT (retired) Larry Scofield, ACPA/IGGA Tom Scullion, Texas A&M University James Signore, NCE Eugene L. Skok, retired John Staton, Michigan DOT Shiraz Tayabji, ARA Gabriele Tebaldi, University of Parma Italy Jeff Uhlmeyer, Washington State DOT Julie Vandenbossche, University of Pittsburgh Eileen Velez-Vega, Kimley-Horn Haifang Wen, Washington State University Tom Yu, FHWA Dan Zollinger, Texas A&M University

SOME MAJOR PAVEMENT REHABILITATION HIGHLIGHTS, 1976-2016

A partial listing of legislation and pavement technologies, treatments, and techniques that influenced the pavement rehabilitation world between 1976 and 2016.



PARTIAL LISTING OF SELECTED NOTEWORTHY PAVEMENT REHABILITATION REFERENCES, 1980-2017

The following is a partial listing of selected noteworthy references on pavement rehabilitation produced during the period from 1980 to 2016. It is not a comprehensive list of all pavement rehabilitation literature produced during that era, but instead is intended to highlight some of the more noteworthy publications that provided valuable guidance to the pavement practitioner.

1980-1989

Asphalt Institute (AI). 1980. *Asphalt Hot Mix Recycling*. MS-20. The Asphalt Institute, College Park, MD.

Darter, M. I., S. H. Carpenter, M. Herrin, E. J. Barenberg, B. J. Dempsey, M. R. Thompson, and R. E. Smith. 1980. *Techniques for Pavement Rehabilitation—A Training Course*. National Highway Institute/Federal Highway Administration, Washington, DC.

Epps, J. A., D. N. Little, R. J. Holmgren, and R. L. Terrel. 1980. *Guidelines for Recycling Pavement Materials*. NCHRP Report 224. Transportation Research Board, Washington, DC.

Hicks, R. G. and J. P. Mahoney. 1981. *Collection and Use of Pavement Condition Data*. NCHRP Synthesis of Highway Practice 76. Transportation Research Board, Washington, DC.

Sherman, G. 1982. *Minimizing Reflection Cracking of Pavement Overlays*. NCHRP Synthesis of Highway

Practice 92. Transportation Research Board, Washington, DC.

Asphalt Institute (AI). 1983. *Asphalt Cold-Mix Recycling*. MS-21. Asphalt Institute, College Park, MD.

Asphalt Institute (AI). 1983. *Asphalt Overlays for Highway and Street Rehabilitation*. MS-17. The Asphalt Institute, College Park, MD.

Finn, F. N. and C. L. Monismith. 1984. *Asphalt Overlay Design Procedures*. NCHRP Synthesis of Highway Practice 116. Transportation Research Board, Washington, DC.

Wood, W. A. 1984. *Reducing Reflection Cracking in Bituminous Overlays*. FHWA-EP-85-02. National Experimental and Evaluation Program (NEEP) Project No. 10. Federal Highway Administration, Washington, DC.

Darter, M. I., E. J. Barenberg, and W. A. Yrjanson. 1985. *Joint Repair Methods for Portland Cement Concrete Pavements*. NCHRP Report 281. Transportation Research Board, Washington, DC.

Federal Highway Administration (FHWA). 1985. *FHWA Pavement Rehabilitation Manual*. FHWA-ED-88-025. Federal Highway Administration, Washington, DC. (Manual supplemented April 1986, July 1987, March 1988, February 1989, October 1990).

American Association of State Highway and Transportation Officials (AASHTO). 1986. *Guide for Design of Pavement Structures*. American Association of State Highway and Transportation Officials, Washington, DC.

Asphalt Institute (AI). 1986. *Asphalt Hot-Mix Recycling*. MS-20. Asphalt Institute, College Park, MD.

Epps, J. A. and C. L. Monismith. 1986. *Equipment for Obtaining Pavement Condition and Traffic Loading Data*. NCHRP Synthesis of Highway Practice 126. Transportation Research Board, Washington, DC.

Lahue, S. P. (ed). 1986. *Solutions for Pavement Rehabilitation Problems*. Proceedings of a Conference. American Society of Civil Engineers, New York, NY.

Federal Highway Administration (FHWA). 1987. *Pavement Recycling Guidelines for Local Governments*. Report No. FHWA-TS-87-230. Federal Highway Administration, Washington, DC.

Gulden, W. and D. Brown. 1987. *Improving Load Transfer in Existing Jointed Concrete Pavements*. FHWA/RD-82/154. Federal Highway Administration, Washington, DC.

Smith, K. D., M. I. Darter, K. T. Hall, and J. B. Rauhut. 1987. *Distress Identification Manual for the Long-Term Pavement Performance Studies*. Federal Highway Administration, Washington, DC.

Asphalt Institute (AI). 1988. *Sawcut & Seal After Overlay with Asphalt Concrete*. Technical Bulletin TB-2. Asphalt Institute, College Park, MD.

Janoff, M. S. 1988. *Pavement Roughness and Rideability Field Evaluation*. NCHRP Report 308. Transportation Research Board, Washington, DC.

Asphalt Institute (AI). 1989. *Crack Relief Layer*. Technical Bulletin No. 4. Asphalt Institute, College Park, MD.

Asphalt Institute (AI). 1989. *Portland Cement Concrete Rehabilitation: Rubblizing Prior to Overlay with Asphalt Concrete*. Technical Bulletin 3. Asphalt Institute, College Park, MD.

American Concrete Pavement Association (ACPA). 1989. *Guidelines for Full-Depth Repair*. TB-002.0 CPR. American Concrete Pavement Association, Arlington Heights, IL.

American Concrete Pavement Association (ACPA). 1989. *Guidelines for Partial-Depth Repair*. TB-003P. American Concrete Pavement Association, Arlington Heights, IL.

Crawford, C. 1989. *Cracking and Sealing of PCC Pavements Prior to Overlaying with Hot-Mix Asphalt*. Information Series 98. National Asphalt Pavement Association, Lanham, MD.

Hall, K. T., J. M. Connor, M. I. Darter, and S. H. Carpenter. 1989. *Rehabilitation of Concrete Pavements, Volume III—Concrete Pavement Evaluation and Rehabilitation System*. FHWA-RD-088-073. Federal Highway Administration, McLean, VA.

Snyder, M. B., M. J. Reiter, K. T. Hall, and M. I. Darter. 1989. *Rehabilitation of Concrete Pavements, Volume I—Repair Rehabilitation Techniques*. FHWA-RD-88-071. Federal Highway Administration, Washington, DC.

Thompson, M. R. 1989. *Breaking/Cracking and Sealing Concrete Pavements*. NCHRP Synthesis of Highway Practice 144. Transportation Research Board, Washington, DC.

Yrjanson, W. A. 1989. *Recycling of Portland Cement Concrete Pavements*. NCHRP Synthesis of Highway Practice 154. Transportation Research Board, Washington, DC.

1990-1999

American Concrete Pavement Association (ACPA). 1990. *Guidelines for Unbonded Concrete Overlays*. TB-005P. American Concrete Pavement Association, Arlington Heights, IL.

American Concrete Pavement Association (ACPA). 1990. *Guidelines for Bonded Concrete Overlays*. TB-007.0-C. American Concrete Pavement Association, Arlington Heights, IL.

American Concrete Pavement Association (ACPA). 1990. *Diamond Grinding and Concrete Pavement Restoration 2000*. TB-008.0 CPR. American Concrete Pavement Association, Arlington Heights, IL.

Benson, K., H. Castedo, and D. G. Goulias. 1990. *Distress Identification Manual for the Long-Term Pavement Performance Studies*. Strategic Highway Research Program, Washington, DC.

Epps, J. A. 1990. *Cold Recycled Bituminous Concrete Using Bituminous Materials*. NCHRP Synthesis 160. National Cooperative Highway Research Program, Transportation Research Board, Washington, DC.

Darter, M. I. and K. T. Hall. 1990. *Structural Overlay Strategies for Jointed Concrete Pavements, Volume IV—Guidelines for the Selection of Rehabilitation Alternatives*. FHWA-RD-89-145. Federal Highway Administration, Washington, DC.

Woodstrom, J. H. 1990. *Measurements, Specifications, and Achievement of Smoothness for Pavement Construction*. NCHRP Synthesis of Highway Practice 167. Transportation Research Board, Washington, DC.

Barksdale, R. D. 1991. *Fabrics in Asphalt Overlays and Pavement Maintenance*. NCHRP Synthesis of Highway Practice 171. Transportation Research Board, Washington, DC.

National Asphalt Pavement Association (NAPA). 1991. *Guidelines and Methodologies for the Rehabilitation of Rigid Highway Pavements Using Asphalt Concrete Overlays*. Technical Report. National Asphalt Pavement Association, Lanham, MD.

Roberts, F. L., P. S. Kandhal, E. R. Brown, D. Lee, and T. W. Kennedy. 1991. *Hot-Mix Asphalt Materials, Mix Design, and Construction*. First Edition. National Asphalt Pavement Association, Lanham, MD.

Raza, H. 1992. *An Overview of Surface Rehabilitation Techniques for Asphalt Pavements*. FHWA-PD-92-008. Federal Highway Administration, Washington, DC.

Smith, H. A. 1992. *Performance Characteristics of Open-Graded Friction Courses*. NCHRP Synthesis of Highway Practice 180. Transportation Research Board, Washington, DC.

American Association of State Highway and Transportation Officials (AASHTO). 1993. *AASHTO Guide for Design of Pavement Structures*. American Association of State Highway and Transportation Officials, Washington, DC.

Evans, L. D. and A. R. Romine. 1993. *Innovative Materials Development and Testing, Volume 4: Joint Seal Repair*. SHRP-H-355. Strategic Highway Research Program, Washington, DC.

Evans, L.D. and A. R. Romine. 1993. *Manual of Practice: Materials and Procedures for the Repair of Joint Seals in Concrete Pavements*. SHRP-H-349. Strategic Highway Research Program, Washington, DC.

Good-Mojab, A. J. Patel, and A. R. Romine. 1993. *Innovative Materials Development and Testing, Volume 5: Partial-Depth Spall Repair in Jointed Concrete Pavements*. SHRP-H-356. Strategic Highway Research Program, Washington, DC.

Patel, A. J., C. G. Mojab, and A. R. Romine. 1993. *Manual of Practice: Materials and Procedures for Rapid Repair of Partial-Depth Spalls in Concrete Pavements*. SHRP-H-349. Strategic Highway Research Program, Washington, DC.

Smith, K. L. and A. R. Romine. 1993. *Innovative Materials Development and Testing, Volume 3: Treatment of Cracks in Asphalt Concrete-Surfaced Pavements*. SHRP-H-354. Strategic Highway Research Program, Washington, DC.

Smith, K. L., and A. R. Romine. 1993. *Manual of Practice: Materials and Procedures for Sealing and Filling Cracks in Asphalt-Surfaced Pavements*. SHRP- H-348 Asphalt Pavement Repair Manuals of Practice. Strategic Highway Research Program, Washington, DC.

Wilson, T. P. and A. R. Romine. 1993. *Innovative Materials Development and Testing, Volume 2: Pothole Repair*. SHRP-H-353. Strategic Highway Research Program, Washington, DC.

Wilson, T. P. and A. R. Romine. 1993. *Manual of Practice: Materials and Procedures for the Repair of Potholes in Asphalt-Surfaced Pavements*. SHRP-H-348. Strategic Highway Research Program, Washington, DC.

Strategic Highway Research Program (SHRP). 1993. *Distress Identification Manual for the Long-Term Pavement Performance Project*. Report No. SHRP-P-338. Strategic Highway Research Program, Washington, DC.

Button, J. W., D. N. Little, and C. K. Estakhri. 1994. *Hot In-Place Recycling of Asphalt Concrete*. NCHRP Synthesis 193. National Cooperative

Highway Research Program, Transportation Research Board, Washington, DC.

McGhee, K. H. 1994. *Portland Cement Concrete Resurfacing*. NCHRP Synthesis of Highway Practice 204. Transportation Research Board, Washington, DC.

National Asphalt Pavement Association (NAPA). 1994. *Guidelines for Use of HMA Overlays to Rehabilitate PCC Pavements*. Information Series 117. National Asphalt Pavement Association, Lanham, MD.

American Concrete Pavement Association (ACPA). 1995. *Guidelines for Full-Depth Repair*. Technical Bulletin TB002.02P. American Concrete Pavement Association, Skokie, IL.

American Concrete Pavement Association (ACPA). 1995. *Joint and Crack Sealing and Repair for Concrete Pavements*. Technical Bulletin TB012P. American Concrete Pavement Association, Skokie, IL.

Asphalt Institute (AI). 1996. *Asphalt in Pavement Maintenance*. MS-16. Third Edition. Asphalt Institute, Lexington, KY.

Roberts, F. L., P. S. Kandhal, E. R. Brown, D. Y. Lee, and T. W. Kennedy. 1996. *Hot Mix Asphalt Materials, Mixture Design, and Construction*. Second Edition. National Asphalt Pavement Association Education Foundation, Lanham, MD.

American Concrete Pavement Association (ACPA). 1997. *Concrete Pavement Rehabilitation: Guide for Load Transfer Restoration*. JP001P. American Concrete Pavement Association, Skokie, IL.

American Concrete Pavement Association (ACPA). 1997. *The Concrete Pavement Restoration Guide: Procedures for Preserving Concrete Pavements*. TB020P. American Concrete Pavement Association, Skokie, IL.

Asphalt Institute (AI). 1997. *A Basic Emulsion Manual*. MS-19, Third Edition. Asphalt Institute, Lexington, KY, and the Asphalt Emulsion Manufacturers Association, Annapolis, MD.

Federal Highway Administration (FHWA). 1997. User Guidelines for Waste and Byproduct Materials in Pavement Construction. FHWA-RD-97-148. Federal Highway Administration, Washington, DC.

Kandhal, P. and R. Mallick. 1997. *Pavement Recycling Guidelines for State and Local Governments*. FHWA-SA-98-042. Federal Highway Administration, Washington, DC.

Mack, J. W., C. L. Wu, S. Tarr, and T. Refai. 1997. “Model Development and Interim Design Procedure Guidelines for Ultra-thin Whitetopping Pavements.” *Proceedings, Sixth International Conference on Concrete Pavement Design and Materials for High Performance*. Purdue University, West Lafayette, IN.

Morian, D. A., J. A. Epps, and S. D. Gibson. 1997. *Pavement Treatment Effectiveness, 1995 SPS-3 and SPS-4 Site Evaluation, National Report*. FHWA-RD-96-208. Federal Highway Administration, Washington, DC.

Wade, M. J., G. D. Cuttall, J. M. Vandenbossche, H. T. Yu, K. D. Smith, and M. B. Snyder. 1997. *Performance of Concrete Pavements Containing Recycled Concrete Aggregate*. Report No. FHWA-RD-96-164. Federal Highway Administration, Washington, DC.

American Concrete Pavement Association (ACPA). 1998. *Guidelines for Partial-Depth Repair*. Technical Bulletin TB003.02P. American Concrete Pavement Association, Arlington Heights, IL.

American Concrete Pavement Association (ACPA). 1998. *Whitetopping—State of the Practice*. EB210P. American Concrete Pavement Association, Skokie, IL.

Gagnon, J. S., D. G. Zollinger, and S. D. Tayabji. 1998. *Performance of Continuously Reinforced Pavements, Volume V—Maintenance and Repair of CRC Pavements*. FHWA-RD-98-101. Federal Highway Administration, McLean, VA.

Larson, R. M., D. Peterson, and A. Correa. 1998. *Retrofit Load Transfer, Special Demonstration Project SP-204*. FHWA-SA-98-047. Federal Highway Administration, Washington, DC.

Sayers, M. W. and S. M. Karamihas. 1998. *The Little Book of Profiling—Basic Information about Measuring and Interpreting Road Profiles*. University of Michigan Transportation Research Institute, Ann Arbor, MI.

Walls, J. and M. R. Smith. 1998. *Life-Cycle Cost Analysis in Pavement Design—Interim Technical Bulletin*. FHWA-SA-98-079. Federal Highway Administration, Washington, DC.

Wu, C. L., S. M. Tarr, T. M. Refai, M. A. Nagi, and M. J. Sheehan. 1998. *Development of Ultra-Thin Whitetopping Design Procedure*. Report RD 2124. Portland Cement Association, Skokie, IL.

Evans, L.D., K.L. Smith, and A.R. Romine. 1999. *Materials and Procedures for the Repair of Joint Seals in Portland Cement Concrete Pavements—Manual of Practice*. FHWA-RD-99-146. Federal Highway Administration, McLean, VA.

Smith, K. L. and A. R. Romine. 1999. *Materials and Procedures for Sealing and Filling Cracks in Asphalt-Surfaced Pavements—Manual of Practice*. FHWA-RD-99-147, Federal Highway Administration, Washington, DC.

Wilson, T. P. and A. R. Romine. 1999. *Materials and Procedures for the Repair of Potholes in Asphalt-Surfaced Pavements—Manual of Practice*. FHWA-RD-99-168. Federal Highway Administration, McLean, VA.

Wilson, T. P., K. L. Smith, and A. R. Romine. 1999. *Materials and Procedures for Rapid Repair of Partial-Depth Spalls in Concrete Pavement—Manual of Practice*. Report No. FHWA-RD-99-152. Federal Highway Administration, McLean, VA.

Karamihas, S. M., T. D. Gillespie, R. W. Perera, and S. D. Kohn. 1999. *Guidelines for Longitudinal Pavement Profile Measurement*. NCHRP Report 434. Transportation Research Board, Washington, DC.

Rao, S., H. T. Yu, and M. I. Darter. 1999. *The Longevity and Performance of Diamond-Ground Concrete Pavements*. Portland Cement Association, Skokie, IL.

2000-2009

American Concrete Pavement Association (ACPA). 2000. *Diamond Grinding and Concrete Pavement Restoration*. TB-008.01P. American Concrete Pavement Association, Skokie, IL.

Christopher, B. R. 2000. *Maintenance of Highway Edgedrains*. NCHRP Synthesis of Highway Practice 285. Transportation Research Board, Washington, DC.

Henry, J. J. 2000. *Evaluation of Pavement Friction Characteristics*. Synthesis of Highway Practice No. 291. National Cooperative Highway Research Program, Transportation Research Board, Washington, DC.

Hicks, R. G., S. B. Seeds, and D. G. Peshkin. 2000. *Selecting a Preventive Maintenance Treatment for Flexible Pavements*. FHWA-IF-00-027. Federal Highway Administration, Washington, DC.

Asphalt Recycling and Reclaiming Association (ARRA). 2001. *Basic Asphalt Recycling Manual*. Asphalt Recycling and Reclaiming Association, Annapolis, MD.

Grogg, M. G., K. D. Smith, S. B. Seeds, T. E. Hoerner, D. G. Peshkin, and H. T. Yu. 2001. *HMA Pavement Evaluation and Rehabilitation*. Reference Manual, NHI Course 131063. National Highway Institute, Arlington, VA.

Hoerner, T. E., K. D. Smith, H. T. Yu, D. G. Peshkin, and M. J. Wade. 2001. *PCC Pavement Evaluation and Rehabilitation*. Reference Manual, NHI Course 131062. National Highway Institute, Arlington, VA.

Miller, J. S. and W. Y. Bellinger. 2003. *Distress Identification Manual for the Long-Term Pavement Performance Program (Fourth Revised Edition)*. FHWA-RD-03-031. Federal Highway Administration, McLean, VA.

National Cooperative Highway Research Program (NCHRP). 2004. *Guide for Mechanistic-Empirical Design of New and Rehabilitated Pavement Structures*. Final Report, NCHRP Project 1-37A. Transportation Research Board, Washington, DC.

Rasmussen, R. and D. Rozycki. 2004. *Thin and Ultra-Thin Whitetopping*. NCHRP Synthesis of Highway Practice 338. Transportation Research Board, Washington, DC.

Gransberg, D. and D M. B. James. 2005. *Chip Seal Best Practices*. NCHRP Synthesis 42. Transportation Research Board, Washington, DC.

American Concrete Pavement Association (ACPA). 2006. *Concrete Pavement Field Reference - Preservation and Repair*. Report EB239P. American Concrete Pavement Association, Skokie, IL.

Minnesota Department of Transportation (MnDOT). 2006. *State Aid Concrete Pavement Rehabilitation Best Practices Manual 2006*. Manual Number 2006-31. Minnesota Department of Transportation, St. Paul, MN.

Alavi, S., J. F. LeCates, and M. P. Tavares. 2008. *Falling Weight Deflectometer Usage*. NCHRP Synthesis 381. Transportation Research Board, Washington, DC.

American Association of State Highway and Transportation Officials (AASHTO). 2008. *Mechanistic-Empirical Pavement Design Guide, Interim Edition: Manual of Practice*. American Association of State Highway and Transportation Officials, Washington, DC.

Asphalt Institute (AI) and the Asphalt Emulsion Manufacturers Association (AEMA). 2009. *Basic Asphalt Recycling Manual*. Fourth Edition. Asphalt Institute (AI) and the Asphalt Emulsion Manufacturers Association (AEMA).

National Center for Asphalt Technology (NCAT). 2009. *Hot Mix Asphalt Materials, Mixture Design and Construction*. Third Edition. NAPA Research and Education Foundation, Lanham, MD.

Pierce, L. M., J. Uhlmeier, and J. Weston. 2009. *Dowel Bar Retrofit – Do's and Don'ts*. WA-RD 576.2. Washington State Department of Transportation, Olympia, WA.

Tenison, J. H. and D. I. Hanson. 2009. *Pre-Overlay Treatment of Existing Pavements*. NCHRP Synthesis 388. Transportation Research Board, Washington, DC.

2010-2016

Lytton, R. L. F. L. Tsai, S.-I. Lee, S. Hu, F. Zhou. 2010. *Models for Predicting Reflection Cracking of Hot-Mix Asphalt Overlays*. NCHRP Report 669. Transportation Research Board, Washington, DC.

- Copeland, A. 2011. Reclaimed Asphalt Pavement in Asphalt Mixtures: State of the Practice. FHWA-HRT-11-021. Federal Highway Administration, Washington, DC.

Stroup-Gardiner, M. 2011. *Recycling and Reclamation of Asphalt Pavements Using In-Place Methods*. NCHRP Synthesis 421. Transportation Research Board, Washington, DC.

Peshkin, D., K. L. Smith, A. Wolters, J. Krstulovich, J. Moulthrop, and C. Alvarado. 2011. *Guidelines for the Preservation of High-Traffic-Volume Roadways*. Report No. S2-R26-RR-2. Strategic Highway Research Program (SHRP) 2, Washington, DC.

Frentress, D. P. and D. S. Harrington. 2012. *Guide for Partial Depth Repairs of Concrete Pavements*. Institute for Transportation, Iowa State University, Ames, IA.

Tayabji, S., D. Ye, and N. Buch. 2012. *Precast Concrete Pavement Technology*. Report S2-R05-RR-1. Transportation Research Board, Washington, DC.

Rada, G. R., D. J. Jones, J. T. Harvey, K. A. Senn, and M. Thomas. 2013. *Guide for Conducting Forensic Investigations of Highway Pavements*. NCHRP Report 747. Transportation Research Board, Washington, DC.

Li, Z., N. Dufalla, F. Mu, and J. M. Vandenbossche. 2013. *Bonded Concrete Overlay of Asphalt Pavements Mechanistic-Empirical Design Guide (BCOA-ME)—Theory Manual*. FHWA Pooled Fund Project TPF-5-165. Federal Highway Administration, Washington, DC.

Stroup-Gardiner, M. and T. Wattenberg-Komas. 2013. *Recycled Materials and Byproducts in Highway Applications. Vol 1-8*. NCHRP Synthesis 435. Transportation Research Board, Washington, DC.

Asphalt Recycling & Reclaiming Association (ARRA). 2014. *Basic Asphalt Recycling Manual*. 2nd Edition. Asphalt Recycling and Reclaiming Association, Annapolis, MD.



Decker, D. S. 2014. *Best Practices for Crack Treatments for Asphalt Pavements*. NCHRP Report 784. Transportation Research Board, Washington, DC.

Delatte, N. J. 2014. *Concrete Pavement Design, Construction, and Performance*. Second Edition. CRC Press, Boca Raton, FL.

Federal Highway Administration (FHWA). 2014. *Distress Identification Manual for the Long-Term Pavement Performance Program (Fifth Revised Edition)*. FHWA-HRT-13-092. Federal Highway Administration, McLean, VA.

Harrington, D. and G. Fick. 2014. *Guide to Concrete Overlays, Sustainable Solutions for Resurfacing and Rehabilitating Existing Pavements*. Third Edition. National Concrete Pavement Technology Center, Ames, IA.

McDaniel, R. S., J. Olek, A. Behnood, B. Magee, and R. Pollock. 2014. *Pavement Patching Practices*.

NCHRP Synthesis 463. Transportation Research Board, Washington, DC.

Smith, K., D. Harrington, L. Pierce, P. Ram, and K. Smith. 2014. *Concrete Pavement Preservation Guide*. Second Edition. National Concrete Pavement Technology Center, Ames, IA.

Watson, D. E. and M. Heitzman. 2014. *Thin Asphalt Concrete Overlays*. NCHRP Synthesis 464. Transportation Research Board, Washington, DC.

American Association of State Highway and Transportation Officials (AASHTO). 2015. *Mechanistic-Empirical Pavement Design Guide: A Manual of Practice*. Second Edition. American Association of State Highway and Transportation Officials, Washington, DC.

Stroup-Gardiner, M. 2016. Use of Reclaimed Asphalt Pavement and Recycled Asphalt Shingles in Asphalt Mixtures. NCHRP Synthesis 495. Transportation Research Board, Washington, DC.

APPENDIX: YEAR 2000 MILLENNIAL DOCUMENT

During 1999, to mark the approach of the new millennium, TRB requested the more than 250 technical committees to prepare “white papers” to document the current state of the art and practice and to summarize their perspectives on future directions in their respective areas of focus. The papers were meant to encourage discussion of issues and challenges likely to be faced in the future and to encourage readers to become major players as these issues and challenges are addressed by the transportation community. Under the leadership of Dr. Shiraz Tayabji, the Pavement Rehabilitation Committee (then known as Committee A2B04) produced the document presented below.

PAVEMENT REHABILITATION

SHIRAZ D. TAYABJI, Construction Technology Laboratories, Inc.
JAMES L. BROWN, Georgetown, Texas
JAMES W. MACK, American Concrete Pavement Association
THOMAS M. HEARNE, JR., North Carolina Department of Transportation
JOHN ANDERSON, Post, Buckley, Schuh & Jernian, Inc.
SCOTT MURRELL, Port Authority of New York and New Jersey
AHMED SAMY NOURELDIN, Indiana Department of Transportation

Pavement rehabilitation is a major activity for all highway agencies and has several consequences on agency resources and traffic disruptions because of extensive and extended lane closures. The traffic volumes on the primary highway system, especially in urban areas, have seen tremendous increases over the last 20 years, leading in many instances to earlier-than-expected failures of highway pavements. The aging of the Interstate highway system and other primary systems built during the 1950s and 1960s has resulted in the expenditure of a large portion of highway funds on pavement rehabilitation. Efforts continue to be made to develop techniques and procedures that will result in cost-effective and longer-lasting pavement rehabilitation to serve the nation’s highway system well into the 21st century.

The process of pavement rehabilitation involves the following procedures:

1. Prioritization of pavements in need of rehabilitation, which incorporates monitoring activities to assess the functional and structural condition of pavements;
2. Development of feasible rehabilitation strategies;
3. Selection of the most cost-effective rehabilitation strategy given a set of constraints, which may include reduced service life, life-cycle costs, and budgetary constraints; and
4. Adequate measurement of performance of the rehabilitated pavements.

State of the Practice

The state of the practice of pavement rehabilitation is good but can be better. In the last 10 years, significant improvements have been made in pavement evaluation techniques and in rehabilitation equipment and procedures.

Pavement Evaluation

Considerable progress has been made in techniques to evaluate pavement condition. Equipment for measuring surface profiles and for assessing the structural capacity of pavements is widely used by highway agencies and other practicing pavement engineers. The common availability of the falling weight deflectometer (FWD) has resulted in a more objective assessment of the structural capacity of pavements and timely rehabilitation of underdesigned or overloaded pavements. Additional details on issues related to pavement evaluation technology are presented in the section Future Developments.

Asphalt Pavement Rehabilitation

Asphalt pavement rehabilitation typically involves milling and resurfacing of the existing asphalt pavement to mitigate the effects of per ride rutting, cracking, and other distresses. Resurfacing thickness may depend on the condition of the existing pavement, anticipated future truck traffic, and available funding. Under heavy truck traffic, the expected service life of the rehabilitated pavement is typically about 8 to 12 years. The routine use of stonematrix aggregate (SMA) and Superpave mixes for pavement rehabilitation will certainly help extend the service life of rehabilitated pavements. Asphalt pavements are also rehabilitated using a conventional concrete overlay or the newer technique of ultrathin whitetopping (UTW). The UTW technique is of recent origin and long-term performance data are not yet available.

Concrete Pavement Rehabilitation

Concrete pavement rehabilitation may involve use of concrete pavement restoration (CPR) techniques, asphalt overlay over existing or fractured concrete pavement, bonded concrete overlays, or unbonded concrete overlays. The rehabilitation is performed to correct for poor ride, joint faulting, slab cracking, high-severity joint and crack spalling, and other specific distresses. Many agencies prefer to use a standard thickness of asphalt overlays over existing concrete pavements to minimize traffic disruptions, especially in urban areas. However, such practices typically result in shorter service life for the overlaid pavement. On the other hand, use of the longer-lasting concrete overlays typically requires more extensive lane closures and results in more extensive traffic disruptions. Use of concrete for pavement rehabilitation has benefited from the use of accelerated paving techniques incorporating high-early-strength concrete and zero-clearance paving equipment. Many agencies continue to wrestle with the age-old problem: longer delays now and longer service life versus shorter delays now and shorter service life.

Pavement Recycling and Reclaiming

Pavement recycling and reclaiming is another important process for rehabilitating asphalt pavements. Construction equipment and materials have greatly evolved over the last few years to allow for low-cost, in-place recycling and reclaiming of asphalt pavements.

Optimizing Pavement Rehabilitation

Many agencies are using life-cycle cost (LCC) analysis to help them rationally select the best rehabilitation technique. However, the inability to properly account for user delay costs is a major limitation of LCC analysis. Many agencies continue to wrestle with an extension of the age-old problem: lower initial costs, reduced traffic delays, and lower service life versus higher initial costs, extended traffic delays, and longer service life.

Traffic Management During Rehabilitation

Efficient traffic management during construction on urban and heavily trafficked rural roads has been a long-sought objective. The need to maintain traffic flow through construction zones requires heavy use of nighttime work or longer construction schedules. Efforts continue to be made to improve traffic flow through construction zones by better scheduling of construction activities, use of appropriate paving materials, and public awareness and education.

Special Case: Airport Pavement Rehabilitation

Many of the foregoing issues also apply to airport pavement rehabilitation. The high growth in air travel continues to put heavy demand on airport pavements. The increased use of wide-body and long-range aircraft with heavier wheel loads, new gear configurations, and higher tire pressures is expected to become routine at larger airports. Although airport pavements have their own unique design and construction requirements, almost all developments resulting from improvements in highway pavement rehabilitation technology are applicable to airport pavements. Durable pavement rehabilitation is also a necessity for airport pavements.

Future Developments

As the review of current practice indicates, the challenge in pavement rehabilitation continues to be the achievement of longer-lasting pavement rehabilitation while efficiently managing heavy traffic through construction zones. As such, improvements in technology need to be continually made to improve the whole process of pavement rehabilitation. The key areas that will benefit from improvements include the following:

1. Assessment of the in situ condition of existing pavements. Use of ground-penetrating radar, seismic techniques, and other nondestructive techniques needs to be expanded to complement FWD testing. Also, there is a need to standardize pavement evaluation and testing protocols.

2. Use of durable paving and repair materials that can carry truck traffic within a few hours after placement.
3. Use of zero-clearance paving equipment that will minimize extensive lane closures.
4. Procedures to reliably estimate future truck traffic.
5. Development of rehabilitation design procedures that clearly address mitigation of specific distress types and rationally account for future truck traffic loading.
6. Concrete pavement restoration techniques (e.g., dowel bar retrofit technique) and reflection cracking mitigation techniques.
7. In-place recycling and reclamation technology.
8. Use of comprehensive LCC analysis procedures that account for all appropriate cost elements associated with pavement rehabilitation.

Activities to Improve Pavement Rehabilitation Technology

Pavement rehabilitation in today's environment is always a complex and challenging process. For improvements to continue in pavement rehabilitation technology in a climate of reduced spending by the federal government on research and development activities, the industry will be tasked in the new millennium with a leadership role in implementing innovations in pavement rehabilitation. The increased use of warranty construction, performance-based specifications, and design/build/operate agreements will create the proper conditions for the industry to meet the challenges.

Other activities that will benefit developments in pavement rehabilitation include the following:

1. Better communication among technologists, practitioners, and legislators;
2. Narrowing the gap between innovation and implementation;
3. Fast-track validation of new paving materials and construction techniques through use of accelerated load-testing machines and dedicated test tracks;
4. Support of research and development activities in pavement rehabilitation through partnerships between the federal agencies, state highway agencies, industry, and the Transportation Research Board's National Cooperative Highway Research Program; this support would include the ongoing Long-Term Pavement Performance (LTPP) program, which includes a large experimental component on pavement rehabilitation techniques;
5. Establishment of undergraduate and graduate college courses on pavement rehabilitation; and
6. Technology transfer programs at regional, national, and international levels.

Pavement rehabilitation will continue to be a challenging and dynamic area, with major innovations still to come. Leadership on the part of the federal and state agencies and industry working as partners will be necessary to ensure that the massive investments in highway and airport pavements continue to support the economic development and otherwise benefit the well-being of transportation users.

